Bank Liquidity Supply and Corporate Investment during the 2008–2009 Financial Crisis

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Dedication

To my wife Jin and my kids for their love.

Abstract

I document a line of credit channel through which bank liquidity supply shocks affected corporate investment during the 2008–2009 financial crisis. By exploiting the predetermined variation in the maturity structure of lines of credit, I find that firms whose last pre-crisis lines of credit became due at the time of the crisis (treated firms) cut investment by more than similar firms whose lines of credit were scheduled to mature after the crisis. Moreover, this effect is stronger for financially constrained firms, bank-dependent firms, and firms whose pre-crisis banks were unhealthy. Within the treated group, firms with unhealthy banks were less likely to obtain lines of credit in the crisis than those with healthy banks. Finally, in the sample of firms with lines of credit before the crisis, I find that those with unhealthy banks experienced lower growth in lines of credit and investment, but this effect is restricted only to unrated firms.

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1 Introduction

During the 2008–2009 financial crisis, banks suffered large losses caused by mortgage delinquencies, and bank lending and corporate investment then declined dramatically. An influential view that explains these crisis events holds that a bank credit supply shock originating outside of the corporate loan sector forced banks to reduce credit to firms, which in turn led to investment cuts and the Great Recession (Brunnermeier, 2009). This bank credit supply shock theory justifies the U.S. government's actions to inject a tremendous amount of liquidity to the banking sector during the crisis, such as $700 billion Troubled Asset Relief Program. However, some researchers argue that firms voluntarily reduced capital expenditure and required less financing because of fewer investment opportunities during the recession and that the bank credit supply shock had little impact on corporate investment (Kahle and Stulz, 2013). In this paper, I study whether the bank credit supply shock can affect corporate investment decisions through a bank line of credit channel.

Firms manage their liquidity mainly through cash and bank lines of credit. Literature shows that most firms have lines of credit, which are of similar magnitude to cash (Sufi, 2009; Campello *et al.*, 2011).[1] Firms also use credit lines to exploit future business opportunities (Lins *et al.*, 2010). Hence, if firms lacked access to this important source of external liquidity during the crisis, then they might be forced to abandon some

[1] Sufi (2009) documents that 81.7% of firm-years have lines of credit for all the public firms in Compustat from 1996 through 2003. He also finds that the average lines of credit to assets ratio is 16% and that lines of credit to cash is about 1 to 1.

investment opportunities. Therefore, it is likely that the bank credit supply shock can be transmitted to firms through a line of credit channel.

I employ two empirical strategies to examine the role of credit line in transmitting the bank credit supply shock to the economy. In the first strategy, I exploit the predetermined variation in the maturity structure of pre-crisis credit lines to investigate whether firms that happened to have credit lines maturing at the time of the crisis performed differently from firms whose credit lines were scheduled to mature after the crisis. If the bank credit supply shock affected corporate investment, then firms with credit lines maturing at the time of the crisis should face more severe liquidity pressures than otherwise similar firms with credit lines maturing after the crisis, because the former group of firms had strong need to renew their credit lines at a time of greater banking fragility. As a result, firms' inability to obtain liquidity on demand might lead to a fall in investment if other sources of financing were also costly. In contrast, the demand shock story predicts that both groups should share similar investment trends because they were facing the same investment opportunities during the crisis.

More specifically, the first approach uses the Abadie and Imbens (2011) matching estimator of the Average Treatment Effect on the Treated (ATT). First, based on the information available *before* the crisis, I separate the sample into two groups: firms whose last pre-crisis credit lines were scheduled to mature at the time of the crisis (treated group) and firms whose last pre-crisis credit lines were scheduled to mature after the crisis (non-treated group). Then, from the non-treated group, I employ the matching estimator to select control firms that were closest to treated firms and compare the *change* in average quarterly investment between the period from October 2006 to June 2007 (the normal period) and

the period from October 2008 to June 2009 (the crisis period) across treated and control firms.[2] In the baseline matching, I match firms based on size, cash flow, cash, market-to-book ratio, leverage, investment, industry, and credit ratings, all measured in 2006.[3]

I find that the maturity structure of pre-crisis credit lines has an economically large effect on crisis investment. The baseline result shows that treated firms reduced their average quarterly investment by 0.45 percentage point more in the crisis (a 20% lower investment rate compared with their pre-crisis investment level) than matched control firms. The parallel trends assumption seems to be satisfied because treated and control firms exhibited similar investment trends in the pre-crisis period. A placebo test shows that firms that had credit lines maturing in the first three quarters of 2007, a non-crisis period, and firms that had credit lines maturing after this non-crisis period experienced a similar change in investment from Q1-Q3 2006 to Q1-Q3 2007. That is, maturing credit lines in a period without bank liquidity shocks does not affect corporate investment. Overall, the results are consistent with the view that banks failed to provide enough liquidity to firms in the need to renew their credit lines, causing such firms to forgo some investment opportunities.

The key identification assumption in the matching strategy is that the assignment to the treated and non-treated group is exogenous to firm outcome variables, conditional on observable firm characteristics. This assumption would be undermined if some smart CEOs might have predicted the 2008 financial crash before the Lehman failure and adjusted their credit lines beforehand. However, it is unlikely that firms could have anticipated the timing and magnitude of the crisis, because even the Federal Reserve failed

[2] I follow the definition of the normal period and the crisis period in Chodorow-Reich (2014).
[3] I follow the control variables in Almeida *et al.* (2011) and Kahle and Stulz (2013).

to predict the most serious financial crisis since the Great Depression, not to mention the industrial firms that did not specialize in the subprime mortgage market. To alleviate the concern of self-selection problem, I examine the maturity structure of credit lines that were originated prior to the end of 2006, a normal time period when firms were less likely to have anticipated the financial turmoil in late 2008.[4] Based on this information set in 2006, treated firms are defined as those whose last *pre-2006* credit lines were scheduled to mature in the crisis, whereas non-treated firms are those whose last *pre-2006* credit lines were scheduled to mature out of the crisis period. I still find that firms in the need to renew their credit lines at the time of the crisis reduced investment by more. The matching estimate of the ATT (−0.37) is slightly smaller than that in the baseline matching (−0.45) but is still statistically significant, which is not surprising given a larger measurement error of maturing credit lines.

I conduct a series of robustness tests and consistently find similar results. First, I document that the matching results are robust to the choice of control variables. Second, I find some evidence that the larger amount of credit lines that became mature in the crisis, the bigger impact of maturing credit lines. Compared with the baseline ATT estimate of –0.45 percentage point, firms with maturing credit lines over assets ratio greater than 5%, 10%, and 15% reduced their investment by –0.51, –0.60, and –0.74 percentage point, respectively. Third, I show that maturing credit lines is not a proxy for maturing long-term debt that is shown to affect crisis investment in Almeida *et al.* (2011), because the matching results remain unchanged when matching additionally on long-term debt due at the time of

[4] The average household debt default rate was around 3.3% in 2006, similar to the previous five years. Banks also functioned normally in 2006.

the crisis. Fourth, the results barely change when the number of control firms goes from one to four. Last, regression tests in the sample of treated and control firms yield similar results.

I next examine whether the effect of maturing credit lines varies with firms' financial constraint levels. If the bank credit supply shock story explains the investment decline in the crisis, then firms that were *ex ante* financially constrained or bank-dependent should be more adversely affected by maturing credit lines in the crisis because it was more costly for these firms to raise external finance. Consistent with this prediction, I find that financially constrained firms (high leverage, non-dividend payer, low payout ratio, high Kaplan-Zingales index, and high industry-level external finance dependence) and bank-dependent firms are more severely affected by maturing credit lines in the crisis.

Furthermore, I test whether the health of pre-crisis banks matters. If the bank credit supply shock affected corporate investment and banking relationships were sticky enough (Chodorow-Reich, 2014), then treated firms that were attached to unhealthy banks in the pre-crisis period should be more adversely affected by expiring credit lines than those that borrowed from healthy banks. I find that the effect of maturing credit lines is stronger for firms that borrowed pre-crisis credit lines from banks that were in greater distress during the crisis: those that reduced loans or had greater exposure to mortgage-backed securities more than the average bank. Further analysis shows that treated firms whose pre-crisis credit lines were from unhealthy banks were less likely to obtain bank lines of credit during the crisis. Therefore, bank lines of credit play an important role in transmitting the bank credit supply shock to firms.

I also examine how firms adjusted their cash policy and other real corporate decisions. I find that treated firms hoarded more cash. Notably, the saved cash (ATT=2.12 percentage points) is of similar magnitude to annual investment cuts (ATT=–0.45×4=–1.80 percentage points), suggesting that firms substituted cash for investment when banks were unable to renew credit lines. This is consistent with the survey evidence in Campello *et al.* (2011) who find that firms appear to replace investment by cash at low levels of credit lines. As for other real variables, I find that treated firms did not adjust their employment or technology spending.

To sum up, I interpret the matching results as follows. When firms' credit lines happened to mature in the crisis, firms suffered an insufficient supply of bank liquidity and consequently were forced to cut investment. Consistent with the bank credit supply shock story, this effect is more pronounced for financially constrained firms, bank-dependent firms, and firms that borrowed pre-crisis credit lines from unhealthy banks. Notably, treated firms that were attached to unhealthy banks in the pre-crisis period were less likely to obtain bank liquidity in the crisis. The results indicate that the bank credit supply shock is transmitted to firms through a line of credit channel.

The second part of this paper examines whether the bank credit supply shock affected corporate liquidity and investment for more general firms irrespective of whether their credit lines were scheduled to mature in the crisis. I follow the empirical strategy in Chodorow-Reich (2014) to relate bank health to corporate liquidity growth and investment growth in the crisis.[5]

[5] Chodorow-Reich (2014) studies the effect of bank credit supply on employment during the crisis.

The key identification assumption in the second strategy is that conditional on observable characteristics, bank health is uncorrelated with the unobserved credit demand shock that might affect liquidity and investment growth. The fact that the 2008–2009 financial crisis originated outside of banks' corporate loan portfolios makes it suitable to disentangle the credit supply effect from the demand effect. In the formal tests, I employ the within-firm estimator to justify the exogeneity of the bank health measure. More specifically, I show that, for the subset of firms that originate lines of credit in both the pre-crisis and crisis periods, the effect of bank health on firm-bank level liquidity growth is the same in regressions with and without firm fixed effects, which would not hold if the unobserved credit demand shock is correlated with bank health.

The results of the second strategy are as follows. First, the loan-level regressions show that for the same firms receiving credit lines from at least two banks in the pre-crisis period, they received more credit lines in the crisis from healthy banks than from unhealthy banks. Such loan-level tests fully control for changes in investment opportunities at the firm level. Second, firm-level regressions indicate that bank health has a large, positive effect on firms' credit lines growth and investment growth. In the baseline OLS regression, a one standard deviation increase in bank health boosts investment by 8.2%. Third, the effects of bank health on the growth of credit lines and investment are restricted only to unrated firms. Last, firms with healthy banks had a higher ratio of credit lines to cash during the crisis. In other words, bank health affects firms' choice of external liquidity lines of credit and internal liquidity cash. Overall, the results of both empirical strategies highlight a line of credit channel through which the bank credit supply shock is transmitted to firms.

This paper is closely related to the recent literature that examines the impact of the 2008 financial crisis on U.S. firms' financial policies and investment. Kahle and Stulz (2013) argue for a demand shock story based on their finding that bank-dependent firms had similar investment trends to non-dependent firms. However, most firms have credit lines (Sufi, 2009), and about 90% of credit lines were scheduled to mature after the crisis (Chodorow-Reich and Falato, 2018).[6] Hence, most firms could potentially draw down their pre-crisis credit lines to withstand bad times. This might explain why bank-dependent firms were shielded against the bank credit supply shock. Almeida *et al.* (2011) show that the maturity structure of long-term debt has a causal effect on firm investment in the crisis. However, their results do not point out whether or not the effect is due to a bank credit supply shock. Existing literature also documents the increased drawdown behavior of firms in the crisis (Ivashina and Scharfstein, 2010; Campello *et al.*, 2010), but they do not quantify the effect of credit lines on investment. Campello *et al.* (2011) examine the connection between liquidity management and pro forma planned investment based on survey data, but they do not argue for a bank credit supply shock story. My focus on lines of credit directly traces the effect of firm outcomes to the bank liquidity supply side, and I employ the predetermined maturity structure of credit lines to establish a causal relation between credit lines and investment. Chodorow-Reich and Falato (2018) study how bank health is transmitted to firms whose loans mature after the crisis. My paper complements their work in that I focus on the firms that are excluded in their paper—that is, firms that

[6] Based on supervisory data (Shared National Credit), Chodorow-Reich and Falato (2018) find that only 10% of bank loans have a remaining maturity of less than one year at the time of the crisis; the remaining 90% of bank loans mature after one year.

have credit lines due at the time of the crisis—and I document a line of credit through which the bank credit supply shock is transmitted to these firms.

This article is also related to a strand of literature that examines firms' choice between cash and lines of credit (Sufi, 2009; Yun, 2009; Acharya *et al.*, 2013). All these papers look at how the characteristics of firms affect their corporate liquidity. This paper is the first to show that bank credit supply shocks can affect firms' choice of cash and lines of credit, which supports the prediction in Acharya *et al.* (2013).

The reminder of this paper is organized as follows. Section 2 presents the data and variable definitions. Section 3 introduces the matching strategy and shows the impact of the maturing credit lines on investment. The results on heterogeneous effects by financial constraints and bank health are also presented. Section 4 uses loan- and firm-level regressions to study the effect of bank health on corporate liquidity growth, investment growth, and corporate liquidity choices. Section 5 concludes.

2 Data

I begin with the loan-level data from Dealscan, which has detailed loan origination data such as loan start date, end date, loan amount, and lenders data. I use such information to identify whether firms have credit lines maturing in the crisis and to construct bank health measure. I clean Dealscan data mainly following Chodorow-Reich (2014). I include all the loans originated in the U.S. and made to the U.S. firms. I also require that at least one of a loan's lead lenders is from the 43 most active lenders in Chodorow-Reich (2014).[7] Based

[7] Follow Chodorow-Reich (2014), I exclude facilities whose lead lenders only made a small number of loans during the sample period, so that I can have a small measurement error of bank health based on the

on these loan origination data, I construct a bank health measure in equation (1) as defined later.

Based on Dealscan, I obtain the loan start date of a firm's last pre-crisis syndication and the information on whether that syndication includes lines of credit. I choose all the firms whose last pre-crisis syndication includes lines of credit. The main reasons to exclude term loans are that they are increasingly provided by non-bank financial institutions such as insurance companies, private equity firms, and hedge funds, and that they are more likely to be sold by banks. It is possible that firms may have refinanced these term loans, for example, by issuing bonds, before they become mature. Therefore, it is harder to know whether firms have term loans maturing in a certain period. But for credit lines, most lenders are commercial banks and these lines are much less likely to be sold by banks, so the maturity structure information is of higher quality. Another reason to focus on credit lines is that firms normally draw down only a small portion of total credit lines, whereas term loans are often fully drawn down when loans start.[8] Therefore, when the crisis happened, firms that borrowed credit lines in the pre-crisis period could potentially draw down their credit lines, whereas firms that borrowed term loans in the pre-crisis period could not further tap liquidity from these loans. In other words, a pre-crisis line of credit could potentially serve as a liquidity source during the crisis, but a pre-crisis term loan could not. The reason to focus on the last, instead of all the pre-crisis credit lines, is that the last credit lines capture the most recent banking relationships, which makes a cleaner

change in the number of loans from the normal period to the crisis period. Like Chodorow-Reich (2014), I also find that this restriction reduces the loan-level sample by less than 5%.

[8] On average, firms draw down about one third of total credit lines in the random sample of Sufi (2009).

firm-level bank health measure. Based on this Dealscan information, I can determine whether firms had last pre-crisis credit lines maturing at the time of the crisis.

I then merge Dealscan data with firm financials data from Compustat's North America Annual and Quarterly data using the Dealscan-Compustat link table from Chava and Roberts (2008). As a result, only public firms are included in the analysis. With the financial data, I can construct the following control variables. Cash flow is defined as EBITDA (oibdq) over lagged assets (atq). Cash is cash (cheq) divided by lagged assets. Size is defined as log of assets. Market-to-book ratio is market value of assets (total assets (atq) + market value of equity (cshoq * prccq) – common equity (ceqq) – deferred taxes (txdbq))/book value of assets. Leverage is total debt over book assets. Credit ratings data are also sourced from Compustat.

In the matching estimation, the outcome variable is the *change* in average quarterly investment from October 2006 - June 2007 to October 2008 - June 2009. Following Chodorow-Reich (2014), I define the crisis period as the three quarters after the Lehman bankruptcy, i.e., October 2008 to June 2009, because the TED spread soared to a record high level right after the Lehman failure (see Figure 1). Corporate investment is defined as quarterly capital expenditures over lagged assets. Similar to Almeida *et al.* (2011), I drop financial firms (SIC 6000s) and utility firms (SIC 4900-4949). I also drop firms with an assets growth rate greater than 100% in a single quarter at some point in my sample period. Firms with assets less than 10 million at the end of 2006 are also dropped because the financials of these small firms are more volatile.[9] After applying these restrictions, the final

[9] This restriction matters little because the average Dealscan syndicate size is much larger than 10 million, so firms with assets less than 10 million normally have no loans in Dealscan. As a result, most small firms will be excluded from the final sample based on the requirement of having credit lines from Dealscan.

sample includes 1,257 firms that once borrowed credit lines before the crisis, out of which 991 firms had active credit lines when Lehman collapsed.

3 The maturity structure of credit lines and firm investment

In this section, I exploit the preexisting variation in the maturity structure of credit lines to investigate whether firms that happened to have credit lines maturing at the time of the crisis performed differently from firms whose credit lines were scheduled to mature after the crisis. Sufi (2009) shows that firms manage liquidity mainly through cash and credit lines. Corporate liquidity decisions are one of the most important decisions for many Chief Financial Officers (CFOs). To a large extent, they view their job as securing funding for investments proposed by Chief Executive Officers (CEOs, see Graham & Harvey, 2001). If bank liquidity supply shocks affect corporate investment, given the prevalence and importance of credit lines in corporate liquidity management, then firms that happened to have credit lines maturing at the time of the crisis should face more severe liquidity pressures than otherwise similar firms whose credit lines were scheduled to mature after the crisis. The former group of firms could not easily replace their credit lines at a time of greater banking fragility, but the latter group of firms could potentially draw down their pre-crisis credit lines to fund daily operations and investment. As a result, firms' inability to obtain liquidity on demand might lead to a fall in investment if other sources of financing were also costly.

3.1 Abadie-Imbens matching method

To investigate whether maturing credit lines affects corporate investment, I compare the *change* in investment of firms whose credit lines were predetermined to

mature at the time of the crisis with that of similar firms whose credit lines were scheduled to mature after the crisis. To implement this comparison, following Almeida *et al.* (2011) and Kahle and Stulz (2013), I employ the Abadie and Imbens matching method (2004). This matching approach minimizes the Mahalanobis distance between a vector of covariates across treated and non-treated companies and chooses the control firms with a minimum distance. A benefit of this approach is that it can produce exact matches over categorical variables. Since the matches on continuous variables will not be exact, it automatically produces a bias-correction term to account for the differences in continuous variables between treated firms and matched control firms.

In the baseline matching, I use the information right before the Lehman bankruptcy (September 15, 2008) to classify firms into treated and non-treated firms. Treated firms are those whose last pre-crisis credit lines were scheduled to mature at the time of the crisis; non-treated firms are those whose last pre-crisis credit lines were scheduled to mature after the crisis. Then from the non-treated group, I use Abadie-Imbens matching estimator to look for control firms that best match treated firms along several dimensions. Following Almeida *et al.* (2011) and Kahle and Stulz (2013), I match on cash flow, cash, size, market-to-book ratio (or "*Q*"), leverage, investment, and categorical variables including industry and ratings (unrated, junk rated, and investment rated), all measured in 2006. All the reported matching results have exact matches on categorical variables. In the end, this matching approach provides an Abadie-Imbens estimate of the ATT.

Based on the matching estimate of the ATT, I can infer whether maturing credit lines has an impact on corporate investment. If bank liquidity supply shocks affect corporate investment, then treated firms should reduce investment relative to control firms,

which implies a negative ATT estimate. As a comparison, the traditional difference-in-differences estimate is also reported in some tables.

For each treated firm, I initially choose one firm from the non-treated group as a control firm. Since matching is done with replacement, there may be a fewer number of unique control firms. In the robustness tests, I further choose two to four control firms. The results are barely changed.

I also exclude firms with sufficient cash because such firms are less affected (Duchin *et al.*, 2010). More specifically, I drop 62 firms with cash ratio greater than 40%. This leads to the final sample of 929 firms. My results are similar without this restriction. There are 94 treated firms and 835 non-treated firms. The baseline matching results in 88 unique control firms. As a comparison, in Almeida *et al.* (2011), there are 86 treated firms and 79 unique control firms in their baseline matching.

3.2 Results

3.2.1 Baseline matching and placebo test

Before implementing Abadie-Imbens matching, I first compare the financial characteristics of treated and non-treated firms and test if the two groups differ significantly along control variables in the normal period.

Table 1 provides a comparison of the means of financials measured at the end of 2006 for treated, non-treated, and matched control firms. Panel A shows that on average treated firms are smaller, slightly less profitable and more cash-rich than non-treated firms. After implementing the Abadie-Imbens matching, Panel B reports that these differences

disappear across treated and control firms. The means of the other financial variables *Q*, leverage, and investment are also indistinguishable.

Table 2 compares the distributions of the financials measured at the end of 2006. Panel A shows that before the matching, treated and non-treated firms differ significantly in the distributions of size, cash, and leverage. Panel B demonstrates that after the matching, treated and control firms are similar in the distributions across all control variables.

Panel A of Table 3 shows that treated firms reduced their average quarterly investment from 2.25 percentage points in the normal period (2006:Q4-2007:Q2) to 1.21 percentage points in the crisis (2008:Q4-2009:Q2), a drop of 1.04 percentage points (or 1.04/2.25=46% lower investment rate), while non-treated companies cut their investment from 1.89 to 1.34, a fall of 0.55 percentage point (or 0.55/1.89=29% lower investment rate). This leads to a difference-in-differences (DiD) estimate of –0.49 percentage point (on a quarterly basis), which is statistically significant. Therefore, treated firms reduced investment by more than non-treated firms.

Panel B of Table 3 presents the main Abadie-Imbens matching results. After the matching, the investment of treated firms still experienced a drop of 1.04 percentage points, whereas the investment of control firms declined by 0.46 percentage point. As a result, the DiD estimate is −0.58 percentage point. The matching estimate of ATT is −0.45 percentage point (or 0.45/2.25=20% lower investment rate). Both the DiD and ATT estimates are statistically significant. Therefore, treated firms also cut investment by more than matched control firms. The ATT estimate is smaller in absolute terms than the DiD estimate because it includes a bias-correction term to account for inexact matches on continuous variables. In this case, as shown in Panel B of Table 1, the matched control firms are slightly bigger,

more profitable, and of higher leverage than treated firms.[10] Such firms should experience a smaller drop in investment. If control firms were to have similar size, cash flow, and leverage to treated firms, then the investment level of control firms in the crisis period might be lower, which would lead to a larger differential reduction across treated and control firms (that is, a large DiD estimate in absolute terms).

To examine whether treated firms and control firms follow parallel trends before the crisis, I plot the evolution of investment rates in Figure 2. Parallel trends assumption seems to be satisfied as treated and control firms exhibited similar investment trends in the pre-crisis period.

A concern is that firms may choose to reduce their investment whenever they have maturing credit lines, irrespective of bank liquidity supply shocks. To alleviate this concern, I choose a placebo period 2007:Q1-Q3 when bank liquidity supply shocks were absent, and I test whether maturing credit lines in this placebo period also affects investment. In this placebo test, the pre-placebo period is defined as 2006:Q1-Q3. I measure the maturity structure of credit lines at the end of 2006. Treated firms are those whose last pre-placebo period credit lines happened to mature in the placebo period 2007:Q1-Q3, and non-treated firms are those whose last pre-placebo period credit lines were scheduled to mature after 2007:Q3. I match on the same set of control variables measured at the end of 2006. Panel C of Table 3 reports the matching results. Treated firms and control firms exhibited similar investment trends from the pre-placebo period to the placebo period. Both the DiD and the ATT estimates are economically small and statistically insignificant, which suggests that

[10] Note that differences are statistically insignificant.

the maturing credit lines has no impact on firm investment in the absence of bank liquidity supply shocks.

Overall, the results are consistent with the view that banks were unable to provide enough liquidity to firms in the need to renew their credit lines during the crisis, causing such firms to forgo investment opportunities.

3.2.2 Predetermined maturity structure tests

The key identification assumption in the matching strategy is that the assignment to the treated and non-treated group is exogenous to firm outcome variables, conditional on observable firm characteristics. In the baseline matching, I measure the predetermined variation in whether firms had their last pre-crisis credit lines maturing at the time of the crisis based on information right before the Lehman bankruptcy (September 15, 2008). This is subject to the criticism that some smart CEOs might have predicted the 2008 financial crash before the Lehman failure and adjusted their credit lines beforehand. However, it is unlikely to be case because even the Federal Reserve failed to predict the worst financial crisis since the Great Depression, not to mention the industrial firms that did not specialize in the subprime mortgage market.

In the data, the median treated firms originated their last pre-crisis credit lines in August 2006, whereas the median control firms received their last pre-crisis credit lines in March 2007, both in a normal period.[11] Considering that it takes about three months between the time a bank approves a term sheet and the time syndication loans start (Murfin,

[11] By construction, matched control firms originated their last credit lines later than treated firms, because I impose the restriction that non-treated firms had pre-crisis credit lines maturing after the crisis. Such restriction naturally pushes facility start date for non-treated firms to a later time.

2012), the decisions of both typical treated firms and control firms to obtain their last pre-crisis credie lines were made in 2006, a normal period in which household debt default rate was still low and similar to historical levels (Mian and Sufi, 2016). In other words, it is unlikely that typical firms could have anticipated the collapse of subprime mortgage market and adjusted their credit lines beforehand. Therefore, the variation in whether firms have their pre-crisis credit lines maturing in the crisis is plausibly exogenous.

Nonetheless, I implement the following test to address the concern that treated dummy is not perfectly predetermined. I use the information available at the end of 2006, a normal time period when firms were less likely to have anticipated the financial turmoil in late 2008, to measure the maturity structure of *pre-2006* credit lines. Based on this information set, treated firms are defined as those whose last *pre-2006* credit lines were scheduled to mature in the crisis, whereas non-treated firms are those whose last *pre-2006* credit lines were scheduled to mature out of the crisis period. In other words, I look for firms' last crisis lines originated before the end of 2006, if such credit lines were scheduled to mature in the crisis period October 2008 to June 2009, then the corresponding firms are assigned to the treated group, regardless of whether these firms amended or refinanced such credit lines during the period from January 2007 to September 2008. If firms' last pre-2006 credit lines were scheduled to mature out of the crisis period, then such firms are assigned to the non-treated group, regardless of whether firms obtained new credit lines afterwards that happened to mature at the time of the crisis. This measurement of maturing credit lines is noisier but more exogenous than the baseline one using information before the Lehman failure. There are 98 treated firms by this definition.

Table 4 presents the matching results based on the maturity structure measured in 2006. I still find some evidence that maturing credit lines has a negative impact on investment. The new matching estimate of ATT (−0.37) is slightly smaller than that (−0.45) in the baseline matching based on the information before the Lehman failure, which is not surprising because the new measure of maturing credit lines using 2006 information is noisier. However, the ATT estimate is still statistically significant. The new DiD estimate (−0.43) is also slightly smaller than that in the baseline matching (−0.58), but it is only marginally significant (p-value=0.119)

3.2.3 The heterogeneous effect by financial constraints

I next examine whether the effect of maturing credit lines varies with firms' financial constraints levels. If the bank credit supply shock story explains the investment decline in the crisis, then firms that are *ex ante* more financially constrained or more reliant on external financing should be more adversely affected by maturing credit lines, because such firms should find it harder to raise external finance. Therefore, within the treated firms that had credit lines maturing in the crisis, the investment behaviors of financially constrained firms should drive the main matching result.

To implement the tests, I split the 94 treated firms into two groups based on the medians of *ex ante* financial constraint measures or external financing dependence measure in the treated sample. Then I separately match each subgroup to non-treated firms. For example, when splitting based on pre-crisis leverage, I first find the median of leverage within 94 treated firms. Then all the treated firms below the median leverage will be matched to non-treated firms, resulting in an ATT estimate of −0.28 (column 1 row 1 in Panel A of Table 5), which is statistically insignificant. Similarly, all the treated firms

above the median leverage will also be matched to non-treated firms, leading to an ATT estimate of −0.92 (column 1 row 2 in Panel A of Table 5), which is significant at 5% level. Therefore, it is highly levered treated firms that drive the main matching results.

The other financial constraint measures include non-dividend payer, payout ratio, Kaplan-Zingale index, and bank dependence, all measured at the end of 2006.[12] Non-dividend payer is equal to one if firms did not pay any dividends in the past three years prior to 2006 and zero otherwise. Bank-dependent firms are defined as those that had two or more loans from the same U.S. lead lender in the five years before 2006; the rest firms form the non-bank dependent group (Kahle and Stulz, 2013). The variable to measure the extent to which firms rely on external financing is industry-level external finance dependence. Firm-level external finance dependence is defined as the proportion of investment not financed by cash flow from operations. Industry-level external finance dependence is defined as the industry (SIC2) median of firm-level external finance dependence (Duchin *et al.*, 2010). This industry-level variable is less influenced by firm choices. Thus, it is more exogenous.

Table 5 reports the matching results for these financial constraint measures and external finance dependence measure. I consistently find that treated firms in the financially constrained group (high leverage, non-dividend payer, low payout ratio, high Kaplan-Zingales index, and bank-dependent firms) or in the high level of external financing dependence group are more adversely affected by maturing credit lines in the crisis than treated firms in the financially unconstrained group (low leverage, dividend

[12] Kaplan-Zingales (1997) index=−1.002*Cash flow+0.283*Q+3.319*Debt−39.368*Dividends−1.315*Cash. Payout ratio=(Cash dividends (dvp+dvc)+repurchases (prstkc))/income before extraordinary items (ib).

payer, high payout ratio, low Kaplan-Zingales index, non-bank dependent) or in the low level of external financing dependence group. In sum, treated firms that were *ex ante* financially constrained were more severely affected by maturing credit lines, consistent with the bank credit supply shocks story.

3.2.4 The heterogeneous effect by bank health

To more directly examine if the bank liquidity shock affect the corporate investment, I exploit the variation in bank health. If the bank liquidity supply story explains the differential response of treated and control firms, then treated firms whose pre-crisis banks were unhealthy were more likely to be adversely affected by maturing credit lines, because such treated firms might be less likely to obtain new bank liquidity in the crisis.

I measure the bank health in two ways (Chodorow-Reich, 2014). First, I use the percentage change in the number of loans to all other borrowers $\Delta L_{-i,b}$ (see equation (1) as shown later). Specifically, $\Delta L_{-i,b}$ equals the change in the number of loans made by firm i's lead bank b to all other firms between the periods 2005:10-2006:6 & 2006:10-2007:6 and the crisis periods 2008:10-2009:6. The lead bank refers to that in the firm's last pre-crisis credit lines. The second measure of bank health is ABX exposure, which is defined as the lead bank's exposure to ABX AAA 2006-H1 index. This index tracks the price of residential mortgage-backed securities issued in later 2005 and it had an AAA rating at issuance. The ABX exposure is calculated as the loading of a bank's stock price to this index over the period October 2007 to December 2007. I obtain the ABX exposure data from Chodorow-Reich's website. Firm-level measures of ΔL_i (see equation (2)) and ABX exposure are the weighted average by bank allocation over the lead banks in the last pre-crisis credit lines.

The matching procedure is the same as the one in analyzing the heterogeneous effects by financial constraints. First, I split the 94 treated firms into two subgroups based on the medians of bank health measures. I then match each subgroup to non-treated firms. Table 6 presents the results. Column 1 reports that treated firms with unhealthy banks (low ΔL_i) in the last pre-crisis credit lines were severely affected by maturing credit lines. They reduced investment by 0.59 percentage point, but firms with healthy banks (high ΔL_i) cut investment by 0.35 percentage point. Column 2 shows that treated firms attached to banks with a large ABX exposure reduced investment by 0.70 percentage points, which is significant at 5% level. However, treated firms attached to banks with a small ABX exposure cut investment by a small magnitude of 0.19 percentage points, which is statistically insignificant. This result directly traces the investment behaviors of the treated firms to the bank credit supply shock caused by "toxic" assets.

However, the above matching results are subject to criticism of imprecise matching. If bank health does affect corporate investment, then the channel through which bank health imposes its influence should be through relieving the financial constraints of firms with maturing credit lines, potentially by banks providing new liquidity in the crisis to these firms. In Table 7, formal regression tests within the 94 treated firms consistently find that treated firms that borrowed credit lines from healthy banks in the pre-crisis were also more likely to renew their credit lines in the crisis. This further supports that the bank credit supply shock is transmitted to firms through a line of credit channel.

3.3 Robustness tests

In section 3.2, I already show that 1) parallel trends assumption seems satisfied, 2) the results cannot be explained by firms matching the life of credit lines to that of their

investment opportunities (see Panel C of Table 3), 3) the results are unchanged when I use the more predetermined maturity structure measured in 2006, and 4) maturing credit lines has a larger impact on firms that should be more adversely affected by the bank credit supply shock. In this section, I further examine whether the baseline matching results are robust. The findings are as follows.

First, the matching results are consistently economically large and statistically significant when different selections of control variables are used as reported in Table 8. The ATT estimates range from the baseline –0.45 to –0.72 percentage point.

Second, I find some evidence that the larger amount of credit lines that became mature in the crisis, the bigger impact of maturing credit lines. Table 9 shows that compared with the baseline ATT estimate of –0.45 percentage point, firms with maturing credit lines over assets ratio greater than 5%, 10%, and 15% reduced their investment by –0.51, –0.60, and –0.74 percentage point, respectively, which are all statistically significant. The DiD estimates also follow the similar trends but are statistically weaker.

Third, one may wonder if maturing credit lines is just a proxy for maturing long-term debt that affects investment as documented in Almeida *et al.* (2011). To exclude this concern, I match additionally on long-term debt due defined as in Almeida *et al.* (2011)[13], the results are still similar.[14] Thus, the bank liquidity shock is transmitted to firms through a new channel, the credit line channel.

[13] I adjust the long-term debt due measure to represent the portion that would become due in 2008 and 2009. Specifically, it is defined as long-term debt due in year 2 (*dd2*) plus long-term debt due in year 3 (*dd3*) divided by assets, all measured at 2006 fiscal year end.
[14] The ATT estimate is -0.46 percentage point, and the DiD estimate is -0.37, both statistically significant.

Fourth, I also confirm that matching on the number of matched controls from one to four produces similar results. The results are also unchanged when matching on two-digit SIC.

Last, I use regressions to test if the baseline matching results still hold. The answer is yes. In the sample of treated and control firms, I regress change in investment on the same set of control variables measured at 2006. Treated firms still cut investment by more.

3.4 Adjustment of cash and other policies

This section examines how treated firms adjust cash and other policies in response to their maturing credit lines. Previous research documents that firms substitute between cash and credit lines (Lins *et al.*, 2010; Campello *et al.*, 2011).[15] When the best all-around substitute for cash holdings matures in the bad times, treated firms may be forced to hoard cash to pay for additional expenses that were previously covered by credit lines if they could hardly reduce these expenses.

As shown in column 1 of Table 10, treated firms saved cash by more. The ATT estimate of is 2.12 percentage points and statistically significant. In terms of the economic magnitude, the saved cash is of similar magnitude to annual investment cuts (ATT=–0.45×4=–1.80 percentage points), suggesting that firms substituted cash for investment when banks were unable to renew credit lines. This is consistent with the survey findings in Campello *et al.* (2011) who find that firms appear to replace investment by cash at low levels of credit lines. Column 2 and 3 document that treated firms barely adjusted

[15] Campello *et al.* (2011) find that firms with abundant cash voluntarily choose to have smaller credit lines and fewer drawdowns. I show in this section that firms with maturing credit lines in the bad times choose to hoard cash.

technology spending (R&D) and employment. In the untabulated results, I find that treated and control firms also share similar growth in cost of goods sold (COGS), selling, general and administrative expense (SG&A), and sales. Taken together, the results suggest that firms facing maturing credit lines in a period with disruptions in the banking system chose to cut investment and save cash, possibly due to their inability to adjust other policies.

To sum up, I interpret the matching results as follows. When firms' pre-crisis bank lines of credit matured in the crisis, firms suffered insufficient bank liquidity supply and consequently were forced to cut investment. However, financially unconstrained firms and firms whose pre-crisis banks were healthy were more likely to obtain credit lines in the crisis, and thus were less adversely affected by maturing credit lines.

4 Bank health, corporate liquidity, and investment

Previous analysis demonstrates that 94 firms with last pre-crisis credit lines maturing in the crisis experienced a large decline of investment relative to control firms, and *within* these treated firms, bank health affects the severity of investment cuts and the availability of new credit lines in the crisis. However, it is silent on whether bank health has an impact on corporate liquidity and investment for more general firms which did not have credit lines maturing in the crisis.

To answer these questions, I follow the empirical strategy in Chodorow-Reich (2014) to relate bank health to corporate liquidity growth and investment growth in the crisis.

First, I show that, within the sample of firms that originated credit lines in both the pre-crisis and the crisis periods, bank health is uncorrelated with unobserved credit demand, conditional on firm observable characteristics. Thus, bank health is plausibly exogenous. Second, I examine the effects of bank health on the growth in lines of credit and investment. Third, I show how the effects of bank health varies by firm types. Last, I examine whether the bank liquidity supply shock affects the composition of lines of credit and cash.

4.1 Bank health measure

Following Chodorow-Reich (2014), I measure bank health using the percentage change in the number of loans to all other firms between the normal and the crisis periods. Specifically, suppose firm *i* receives a loan from bank *b* at time *t*, then I define $L_{i,b,t}$=1. The bank health measure is defined as

equation (1)

$$\Delta L_{-i,b} = \frac{\sum_{j \neq i} \alpha_{j,b,crisis} \times L_{j,b,crisis}}{0.5 \sum_{j \neq i} \alpha_{j,b,normal} \times L_{j,b,normal}} - 1$$

where α is the bank allocation to denote the importance of that bank to the syndicate. Crisis definition is the same as previous analysis, that is, from October 2008 to June 2009. Normal period includes October 2005 to June 2006 and October 2006 to June 2007.

The firm level bank health measure is the weighted average of $\Delta L_{-i,b}$ over the lead lenders of the last pre-crisis syndicate. More specifically, firm's bank health is

equation (2)

$$\Delta L_i = \sum_b \alpha_{i,b,last} \times \Delta L_{-i,b}$$

where b is a lead lender in the last pre-crisis syndicate; α is the bank allocation of that lead lender in the last pre-crisis syndicate.

4.2 Identification

To investigate whether bank health matters for corporate liquidity and investment, I regress the outcome variable (credit lines growth or investment growth) on the firm level bank health ΔL_i and a set of financial controls measured at the end of 2006. That is, I run the following regression:

equation (3)

$$g_i = \beta \Delta L_i + firm\ controls_i + \varepsilon_i$$

where g_i is $\Delta\log(investment)_i$ or $\Delta\log(lines\ of\ credit)_i$, that is, change in the log of outcome variable from the normal period October 2006 to June 2007 to the crisis October 2008 to June 2009. Investment is defined as a firm's total capital expenditures in corresponding quarters. Firm controls include size, cash, cash flow, leverage and *Q*. Industry (SIC 2), state, and rating fixed effects are also included. The identification assumption is that firm level bank health ΔL_i is orthogonal to the unobserved characteristics that affect credit or investment outcomes.

Like Chodorow-Reich (2014), I also use ABX exposure to instrument firm level bank health ΔL_i. Similar to the construction of ΔL_i, the firm level ABX exposure is defined as the weighted average of bank level ABX exposures over the lead lenders of the last pre-crisis syndicate.

4.3 Exogeneity of bank health

I use firm-bank level data to examine whether bank health is plausibly exogenous. To this end, I select only firms that originated credit lines in both the pre-crisis and the crisis periods. In addition, I also require that firms' last pre-crisis credit lines have at least two lenders so that firm fixed effects can be included in regression. I then investigate for the same firms receiving credit lines liquidity from two different banks in the last pre-crisis syndicate, whether they would receive more credit lines in the crisis from healthy banks than from unhealthy banks. To fully control for the change in the credit demand, I add the firm fixed effect when regressing *change* in bank-firm level credit lines on bank health measure $\Delta L_{-i,b}$. Since the dependent variable is the *change*, not the level of firm-bank level credit lines, the firm fixed effect fully absorbs both observed and unobserved change in credit demand. As a result, this bank-firm level regression provides an unbiased estimation of bank health. More specifically, I run the following bank-firm regression:

equation (4)

$$\log\left(1 + \alpha_{i,b,crisis} \times V_{i,crisis}\right) - \log\left(\alpha_{i,b,last} \times V_{i,last}\right) = \beta \Delta L_{-i,b} + firm\ FE_i + \varepsilon_{i,b}$$

where $V_{i,last}$ is the amount of last credit lines; $\alpha_{i,b,last}$ is the bank b's allocation in the last pre-crisis credit lines to firm i; $\alpha_{i,b,last} \times V_{i,last}$ represents firm's credit lines from bank b in the last syndicate; $\alpha_{i,b,crisis} \times V_{i,crisis}$ is firm's credit lines form bank b in the crisis credit lines. Since a pre-crisis bank can decline to offer liquidity in the crisis credit lines, I add one to the bank's crisis credit lines $\alpha_{i,b,crisis} \times V_{i,crisis}$ so that log form is meaningful.

Table 11 reports the results of this firm-bank level regressions using 94 firms that have credit lines originations in both the pre-crisis and the crisis periods. Column 1 shows the result of regression without firm fixed effects Column 2 adds firm fixed effects. Again, since the dependent variable is the *change*, not the level of liquidity, this firm fixed effects fully absorbs any observed and unobserved credit demand change from the normal period to the crisis period. Therefore, the coefficient in column 2 can be viewed as an unbiased estimate of bank health. Column 3 excludes firm fixed effects and add firm financial controls measured in 2006 that potentially affect credit demand. Any unobserved factors that could potentially affect change in credit demand are in the error terms. If unobserved credit demand correlates with bank health $\Delta L_{-i,b}$, then one would expect the coefficient of bank health to change substantially compared with the coefficient estimate with firm fixed effects in column 2. The results in column 1-3 demonstrate that there is little variation in the coefficient estimates of bank health. Therefore, I conclude that bank health is uncorrelated with unobserved firm characteristics that affect credit demand, conditional on observables. The positive coefficient of bank health means that for the same firms receiving credit lines from two banks in the pre-crisis credit lines, they receives more credit lines in the crisis from healthy banks than from unhealthy banks. In other words, unhealthy banks reduced liquidity by more than healthy banks to the same firms. Therefore, the bank liquidity shock can be transmitted to firms through less liquidity provisions by unhealthy banks.

4.4 Bank health, liquidity growth, and investment growth

The next question is whether bank health affects corporate liquidity and investment growth in the full sample. Building on the results of exogeneity of bank health in Table 11, I regress

outcome variables (corporate liquidity growth and investment growth) on firm level bank health ΔL_i. The regressions are at the firm level, so I cannot include firm fixed effects. Table 12 reports that bank health consistently has a large and statistically significant effect on firms credit lines growth. I normalize bank health to have unit variance. Column 2 shows that a one standard deviation increase of bank health increases credit lines by 90%. It should be noted that the amount of credit lines is not extracted from 10-K or 10-Q, but it is constructed by aggregating all the outstanding credit lines from Dealscan at a given point in time (Acharya *et al.*, 2013).

Table 13 presents the main results of the effect of bank liquidity supply on corporate investment for the sample of firms that have ever had credit lines in the pre-crisis period. Formal regressions consistently show that firms that borrowed from healthy lenders before the crisis experienced a higher investment growth than firms that borrowed from unhealthy banks. Based on the result of column 2, a one standard deviation (19%) increase of bank health ΔL_i makes investment grow by 8.2%. Borrowing from 75th percentile (–16.8%) rather than 25th percentile of bank health (–42.9%) results in an investment growth of 11.2% ((–16.8% + 42.9%) /19% * 8.2%=11.2%).

Since the firm-level bank health measure is based on the health of last pre-crisis syndicate, to alleviate the concern that some firms might have predicted the financial crash and adjusted banking relationships beforehand, I use only firms that obtained their last pre-crisis syndicate before 2006 year end and find similar effects of bank health on the growth in credit lines and investment.

I then examine whether bank health has a heterogenous effect on credit lines and investment across firm ratings. Table 14 reports that bank health has an economically large

and statistically significant effect on the growth in credit lines and investment for unrated firms, but the effect is economically small and statistically insignificant for rated firms, especially the effect on investment growth. The results are consistent with Chodorow-Reich (2014) who shows that bank health has a large impact on unrated firms' employment growth, but no such impact on rated firms.

4.5 Bank liquidity shocks and corporate liquidity composition

Last, I analyze whether the bank liquidity shock affected the composition of lines of credit and cash. Existing literatures that study the corporate liquidity management almost exclusively focus on whether and how certain firm characteristics affect the composition of lines of credit and cash. Table 15 column 1-2 demonstrate that firms with healthy banks before the crisis increased the proportion of credit lines in their total liquidity (credit lines plus cash) relative to those firms attached to unhealthy banks. A one standard deviation of increase in ΔL_i (19%) increases the credit lines to total liquidity ratio by 3%. Column 3-4 show that it is the increase of credit lines that drives the results. Unreported results show that bank health has no impact on cash over net assets.

Overall, the results from the second empirical strategy also support that the bank liquidity shock is transmitted to firms through a line of credit channel. For the firms that borrowed credit lines in both the pre-crisis and the crisis periods, healthy banks provided more liquidity than unhealthy banks to the same firms. For more general firms that have ever had credit lines before the crisis, firms that borrowed from healthy banks in pre-crisis have higher growth in credit lines and investment in the crisis.

5 Conclusion

Through the role of an important source of external liquidity—bank lines of credit—I use two empirical strategies to study whether bank liquidity supply shocks affected corporate investment during the 2008-2009 financial crisis. In the first approach, I exploit the predetermined variation in the maturity structure of credit lines and find that unlucky firms that happened to have credit lines maturing at the time of the crisis reduced investment by more than otherwise similar firms whose credit lines were scheduled to mature after the crisis. In addition, the effect of maturing credit lines is more pronounced for financially constrained firms and bank-dependent firms. Notably, treated firms that borrowed credit lines from unhealthy banks in the pre-crisis period were more adversely affected because they were less likely to obtain credit lines in the crisis. A battery of robustness tests produce similar results. In particular, I show that the results still hold when I measure the maturity structure of credit lines in 2006. I also find that firms with maturing credit lines chose to save cash rather than to invest, which is consistent with survey evidence that firms substituted between credit lines and cash during the crisis (Campello *et al.*, 2011).

The second approach directly links bank health to corporate liquidity and investment. For the firms that obtained credit lines in both the pre-crisis and crisis periods, unhealthy banks reduced the liquidity provision by more than healthy banks to the same firms. For more general firms that borrowed credit lines in the pre-crisis period, firms that borrowed lines from unhealthy banks experienced lower growth in credit lines and investment during the crisis. Overall, these findings are consistent with the causal effect of

bank credit supply shocks on firm outcomes. Importantly, I document a line of credit channel through which bank credit supply shocks are transmitted to firms.

Figure 1. TED spread.

This figure shows the TED spread from January 2007 to December 2009. TED spread is defined as the difference between the 3-month interest rates on interbank loans (LIBOR) and 3-month Treasury bills. It is an indicator of perceived credit risk in the economy. Shaded area indicates the recession period from December 2007 to June 2009. Source: Federal Reserve Bank of St. Louis.

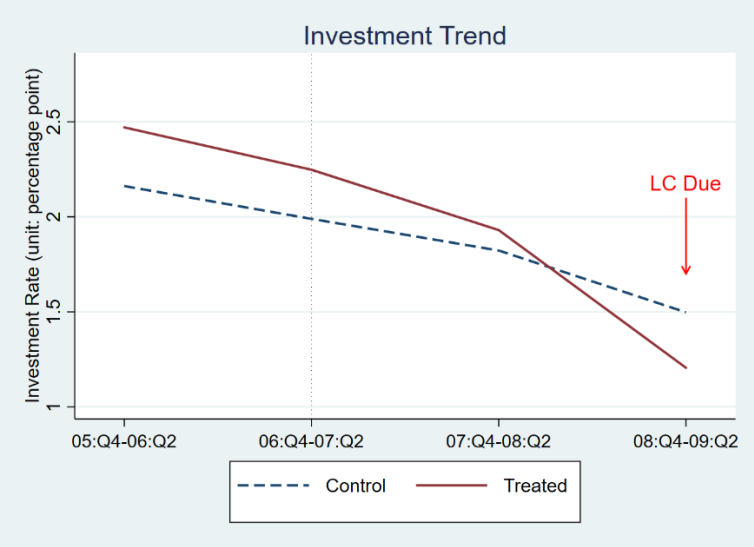

Figure 2. Investment trends for treated and control firms.

This figure shows the evolution of investment (unit: percentage point) for treated and control firms resulted from the baseline matching. Each point is the average quarterly investment in a three-quarter period across all treated firms (red real line), or control firms (blue dashed line). Investment is defined as capital expenditures over lagged assets. The treated firms (94 firms) are defined as those whose last pre-crisis credit lines became due in the crisis October 2008 to June 2009. The non-treated firms are defined as those whose last pre-crisis credit lines were scheduled to mature after June 2009. Control firms are selected from the non-treated group based on Abadie-Imbens estimator using matching variables including size, cash flow, cash, Q, leverage, investment, 1-digit SIC, and credit ratings, all measured at the end of 2006 (dashed line).

Table 1. Pre-crisis financial characteristics of treated, non-treated, and control firms

	Size	Cash Flow	Cash	Q	Leverage	Investment
Panel A. Means for treated and non-treated firms in 2006						
Treated	6.693	0.138	0.112	2.016	0.221	0.022
Non-Treated	7.145	0.153	0.088	1.926	0.235	0.019
Difference	–0.452	–0.015	0.024	0.090	–0.014	0.003
p-value	0.009	0.135	0.014	0.476	0.540	0.201
Panel B. Means for treated and matched control firms in 2006						
Treated	6.693	0.138	0.112	2.016	0.221	0.022
Control	6.807	0.145	0.104	1.941	0.216	0.019
Difference	–0.114	–0.007	0.008	0.075	0.005	0.003
p-value	0.680	0.596	0.577	0.638	0.881	0.521

Notes. This table provides a comparison of the means of financial variables for treated, non-treated, and matched control firms. The sample consists of 929 firms whose last pre-crisis syndicate includes lines of credit. The treated firms (94 firms) are defined as those whose last pre-crisis credit lines became due in the crisis October 2008 to June 2009. The non-treated firms (835 firms) are defined as those whose last pre-crisis credit lines were scheduled to mature after June 2009. Matched control firms are selected from the non-treated group based on Abadie-Imbens estimator using matching variables including size, cash flow, cash, *Q*, leverage, investment, 1-digit SIC, and credit ratings, all measured at the end of 2006. See the main text for variable definitions. P-values of two sample t test are reported.

Table 2. Pre-crisis financial distributions of treated, non-treated, and control firms

		25%	Median	75%	Kolmogorov-Smirnov Test p-value
		Panel A. Treated vs. Non-Treated firms in 2006			
Size	Treated	5.258	6.402	8.019	0.004
	Non-Treated	6.116	7.117	8.020	
Cash Flow	Treated	0.086	0.127	0.186	0.205
	Non-Treated	0.102	0.140	0.196	
Cash	Treated	0.026	0.084	0.188	0.035
	Non-Treated	0.020	0.053	0.133	
Q	Treated	1.295	1.679	2.280	0.893
	Non-Treated	1.276	1.630	2.220	
Leverage	Treated	0.008	0.164	0.352	0.051
	Non-Treated	0.093	0.207	0.329	
Investment	Treated	0.006	0.010	0.022	0.825
	Non-Treated	0.006	0.011	0.021	
		Panel B. Treated vs. Matched control firms in 2006			
Size	Treated	5.258	6.402	8.019	0.330
	Control	5.455	6.544	7.953	
Cash Flow	Treated	0.086	0.127	0.186	0.248
	Control	0.096	0.135	0.184	
Cash	Treated	0.026	0.084	0.188	0.782
	Control	0.023	0.073	0.147	
Q	Treated	1.295	1.679	2.280	0.662
	Control	1.318	1.654	2.240	
Leverage	Treated	0.008	0.164	0.352	0.782
	Control	0.047	0.189	0.330	
Investment	Treated	0.006	0.010	0.022	0.540
	Control	0.006	0.009	0.018	

Notes. This table compares the distributions of financials for treated, non-treated, and control firms. The sample consists of 929 firms whose last pre-crisis syndicate includes lines of credit. The treated firms (94 firms) are defined as those whose last pre-crisis credit lines became due in the crisis October 2008 to June 2009. The non-treated firms (835 firms) are defined as those whose last pre-crisis credit lines were scheduled to mature after June 2009. Matched control firms are selected from the non-treated group based on Abadie-Imbens estimator using matching variables including size, cash flow, cash, *Q*, leverage, investment, 1-digit SIC, and credit ratings, all measured at the end of 2006. See the main text for variable definitions. P-values of two sample Kolmogorov-Smirnov test for equality of distribution functions are reported.

Table 3. Investment comparison in the crisis and placebo periods

Panel A: Crisis investment comparison (Treated vs Non-Treated)

	2006Q4-2007Q2	2007Q4-2008Q2	2008Q4-2009Q2	
	(1)	(2)	(3)	(3)-(1)
Treated firms	2.25***	1.93***	1.21***	–1.04***
	(0.33)	(0.28)	(0.12)	(0.26)
Non-Treated firms	1.89***	1.83***	1.34***	–0.55***
	(0.08)	(0.09)	(0.05)	(0.06)
Treated - Non-Treated	0.36	0.10	–0.13	–0.49*
	(0.34)	(0.30)	(0.13)	(0.27)

Panel B: Crisis investment comparison (Treated vs Matched Control)

	2006Q4-2007Q2	2007Q4-2008Q2	2008Q4-2009Q2	
	(1)	(2)	(3)	(3)-(1)
Treated firms	2.25***	1.93***	1.21***	–1.04***
	(0.33)	(0.28)	(0.12)	(0.26)
Control firms	1.95***	1.81***	1.49***	–0.46**
	(0.33)	(0.25)	(0.21)	(0.19)
Treated - Control	0.30	0.12	–0.28	–0.58*
	(0.47)	(0.38)	(0.24)	(0.33)
Matching estimator				–**0.45****
(Abadie-Imbens)				(0.17)

Panel C: Placebo period investment comparison (Treated vs Matched Control)

	2006Q1-Q3	2007Q1-Q3	
	(1)	(2)	(2)-(1)
Treated firms	1.42***	1.53***	0.11
	(0.18)	(0.18)	(0.12)
Control firms	1.19***	1.30***	0.11
	(0.14)	(0.19)	(0.08)
Treated - Control	0.23	0.23	0.00
	(0.23)	(0.26)	(0.14)
Matching estimator			–0.06
(Abadie-Imbens)			(0.15)

Notes. Panel A and B compare the average quarterly investment from 2006Q4-2007Q2 (column 1) with that from 2008Q4-2009Q2 (column 3). Panel C compares the average quarterly investment from 2006Q1-Q3 with that from placebo period 2007Q1-Q3. Investment is defined as quarterly capital expenditure over lagged assets and is displayed in percentage points (unit: percentage point). In Panel A, treated firms and non-treated firms are compared. In Panel B, treated and matched control firms are compared. In Panel A and Panel B, the treated firms (94 firms) are defined as those whose last pre-crisis credit lines became due in the crisis October 2008 to June 2009. The non-treated firms (835 firms) are defined as those whose last pre-crisis credit lines were scheduled to mature after June 2009. Matched control firms are selected from the non-treated group based on Abadie-Imbens estimator using matching variables including size, cash flow, cash, *Q*, leverage, investment, 1-digit SIC, and credit ratings, all measured at the end of 2006. In Panel C, treated firms are defined as those whose last pre-2006 credit lines were scheduled to mature in the placebo period

2007Q1-Q3; non-treated firms are defined as those whose last pre-2006 credit lines were scheduled to mature after September 2007. Matching is also based on the same set of financial variables measured at the end of 2006. There are 94 treated firms and 88 unique control firms in Panel B, and 68 treated and 66 unique control firms in Panel C. Robust standard errors clustered by firms are reported in parenthesis for the Difference-in-Differences estimates. Heteroskedasticity consistent robust standard errors are displayed in parenthesis for the matching ATT estimates. ***, **, * represents significance levels are the 1%, 5%, and 10%, respectively.

Table 4. Investment comparison based on the predetermined maturity structure measured at the end of 2006

Difference in differences (DiD)	–0.43
	(0.28)
Matching estimator (Abadie-Imbens)	–0.37**
	(0.18)
Number of firms in treated	98

Notes. This table compares change in average quarterly investment from 2006Q4-2007Q2 to 2008Q4-2009Q2 across treated firms and matched control firms based on the maturity structure information at the end of 2006. Treated firms are those whose last pre-2006 credit lines were scheduled to mature in the crisis 2008Q4-2009Q2, irrespective of whether they amended or refinanced their last pre-2006 credit lines in the period between January 2007 and September 2008. Non-treated firms are those whose last pre-2006 credit lines were scheduled to mature out of the crisis based on the 2006 information set. Control firms are selected from the non-treated group based on Abadie-Imbens estimator using matching variables including size, cash flow, cash, Q, leverage, investment, 1-digit SIC, and credit ratings, all measured at the end of 2006. Robust standard errors clustered by firms are reported in parenthesis for the difference-in-differences estimates. Heteroskedasticity consistent robust standard errors are displayed in parenthesis. ***, **, * represents significance levels are the 1%, 5%, and 10%, respectively.

Table 5. Investment comparison by financial constraint measures

Panel A				
	Matching estimator (Abadie-Imbens)			#
	(1)	(2)	(3)	treated
Low leverage	–0.28			47
	(0.25)			
High leverage	–0.92**			47
	(0.36)			
Dividend Payer		–0.29		43
		(0.22)		
Non-dividend Payer		–0.63**		51
		(0.27)		
Payout Ratio High			–0.25	47
			(0.28)	
Payout Ratio Low			–0.94***	47
			(0.30)	

Panel B				
	Matching estimator (Abadie-Imbens)			#
	(1)	(2)	(3)	treated
Kaplan-Zingales index Low	–0.26			47
	(0.22)			
Kaplan-Zingales index High	–0.78***			47
	(0.26)			
Non-bank dependent		–0.20		38
		(0.30)		
Bank-Dependent		–0.68***		56
		(0.24)		
Industry level external finance dependence Low			–0.18	50
			(0.17)	
Industry level external finance dependence High			–0.73**	44
			(0.30)	

Notes. This table reports the Abadie-Imbens ATT estimates of investment comparison (2006Q4-2007Q2 vs 2008Q4-2009Q2) by splitting the 94 treated firms into two groups based on the median *ex ante* financial constraint measures of treated firms. For example, when splitting based on leverage, all the treated firms below the median leverage of 94 treated sample firms are matched to non-treated firms, the matching estimate of ATT for this matching is reported in column 1 row 1; all the treated firms above the median leverage are matched to non-treated firms, the corresponding ATT estimate is reported in column 1 row 2 of Panel A. Non-dividend payer is the group of firms that did not pay dividend in the past three years prior to 2006; the rest firms form the dividend payer group. Payout ratio=(cash dividends (dvp+dvc)+repurchases(prstkc))/income before extraordinary items (ib). Kaplan-Zingales index= –1.002*cash flow+0.283*Q + 3.319*debt–39.368*Dividends–1.315*cash. Bank-dependent firms are defined as those that had two or more loans with the same US lead lender in the five years before 2006 (Khale and Stulz, 2010); the rest firms form the non-bank dependent firms. Firm level external finance dependence is the proportion of investment not financed by cash flow from operations, which is (capital expenditures (capx)

–funds from operations (fopt))/capital expenditures (capx). Industry level external finance dependence is the SIC2-median of firm level external finance dependence. The low and high subsamples consist of firms with each measure above and below the median. Heteroskedasticity consistent robust standard errors are displayed in parenthesis. ***, **, * represents significance levels are the 1%, 5%, and 10%, respectively.

Table 6. Investment comparison by bank health

	Matching estimator		number of treated firms by type
	(1)	(2)	
%Δ loans to other borrowers (ΔL_i) High	–0.35*		47
	(0.18)		
%Δ loans to other borrowers (ΔL_i) Low	–0.59**		47
	(0.29)		
Small ABX exposure		–0.19	47
		(0.17)	
Large ABX exposure		–0.70**	47
		(0.32)	

Notes. This table reports the Abadie-Imbens ATT estimates of investment comparison (2006Q4-2007Q2 vs 2008Q4-2009Q2) by splitting the 94 treated firms into two groups based on the median of bank health measures. For example, when splitting based on the ABX exposure, all the treated firms below the median will be matched to the non-treated firms, the ATT estimate for this matching is reported in column 2 row 3; all the treated firms above the median will also be matched to the same non-treated firms, the corresponding ATT estimate is reported in column 2 row 4. %Δ loans to other borrowers (ΔL_i) equals the change in the number of loans made by firms' lead bank to all other firms between the periods October 2005-June 2006 & October 2006-June 2007 and the crisis period October 2008-June 2009. Lead bank refers to that in the borrower's last pre-crisis lines of credit syndicate. Firms whose lead bank experienced a severe drop of bank lending will be categorized into ΔL_i Low group, while firms whose lead bank has a mild drop will be in ΔL_i High group. ABX exposure is lead bank's exposure to ABX AAA 2006-H1 index (ABX exposure data is from Chodorow-Reich's website). Firm level measures of ΔL_i and ABX exposure are the weighted average by bank allocation over the lead banks in the last pre-crisis syndicate. Heteroskedasticity consistent robust standard errors are displayed in parenthesis. ***, **, * represents significance levels are the 1%, 5%, and 10%, respectively.

Table 7. Lines of credit availability in the crisis and bank health for treated firms

	Dependent: firms obtaining new credit lines in the crisis			
	Probit	Probit	OLS	IV
				ABX exposure
	(1)	(2)	(3)	(4)
%Δ loans to other borrowers (ΔL_i)	0.401***	0.266**	0.076**	0.172**
	(0.148)	(0.133)	(0.037)	(0.073)
Financial controls	NO	YES	YES	YES
Industry	NO	YES	YES	YES
Rating	NO	YES	YES	YES
First stage F statistics				30.11
Lead lender 1 cluster	23	23	23	23
Lead lender 2 cluster	24	24	24	24
Observations	94	94	94	94

Notes. This table reports the firm level regression of whether 94 treated firms obtained new credit lines in the crisis October 2008-June 2009 on their bank health measure ΔL_i. %Δ loans to other borrowers (ΔL_i) equals the change in the number of loans made by firms' lead bank to all other firms between the periods October 2005-June 2006 & October 2006-June 2007 and the crisis period October 2008-June 2009. ABX exposure is lead bank's exposure to ABX AAA 2006-H1 index (ABX exposure data is from Chodorow-Reich's website). Firm level measures of ΔL_i and ABX exposure are the weighted average by bank allocation over the lead banks in the last pre-crisis syndicate. Financial controls include Q, cash flow, cash, size (log of assets) and leverage. Industry is 1-digit SIC dummy, Rating are categorized into unrated, below-investment grade, and investment grade. Standard errors are two-way clustered on the lead lenders in the borrower's last pre-crisis lines of credit syndicate, and are displayed in parenthesis. ***, **, * represents significance levels are the 1%, 5%, and 10%, respectively.

Table 8. Investment comparisons with different matching variables

	(1)	(2)	(3)	(4)	(5)	(6)
Difference in differences	–0.57*	–0.71**	–0.50	–0.67**	–0.64**	–0.58*
	(0.29)	(0.29)	(0.31)	(0.31)	(0.30)	(0.33)
Matching estimator	–0.56**	–0.72***	–0.51**	–0.69**	–0.70***	–0.45***
(Abadie-Imbens)	(0.26)	(0.27)	(0.24)	(0.28)	(0.21)	(0.17)
Cash	×	×	×	×	×	×
Cash flow		×	×	×	×	×
Size			×	×	×	×
Leverage				×	×	×
Q					×	×
Investment						×
Ratings	×	×	×	×	×	×
Industry	×	×	×	×	×	×

Notes. This table compares the average quarterly investment (quarterly capital expenditures divided by lagged assets) from 2006Q4-2007Q2 to 2008Q4-2009Q2 by gradually adding matching variables. For example, column 1 matches on cash, ratings and industry, and column 6 uses all the matching variables (baseline matching). The treated firms (94 firms) are defined as those whose last pre-crisis credit lines became due in the crisis October 2008 to June 2009. The non-treated firms (835 firms) are defined as those whose last pre-crisis credit lines were scheduled to mature after June 2009. Control firms are selected from the non-treated group by matching on variables measured at the end of 2006. Robust standard errors clustered by firms are reported in parenthesis for the difference-in-differences estimates. Heteroskedasticity consistent robust standard errors are displayed in parenthesis for the matching ATT estimates. ***, **, * represents significance levels are the 1%, 5%, and 10%, respectively.

Table 9. Investment comparisons by the amount of maturing credit lines

	(1) Treated: firms with maturing credit lines	(2) Treated: firms with maturing credit lines/assets>5%	(3) Treated: firms with maturing credit lines/assets>10%	(4) Treated: firms with maturing credit lines/assets>15%
Difference in differences	–0.58*	–0.55	–0.66	–0.83
	(0.33)	(0.39)	(0.51)	(0.64)
Matching estimator	–0.45***	–0.51***	–0.60***	–0.74**
	(0.17)	(0.20)	(0.23)	(0.30)
Number of Treated firms	94	76	52	41

Notes. This table compares the change in average quarterly investment from 2006Q4-2007Q2 to 2008Q4-2009Q2 across treated and control firms. In column 1, the treated firms (94 firms) are defined as those whose last pre-crisis credit lines became due in the crisis (baseline). In column 2, 3, and 4, I require treated firms to have maturing credit lines over assets ratio greater than 5%, 10%, and 15%, respectively. The non-treated firms (835 firms) are defined as those whose last pre-crisis credit lines were scheduled to mature after June 2009. Matched control firms are selected from the non-treated group based on Abadie-Imbens estimator using matching variables including size, cash flow, cash, *Q*, leverage, investment, 1-digit SIC, and credit ratings, all measured at the end of 2006. Robust standard errors clustered by firms are reported in parenthesis for the difference-in-differences estimates. Heteroskedasticity consistent robust standard errors are displayed in parenthesis for the matching ATT estimates. ***, **, * represents significance levels are the 1%, 5%, and 10%, respectively.

Table 10. Comparison of cash and other policies

	(1) Cash	(2) Employment	(3) R&D
Difference in differences	1.98*	0.80	0.00
	(1.11)	(3.57)	(0.09)
Matching estimator	2.12**	0.79	0.00
	(1.06)	(3.39)	(0.12)

Notes. This table compares cash and other policies from 2006Q4-2007Q2 to 2008Q4-2009Q2 across treated and matched control firms. Cash is defined as quarterly cash divided by assets. Employment is defined as percentage change in the number of employees. R&D is defined as quarterly R&D expense over lagged assets to make it comparable with the definition of investment. In the DiD regressions, I regress outcome variables (change in cash, employment growth, change in R&D) on treated dummy and control variables used in matching. The treated firms are defined as those whose last pre-crisis credit lines became due in the crisis October 2008 to June 2009. The non-treated firms are defined as those whose last pre-crisis credit lines were scheduled to mature after June 2009. Matched control firms are selected from the non-treated group based on Abadie-Imbens estimator using matching variables including size, cash flow, cash, *Q*, leverage, investment, 1-digit SIC, and credit ratings, all measured at the end of 2006. In column (1) and (2), there are 94 treated firms and 88 unique control firms. For the comparison of R&D, I restrict the sample to firms with positive R&D expenditures in the normal period 2006Q4-2007Q2. There are 44 treated firms and 40 unique control firms in column (3). The unit is percentage point in column (1). Robust standard errors clustered by firms are reported in parenthesis for the difference-in-differences estimates. Heteroskedasticity consistent robust standard errors are displayed in parenthesis for the matching ATT estimates. ***, **, * represents significance levels are the 1%, 5%, and 10%, respectively.

Table 11. Test for exogeneity of bank health (firm-bank level regression)

	Δ Log(lines of credit in firm-bank pair)		
	No firm FE effect	firm FE effect	No firm FE effect
	(1)	(2)	(3)
% Δ loans to other borrowers ($\Delta L_{-i,b}$)	1.16**	1.11***	1.16***
	(0.48)	(0.41)	(0.43)
Size			1.71***
			(0.48)
Cash flow			33.44***
			(10.76)
Leverage			–4.84
			(3.25)
Cash			–5.83
			(3.55)
Q			–1.09
			(0.79)
Borrower FE	NO	**Yes**	NO
Rating FE	Yes	NO	Yes
Industry FE	Yes	NO	Yes
Adjusted R^2	0.06	0.31	0.15
Borrowers	94	94	94
Banks	42	42	42
Observations	695	695	695

Notes. This sample includes firms that obtain new credit lines in the crisis October 2008-June 2009. I also require such firms' last pre-crisis facility includes credit lines and has at least two lenders. The restrictions lead to 94 firms. The regression is at the loan level, so each bank-firm pair in a firm's last pre-crisis syndicate is an observation. The dependent variable is the log change in the dollar amount of credit lines from that bank to the borrower. %Δ loans to other borrowers ($\Delta L_{-i,b}$) equals the change in the number of loans made by firms' bank *b* to all other firms between the periods October 2005-June 2006 & October 2006-June 2007 and the crisis period October 2008-June 2009. $\Delta L_{-i,b}$ has been normalized so it has unit variance. Industry is 1-digit SIC dummy. Rating are categorized into unrated, below-investment grade, and investment grade. All regressions in the table are estimated by OLS. Standard errors are clustered on the last pre-crisis lender in column 2, and on the last pre-crisis lender and borrower in column 1 and 3. ***, **, * represents significance levels are the 1%, 5%, and 10%, respectively.

Table 12. The effect of bank liquidity supply on credit lines growth (firm-level regression)

	Lines of credit growth rate		
	OLS	OLS	IV (ABX exposure)
	(1)	(2)	(3)
%Δ loans to other borrowers (ΔL_i)	1.152***	0.897***	0.916**
	(0.349)	(0.306)	(0.341)
Financial variables	No	Yes	Yes
Industry FE	Yes	Yes	Yes
Rating FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes
First stage F-statistics			43.53
Lead bank cluster 1	40	40	40
Lead bank cluster 2	42	42	42
Observations	1257	1257	1257

Notes. This sample includes firms that had at least one facility before the crisis October 2008-June 2009. The restriction leads to 1257 firms. The regression is at the firm level. The dependent variable is the credit lines growth rate defined as the change in log (average lines of credit) from October 2006-June 2007 to the crisis period October 2008-June 2009. credit lines amount is not extracted from 10-K or 10-Q, but it is constructed by aggregating all the outstanding credit lines facilities from Dealscan at a given point in time (Acharya et al., 2013). %Δ loans to other borrowers (ΔL_i) equals the change in the number of loans made by firms' lead bank to all other firms between the periods October 2005-June 2006 & October 2006-June 2007 and the crisis period October 2008-June 2009. ΔL_i has been normalized, so it has unit variance. ABX exposure is the lead bank's exposure to ABX AAA 2006-H1 index (ABX exposure data is from Chodorow-Reich's website). Firm level measures of ΔL_i and ABX exposure are the weighted average by bank allocation over the lead banks in the last pre-crisis syndicate. Financial variables include size, cash flow, cash, Q, and leverage. Industry is 2-digit SIC. Ratings are categorized into unrated, below-investment grade, and investment grade. Standard errors are two-way clustered on the lead lenders in the borrower's last pre-crisis syndicate and are displayed in parenthesis. ***, **, * represents significance levels are the 1%, 5%, and 10%, respectively.

Table 13. The effect of bank liquidity supply on investment (firm-level regression)

	Investment growth rate		
	OLS	OLS	IV (ABX exposure)
	(1)	(2)	(3)
%Δ loans to other borrowers (ΔL_i)	0.083**	0.082**	0.137***
	(0.036)	(0.035)	(0.028)
Financial variables	No	Yes	Yes
Industry FE	Yes	Yes	Yes
Rating FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes
First stage F-statistics			46.6
Lead bank cluster 1	40	40	40
Lead bank cluster 2	42	42	42
Observations	1257	1257	1257

Notes. This sample includes firms that have at least one facility before the crisis October 2008-June 2009. The restriction leads to 1257 firms. The regression is at the firm level. The dependent variable is the investment growth rate defined as the change in log(total quarterly capital expenditures) from October 2006-June 2007 to the crisis period October 2008-June 2009. %Δ loans to other borrowers (ΔL_i) equals the change in the number of loans made by firms' lead bank to all other firms between the periods October 2005-June 2006 & October 2006-June 2007 and the crisis period October 2008-June 2009. ΔL_i has been normalized, so it has unit variance. ABX exposure is the lead bank's exposure to ABX AAA 2006-H1 index (ABX exposure data is from Chodorow-Reich's website). Firm level measures of ΔL_i and ABX exposure are the weighted average by bank allocation over the lead banks in the last pre-crisis syndicate. Financial variables include size, cash flow, cash, *Q*, and leverage. Industry is 2-digit SIC. Ratings are categorized into unrated, below-investment grade, and investment grade. Standard errors are two-way clustered on the lead lenders in the borrower's last pre-crisis syndicate and are displayed in parenthesis. ***, **, * represents significance levels are the 1%, 5%, and 10%, respectively.

Table 14. The effect of bank liquidity supply on credit lines and investment by ratings

	Lines of credit growth rate	Investment growth rate
	(1)	(2)
%Δ loans to other borrowers (ΔL_i) * Unrated	1.068***	0.117**
	(0.383)	(0.050)
%Δ loans to other borrowers (ΔL_i) * Rated	0.496	0.015
	(0.309)	(0.035)
Financial controls	Yes	Yes
Industry FE	Yes	Yes
Rating FE	Yes	Yes
State FE	Yes	Yes
Lead bank cluster 1	40	40
Lead bank cluster 2	42	42
Observations	1257	1257

Notes. This sample includes firms that have at least one facility before crisis October 2008-June 2009. The restrictions lead to 1257 firms. The regression is at the firm level. The dependent variable in column 1 is the bank liquidity growth rate defined as the change in log (average lines of credit) from 2006:10-2007:6 to 2008:10-2009:6. The dependent variable in column 2 is the investment growth rate defined as the change in log (total capital expenditures) from October 2006-June 2007 to 2008-June 2009. %Δ loans to other borrowers (ΔL_i) equals the change in the number of loans made by firms' lead bank to all other firms between the periods October 2005-June 2006 & October 2006-June 2007 and the crisis period October 2008-June 2009. ΔL_i has been normalized, so it has unit variance. Firm level measures of ΔL_i are the weighted average by bank allocation over the lead banks in the last pre-crisis syndicate. Financial variables include size, cash flow, cash, Q, and leverage. Industry is 2-digit SIC. Rating are categorized into unrated, below-investment grade, and investment grade. Standard errors are two-way clustered on the lead lenders in the borrower's last pre-crisis syndicate and are displayed in parenthesis. ***, **, * represents significance levels are the 1%, 5%, and 10%, respectively.

Table 15. The effect of bank liquidity supply on choice between cash and credit lines

	credit lines/(credit lines+cash)		credit lines /net assets	
	OLS	IV (ABX exposure)	OLS	IV (ABX exposure)
	(1)	(2)	(3)	(4)
%Δ loans to other borrowers (ΔL_i)	0.030***	0.039***	0.021**	0.026***
	(0.011)	(0.014)	(0.009)	(0.009)
Financial controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Rating FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
First stage F-statistics		47.1		47.1
Lead bank cluster 1	40	39	40	39
Lead bank cluster 2	42	42	42	42
Observations	1257	1257	1257	1257

Notes. This sample includes firms that have at least one facility before crisis October 2008-June 2009. The restriction leads to 1257 firms. The regression is at the firm level. The dependent variable in column 1 – 2 is change in average credit lines /(credit lines+cash) from October 2006-June 2007 to the crisis period October 2008-June 2009. The dependent variable in column 3 – 4 is change in average credit lines/net assets from October 2006-June 2007 to the crisis period October 2008-June 2009. %Δ loans to other borrowers (ΔL_i) equals the change in the number of loans made by firms' lead bank to all other firms between the periods October 2005-June 2006 & October 2006-June 2007 and the crisis period October 2008-June 2009. ΔL_i has been normalized, so it has unit variance. ABX exposure is lead bank's exposure to ABX AAA 2006-H1 index (ABX exposure data is from Chodorow-Reich's website). Financial variables include size, cash flow, Q, leverage, net worth ((assets – liabilities)/assets), and tangibility (tangible assets/total assets). Firm level measures of ΔL_i and ABX exposure are the weighted average by bank allocation over the lead banks in the last pre-crisis syndicate. Industry is 2-digit SIC. Ratings are categorized into unrated, below-investment grade, and investment grade. Standard errors are two-way clustered on the lead lenders in the borrower's last pre-crisis syndicate and are displayed in parenthesis. ***, **, * represents significance levels are the 1%, 5%, and 10%, respectively.

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