Commercial Paper, Lines of Credit, and the Real Effects of the Financial Crisis of 2008: Firm-Level Evidence from the Manufacturing Industry[*]

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We use firm-level data to examine the interplay between the use of lines of credit and commercial paper, which reveals the real effects of the recent financial crisis on nonfinancial firms. We find that aggregate commercial paper borrowing declined 15% after the collapse of Lehman Brothers, but the effect was concentrated among firms with high default risk: CP-rated firms with high default risk reduced their commercial paper divided by assets by 91% from the pre-crisis level. These high default risk firms drew heavily from existing lines of credit to substitute lost borrowing from the commercial paper market. However, there is no evidence that firms with low default risk drew excessively from their lines of credit and hoarded cash. The average size of the committed lines of credit scaled by assets decreased immediately after the collapse of Lehman Brothers, but increased after a liquidity injection by the Fed. Finally, firms with access to liquidity did not change their policies, such as investment and inventory, while firms without liquidity significantly reduced their business activities. The findings of this paper suggest that lines of credit play critical roles in providing liquidity to firms in times of need as well as screening creditworthy borrowers.

JEL classifications: G18; G21; G28; G32; G38
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1. Introduction

The series of failures of financial intermediaries following the collapse of Lehman Brothers in September 2008 raised concerns that a weakened financial sector would lead to a credit crunch for nonfinancial firms. The market responded negatively to this concern: the deterioration of American International Group, Inc. intensified, investors lost confidence in the safety of U.S. money-market mutual funds, and, notably, the commercial paper market broke down immediately after Lehman Brothers announced its bankruptcy filings (Mollenkamp, Whitehouse, Hilsenrath, and Dugan, 2008). According to market observers and commentators, the collapse of Lehman Brothers was followed by a virtual closing of the commercial papers market, and a number of firms drew excessively on their remaining lines of credit out of fear that weakened banks would reduce their loan commitments.[1] In his testimony before the Financial Services Subcommittee Hearing (June 9, 2009), Timothy Geithner, the Secretary of U.S. Treasury, stated, "If you look back at that period of time [fall of 2008], lending absolutely stopped." The hoarding of cash by nonfinancial firms in turn could further weaken the financial sector.

Consistent with these observations, Figure 1 displays the spreads between 3-month LIBOR, financial commercial paper rates, and nonfinancial commercial paper rates over T-bill rates for the period of January 2000 to April 2009. All spreads started to widen around August 2007, but they jumped to unprecedented levels by October 2008. For instance, the average daily

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[1] For example, when the commercial-paper market dried up during the fall of 2008, hampering American Electric Power (AEP)'s ability to raise near-term cash, AEP drew $2 billion from the facility, banked cash, and gradually retired the commercial paper. Holly Koeppel, the Chief Financial Officer of AEP, said: "that was our bridge to get us through the end of the year so we could stay out of the long-term credit market when it was rolling……Our ability to move early in drawing on our lines of credit has benefited us, giving us the flexibility to wait out the current crisis to resume more normal refinancing." (Banham, 2009). Similarly, the financial chief of Sally Beauty, which has 3,700 stores and annual sales of $2.5 billion, said that his firm is not affected directly by Lehman, but he drew $74 million from a $400 million revolver for precautionary purposes (McCracken and Enrich, 2008). The Journal reports that, within a month after the collapse of Lehman Brothers, at least 17 companies, including Goodyear Tire & Rubber, drew on lines to create a rainy-day fund (Enrich and McCracken, 2008).

LIBOR, financial commercial paper, and nonfinancial commercial paper rates over T-bill spreads reached 3.39%, 2.52%, and 1.40%, respectively (annualized).

The precipitously deteriorating credit market and the repercussions across the economy offer a unique opportunity to study several important issues. First, to what extent has the disruption in the commercial paper market impacted the liquidity of nonfinancial firms? Second, did nonfinancial firms seek to rebalance their liquidity position by using lines of credit or adjusting their cash balances? Third, how did the changes in firms' liquidity positions impact performance and policy?

In this paper, we investigate how *individual* manufacturing firms responded to the weakened financial sector and the downturn in overall commercial lending market activity. We use information from the 10-K and 10-Q filings during the last three quarters of 2008 to construct a unique data set of firm-level commercial paper outstanding, total committed lines of credit, and unused lines of credit for 914 publicly-listed manufacturing firms (including 109 CP-rated firms) in the United States. We find a significant decrease in firms' use of commercial paper after the default of Lehman Brothers. In aggregate, commercial paper outstanding in the manufacturing industry declined 15% after the default of Lehman Brothers. However, the reduction in outstanding commercial paper was concentrated primarily among firms with high risk as measured by stock return volatility, earnings volatility, and expected default frequency (EDF). For example, while commercial paper scaled by assets remained unchanged for firms with low EDF after the default by Lehman Brothers, that of firms with high EDF declined by 3%, which is equivalent to a 91% reduction from the pre-crisis level. To make up for the shortfall in liquidity due to the decline in commercial paper lending, firms drew on their existing lines of credit. The firms with a high EDF, which suffered the most severe declines in

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commercial paper borrowing after the collapse of Lehman Brothers, drew 35% more from their existing lines of credit than those with a low EDF. Firms with strong banking lending relationships were able to draw more funds than those with weak relationships.

Finally, we investigate the real effect of commercial paper disruption on nonfinancial firms. We find that firms without access to liquidity significantly cut back on their investment and experienced declines in profitability, while those with liquid funds maintained their business activities at the pre-crisis level.

Our paper contributes to several threads of literature. First, this paper is related to the literature on credit channels and nonfinancial sector real business activities. Early work by Kashyap, Stein, and Wilcox (1993) provides evidence that firms switch from bank loans to commercial paper following shifts toward tight monetary policy. Gatev and Strahan (2006) provide empirical evidence on the supply of bank liquidity when market liquidity dries up. They show that banks experience funding inflows when CP spreads widen, and this increase in deposits in turn allows banks to increase their lending activities. We provide the next link in the chain. We empirically characterize of the behaviors of high and low risk borrowers during a financial crisis. High risk borrowers that were negatively impacted by the decline in the commercial paper market after Lehman's default substituted commercial paper with lines of credit. In contrast, low risk borrowers did not encounter such degradation in the commercial paper market, and thus did not change external financing sources. The commercial paper/lines of credit substitution effect is also related to prior empirical work on lines of credit (Sufi, 2009; Yun, 2009), which finds that lines of credit are endogenously determined with cash holdings. In addition to cash, change in commercial paper market conditions is a key determinant of the utilization of existing lines.

Second, this paper contributes to the literature by shedding light on the importance of considering heterogeneous attributes of individual firms when assessing the impact of a financial crisis. In particular, our work is related to the study by Gertler and Gilchrist (1994), who find that the financial propagation mechanism is asymmetric due to access to alternative sources of funds. Historically, firms with CP rating are usually considered the highest credit quality borrowers. Calomiris, Himmelberg, and Wachtel (1995) suggest that flight-to-quality among lenders during a crisis may have given these borrowers access to financing alternatives like lines of credit (Bernanke, Gertler, and Gilchrist 1996). Complimenting to their findings, we document cross sectional heterogeneity among CP-rated firms. While there is a significant decline in aggregate financing (e.g., commercial paper borrowing), changes of averages after scaling by assets are mostly insignificant or less extreme than the changes in aggregates, except for high risk borrowers. Among the high risk borrowers, there are significant declines in commercial paper borrowing scaled by assets, and increases in the use of lines of credit. This reflects the fact that for most nonfinancial firms, the decline in financing activities is an outcome of decline in business activities and their economic scale (e.g., total assets) rather than a response to fears that a credit crunch will lead to the further deterioration of economic conditions. Market forces are at work even under distressed market conditions.

Third, this paper is related to the growing literature on the causes and consequences of the current financial crisis. Chari, Christiano, and Kehoe (2008) show that the impact of the crisis on the overall economy is limited, and call for further examination on the detailed nature of credit channels before massive government intervention. Using syndicated loan data and Call Reports, Ivashina and Scharfstein (2008) show that aggregate new issuance of syndicate loans declined and banks with greater exposure to lines of credit relative to deposits decreased their

lending more than those with less exposure. The existing papers mainly focus on either macro-level time-series evidence (Chari, Christiano, and Kehoe, 2008), or supply-side credit supply effect (Ivashina and Scharfstein, 2008); we provide detailed micro-level time-series characterization of the end-users of credits. In addition, our results on the relationship between firms' pre-crisis liquidity positions and real effects - such as investments, inventories, trade credits, and earnings - relates to the literature on financing constraints. Lemmon and Roberts (2008) examine leverage and investment decisions of firms that borrow from the junk bond markets after regulation changes and the collapse of Drexel Burnham Lambert. Chava and Purnanandam (2008) investigate banking relationships and corporate valuations during the financial crisis in 1998. They find bank-dependent firms whose main bank had greater exposure to Russia experienced larger reductions in valuation. In the context of the recent financial crisis, Duchin, Ozbas, and Sensoy (2008) examine the impact of pre-crisis cash position on post-subprime-mortgage-crisis investment policies. Almeida, Campello, Laranjeira, and Weisbenner (2009) use the rollover needs of long-term debt to establish a causal link between financial contracting and corporate outcome. Our paper focuses on the impact of pre-crisis *total liquidity* position, which accounts for both cash and bank liquidity (i.e., lines of credit), on post-crisis real activities, and thereby accounts for the endogenous nature of cash and lines of credit as alternative means to meet firms' liquidity needs (e.g., Yun, 2009). Campello, Graham, and Harvey (2009) conducted a survey on how CFOs perceive their company's ability to access external funds. Equipped with a direct measure of financial constraints, they show that firms that consider themselves financially constrained decreased overall business activities after the crisis. Our results complement their survey-based study by providing a detailed analysis of changes in short-term financing instruments (cash, commercial paper, total and unused lines of credit)

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around the crisis, and showing the impact of these short-term financing instruments on various

real activities of firms.

The rest of the paper develops as follows. Section 2 provides background on the current

financial crisis. Section 3 includes the description of the data used for this study and provides

summary statistics of the variables. Section 4 presents evidence on the use of lines of credit

during the recent financial crisis. Section 5 provides concluding remarks.

2. The Financial Crisis of 2008

2.1. Background

The increase in subprime mortgage defaults in early 2007 triggered the onset of the

current financial crisis. Subsequently, banks that suffered losses from these loans went into

distress, and, in several cases, failed. In March 2008, Bear Stearns was bailed out and acquired

by J. P. Morgan Chase after facing a liquidity crisis for rolling over their overnight repo loans.

The mortgage delinquency rate rose further, and as a result, Freddie Mac and Fannie Mae were

placed into federal conservatorship.

The most significant event that led the global financial markets into a full-fledged

financial crisis was the announcement of bankruptcy by Lehman Brothers Holdings, Inc. on

September 15, 2008. Lehman's default raised concerns regarding the health of financial

institutions, which subsequently led to a contraction in capital market lending, including lending

in the commercial paper market. Figure 2 shows that outstanding commercial paper severely

declined in the third week of September 2008. This contraction lasted until the end of October,

when the Federal Reserve implemented the Commercial Paper Funding Facility (CPFF). The

CPFF uses a special purpose vehicle (SPV) that purchases commercial paper from issuers using

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financing provided by the Federal Reserve Bank of New York (New York Fed), holds the commercial paper until maturity, and uses the proceeds from maturing commercial paper and other assets of the SPV to repay its loan from the New York Fed. Through this process, the CPFF provides a liquidity backstop to U.S. issuers of commercial paper. As shown in Figure 2, the CPFF greatly improved the liquidity of the commercial paper market.

In this paper, we consider three periods based on Lehman Brothers Holdings, Inc.'s default and the Federal Reserve's intervention in the commercial paper market: pre-Lehman's default (period 1), immediately after Lehman's default (period 2), and post-Fed's intervention (period 3). By examining firms' responses during these three periods, we can identify how the liquidity shock in the commercial paper market impacted firms and how Fed's injection of public liquidity mitigated the liquidity crisis.

2.2. Theoretical motivation and hypothesis development

This paper is motivated by theories on corporate liquidity and credit channels. Studies on corporate liquidity show that firms actively manage cash balances to protect themselves against future liquidity shock.[2] For example, in the theoretical model of Almeida, Campello, and Weisbach (2004), financially constrained firms maintain sufficient cash balances to secure funding for future investment opportunities. The insight from their model is that while financially unconstrained firms can access external capital markets at any time to raise funds for investment opportunities, financially constrained firms may miss profitable future investment opportunities if the realization of cash flow in some states is low. Therefore, financially

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[2] An incomplete list of studies on corporate liquidity includes Blanchard, Lopez-de-Silanez, and Shleifer (1994); Kim, Mauer, and Sherman (1998); Opler, Pinkowitz, Stulz, and Williamson (1999); Almeida, Campello, and Weisbach (2004); Faulkender and Wang (2006); Dittmar and Mahrt-Smith (2007); and Harford, Mansi, and Maxwell (2007).

constrained firms save a larger fraction of cash flows to hedge against potential adverse liquidity shocks.

Prior studies on banking, such as Boot, Thakor, and Udell (1987); Martin and Santomero (1997); and Holmstrom and Tirole (1998), show that in addition to managing cash balances, firms can also rely on lines of credit to overcome insufficient liquidity insurance provision from imperfect capital markets. [3] For instance, Holmstrom and Tirole (1998) suggest that a negative liquidity shock may lead to reduction in the manager's ownership stake, which in turn will reduce the manager's effort and the project's probability of success. When the project's probability of success is too low, it may be terminated because investors refuse to provide additional funds. Such moral-hazard driven inefficiencies can be mitigated by selling lines of credit so that borrowers can access these lines in the second period.

There are several advantages of lines of credit over cash noted in the extant literature. Kashyap, Rajan, and Stein (2002) show that when deposit taking and commitment-based lending are imperfectly correlated, bundling deposit taking and lines of credit business under a single institution gives a cost advantage. Gatev and Strahan (2006) argue that banks have a natural hedge against market-wide liquidity shocks. They examine banks' substitution of commercial paper/lines of credit by relating changes in bank assets and changes in quantity of assets funded by deposits in response to widening of spreads. Recent studies by Sufi (2009) and Yun (2009) suggest that firms use both cash and lines of credit to manage liquidity risk.

The recent crisis in the commercial paper market after the collapse of Lehman Brothers and the subsequent failures of other financial institutions provides a unique opportunity to observe the effectiveness of cash and lines of credit as means of risk management. A number of

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[3] In this paper, we focus on the short-term financing (i.e., liquidity provision) role of lines of credit. DeMarzo and Fishman (2007) show that the need for lines of credit can also arise from long-term optimal contracts, where lines of credit provide efficient levels of financial slack when cash flows are risky.

studies on credit channels note that firms substitute their financing sources when met by a supply shock in a particular type of financing instrument. For example, Kashyap, Stein, and Wilcox (1993) find that firms substitute bank loans with commercial paper when Fed tightens monetary policy and reduces the bank credit available. We expect a similar substitution effect of external financing to occur among the sample of manufacturing firms during the current financial crisis – the adverse shock in the commercial paper market after the collapse of Lehman Brothers will lead to a reduction in commercial paper borrowings and an increase in bank lending in the form of utilization of existing lines of credit.

We also expect the financial crisis to have real effects on firms through liquidity changes. Prior literature on financing constraints notes that financially constrained firms may pass up valuable investment opportunities when their cash flow is low (Fazzari, Hubbard, and Petersen, 1988). As illustrated by Almeida, Campello, and Weisbach (2004), financially constrained firms may manage their cash balances to buffer adverse liquidity shocks. Recent work by Sufi (2009) extends the work by Almeida, Campello, and Weisbach (2004) to incorporate lines of credit in addition to cash, and shows that access to lines of credit is an alternative measure for managing financing constraints. This paper examines the *short-term* adjustments by firms in response to the largely unforeseen series of events of the last half 2008, and the subsequent economic outcomes.. Under the tightened credit market conditions, we expect firms with bank liquidity or cash on hand to be less affected by the weakened lending environment.

Finally, our work provides some initial micro evidence on the effect of public liquidity provisions on corporate liquidity. During the fourth quarter of 2008, Fed intervened in the commercial paper market as well as in the financial industry to provide liquidity. At least one theoretical foundation behind the public provision of liquidity is that the central bank can

efficiently coordinate the allocation of excess liquidity in the economy and avoid systemic

financial meltdown (Holmstrom and Tirole, 1998).[4] This period of time provides a natural

context to assess the impact of Fed's liquidity intervention on corporate liquidity. Our paper

provides some preliminary evidence that Fed intervention had the beneficial effect of allowing

banks to maintain their level of commitments for creditworthy borrowers during the crisis.

Interestingly, this result contrasts with practices in the consumer credit card market, where the

credit card limit was reduced over the time after the crisis (Andriotis, 2009) in the absence of

such liquidity injection.

3. Data

3.1. Construction of the sample

The paper uses several sources of data. The primary data comprise firm-level commercial

paper outstanding, lines of credit available, and lines of credit used for nonfinancial firms in the

United States at quarterly frequency. Commercial papers are short-term promissory notes issued

by corporations with maturities up to 270 days. Corporations use commercial paper as a lower-

cost alternative to bank loans to raise cash needed for current transactions. Lines of credit are

banks' promises for future lending sold to borrowers. The used portion of the line of credit is a

debt obligation which is formally recorded in a firm's balance sheet. The unused portion of the

line of credit is an off-balance sheet item that remains available for future lending unless

covenants of the line of credit are violated. In this paper, we consider both the total committed

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[4] However, public provision of liquidity may incur unintended consequences, such as crowding out private provision of liquidity (Bolton, Santos, and Scheinkman, 2009). We want to make two caveats. First, the focus of our paper is not to test the net welfare implications of these potentially offsetting channels. However, one can still view our evidence as a test of the necessary but not sufficient condition for the central bank's interventions to be effective on the real economy. Second, we cannot directly answer the question of whether Fed's liquidity injection and intervention policy is efficient for individual borrowers. Nevertheless, we provide evidence that the liquidity level prior to the Lehman's failure plays an important role in shaping corporate financial decisions and economic outcomes.

amount and the unused portion of firms' lines of credit because the former indicates banks' total

supply of credit and the latter indicates firms' liquidity buffer as a substitute of cash holdings.

According to Kaplan and Zingales (1997), firms are required to disclose their liquidity

and capital resources by Regulation S-K, and document their lines of credit in their filings with

the Security and Exchange Commission (SEC) as part of the regulatory requirement. Following

prior work on lines of credit (Sufi, 2009; Yun, 2009), we look for seven keywords that refer to

lines of credit in the 10-K and 10-Q filings: credit lines, credit facility, revolving credit

agreement, bank credit line, working capital facility, lines of credit, and line of credit. Also, as

the prior work (Sufi, 2009; Yun, 2009) noted, lines of credit are often used to back up

commercial papers. In such case, to avoid double counting, we subtract the outstanding amount

of commercial paper from the unused amount of the lines of credit to determine the actual

unused amount:

$$UnusedLines_{it} = TotalLines_{it} - UsedLines_{it} - CommercialPaper_{it}, \qquad (1)$$

where i indexes firm and t indexes time period for each observation.

To accommodate the high cost of manually collecting commercial paper and lines of

credit data while also being able to examine the use of lines of credit for nonfinancial firms, we

focus on the U.S. domestic manufacturing industry (SIC codes 2000–3999), which issue a

majority of the lines of credit among nonfinancial firms.[5]

To match the end-of-fiscal-year dates with our three distinct event periods (i.e., pre-

Lehman's default, immediately after Lehman's default, and post-Fed's intervention), we only

consider firms with fiscal years ending in March, June, September, or December. As shown in

Figure 3, we classify each firm's June filings as Period 1 (pre-Lehman's default), September

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[5] Based on estimates from Dealscan, 40% of the lines of credit were issued to manufacturing firms from 1987 to 2002. (See, Yun, 2009).

filings as Period 2 (immediately after Lehman's default), and December filings as Period 3 (post-Fed's intervention).

This panel of lines of credit data is then matched with Compustat Quarterly Files to obtain borrowers' financial characteristics. For an observation to be valid, we require the total asset (Compustat data code: ATQ) to be positive and non-missing. We also drop firms that do not have complete information on commercial paper and lines of credit throughout the sample period. The resulting final sample includes 914 firms during the last three quarters of 2008.

Although most firms have complete information on commercial papers and lines of credit for all quarters, a few firms dropped out from our sample and they discontinued reporting to the SEC. Thus we do not have sufficient information on them. However, the percentage of drop outs is very small (about 3%) and is unlikely to change our result.[6]

3.2. Description of the data

The main variables of interest for this study are commercial papers outstanding, total committed lines, and unused amount of lines of credit. All these variables are divided by total non-cash assets (Total Assets minus Cash and Cash Equivalents, ATQ - CHEQ) following Sufi (2009).[7]

To account for the heterogeneity of borrowers' financial characteristics that may influence firms' use of commercial paper or lines of credit, we control for the following variables: firm size, leverage, market-to-book asset ratio, property plant and equipment, cash

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[6] As shown in Figure 4, the frequency of delisting in 2008 was similar to that in pre-crisis years. We have also included the observations in our main empirical analysis. The results are robust to this sampling choice.
[7] For robustness check, whenever appropriate, we also repeat all of the exercises in tables 3 to 5 using alternative deflators such as Total Assets (Compustat Data Code: ATQ) or lagged Total Assets. The results are robust to these variations.

flow, and net worth. Firm size is measured by the natural log of non-cash assets (ATQ –

CHEQ). Leverage is measured by book debt (DLTTQ + DLCQ) divided by non-cash assets.

The market-to-book asset ratio [(ATQ + PRCCQ) times (CSHOQ – CEQQ)] divided by non-

cash assets captures firms' growth prospects. Property plant and equipment (PPENTQ)

measures firms' asset tangibility. Cash flow (IBQ + DPQ – DVTQ) measures firms'

profitability. Net worth is measured by non-cash assets (ATQ – CHEQ) less total liabilities

(LTQ). Of these financial variables, property plant and equipment, cash flow, and net worth are

divided by non-cash assets (ATQ – CHEQ).

To characterize the risk profiles of borrowers, we use several risk measures. These

measures include the past quarter's daily stock return volatility, the past four quarters' earnings

volatility measured by the standard deviations of the quarterly earnings scaled by total assets,

and the past quarter's average monthly expected default frequency (EDF). The first two are

standard and easy to compute, but they share the drawbacks of being "backward looking" rather

than "forward looking." The last measure, the EDF, is worthy of some explanation. Built on the

insights of Black-Scholes-Merton's contingent claim framework, Moody's-KMV (Crosbie and

Bohn, 2003) developed the concept of EDF. Compared to traditional and much debated low-

frequency credit-rating-based measures, EDF is a more timely predictor of corporate defaults.[8]

The EDF measure used in this paper is computed based on the methodology outlined in Bharath

and Shumway (2008), which uses daily stock return data from CRSP and quarterly accounting

information from Compustat.[9]

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[8] Interested readers can find a comprehensive collection of case studies on EDF predictive power and corporate
default at Moody's-KMV website: http://www.moodyskmv.com/research.
[9] The main difference between the commercial version of EDF® produced by Moody's-KMV and the EDF measure
computed based on Bharath and Shumway (2008) is that the commercial version of EDF® maps the risk neutral
default probability to the physical default probability using a series of proprietary nonparametric models.
Nevertheless, as shown by Bharath and Shumway (2008), the correlation between EDF produced by Moody's-KMV
and EDF by Bharath and Shumway (2008) is about 0.77.

To illustrate the economy-wide and sector-wide aggregate EDF, we first compute each company's EDF, then value-weight an individual firm's EDF by market capitalization. The resulting time series is shown in Figure 5. Interestingly, the time-series plot of aggregate EDF provides yet another motivation for our choice of pre- and post-crisis periods. While the aggregate EDF began to rise in early 2007 when the excessive defaults on subprime mortgages became widely recognized, the most significant change occurred in September 2008 when the bankruptcy of Lehman Brothers was announced – EDF of the manufacturing industry jumped more than four times (from less than 0.02 to 0.08). Hence, it seems reasonable that we classify periods before September 2008 as pre-crisis period and those after it as post-crisis period. [10]

3.3 Summary statistics

Table 1 shows median, mean, and standard deviation of the variables used in this paper for each quarter. In Panel A through Panel C, the left hand side set of columns shows the summary statistics for observations without commercial paper ratings, the center set of columns shows the summary statistics for observations with commercial paper ratings, and the right hand side set of columns shows the difference in means and *t*-statistics between these two samples.

Overall, firms with a commercial paper rating are much bigger in size. These firms also have higher leverage, higher cash flow, and lower EDF. Many of these characteristics are consistent with the empirical regularities identified in Calomiris, Himmelberg, and Wachtel (1994). They find that commercial paper rated (i.e., "CP-rated") firms are higher quality borrowers than those without a commercial paper rating (i.e., "non CP-rated"). However, market-to-book and net worth scaled by assets ratios are not significantly different between these

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[10] Using a simple arithmetic average of an individual firm's EDF (i.e., the equally-weighted average EDF), we generated essentially the same plot.

two samples. Over time, total assets of non CP-rated firms remained stable except for a small decline in the fourth quarter of 2008. In contrast, total assets of CP-rated firms steadily declined over the sample period. Cash flow declined over time for both CP-rated and non CP-rated firms; the means were negative in the post-crisis period for the non CP-rated firms. Also, EDF increased for both samples. While the level of EDF is higher for non CP-rated firms than CP-rated firms, the rate of increase is somewhat higher for the CP-rated sample, which reflects the turmoil in the commercial paper market.

Table 2 shows the aggregate sum of major variables considered in this paper for each quarter during 2008. Panel A of Table 2 shows that the manufacturing industry issued about $71 billion, or 42% of all commercial paper issued by the nonfinancial firms in the second quarter of 2008.[11] Consistent with recent studies (Chari, Christiano, and Kehoe, 2008; Ivashina and Scharfstein, 2008), the aggregate amount of commercial paper significantly decreased after the bankruptcy of Lehman Brothers – commercial paper borrowings by manufacturing firms decreased almost 15% from the second quarter to the third quarter of 2008. However, after the injection of liquidity by Fed through the Commercial Paper Funding Facility in October 2008, the aggregate amount of commercial paper increased back to near its pre-crisis level. The last three columns of Panel A show average commercial paper scaled by the non-cash assets for each quarter. As opposed to the aggregate amount, the change of commercial paper scaled by non-cash assets was more modest.

Panel A of Table 2 also reports the aggregate amount of lines of credit committed by banks and the unused amount of lines, which also decline after the crisis. The decline was much more moderate than that of commercial papers. The total committed amount declined 3% and the

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[11] According to Federal Reserve, the aggregate outstanding commercial paper issued by all nonfinancial firms was $170 billion.

unused lines of credit declined 8% in the third quarter of 2008. To make up for the shortfall in liquidity due to the decline in commercial paper and utilization of lines of credit, firms also used their cash balances. The aggregate amount of cash balances of manufacturing firms decreased significantly in the fourth quarter of 2008. Also, the aggregate amount of total liquidity (sum of cash and unused lines of credit) decreased significantly after the crisis. However, the total amount of liquidity divided by assets remained stable after the crisis and even slightly increased in the fourth quarter of 2008.

Finally, we document the exposure to Lehman Brothers for lines of credit commitments. In aggregate, the total exposure of manufacturing firms to the default of Lehman Brothers is about $2 billion. The direct impact of the default on commitments by Lehman Brothers was small – less than 2% of the firms considered in our sample had an exposure to Lehman Brothers, and the average amount of exposure was less than 5% of the total bank commitment amount.

Panel B of Table 2 shows the aggregate sums of non CP-rated firms. Overall, the changes in commercial paper or lines of credit (total, used, and unused) are much smaller than those of CP-rated firms. A notable change is that the mean used lines of credit divided by total non-cash assets significantly increased after the crisis.

4. Results

4.1. Response from the commercial paper market

As a first step in understanding nonfinancial firms' responses to the crisis, we examine commercial paper borrowings around the crisis. We test whether a firm's commercial paper scaled by total non-cash assets decreases in the post-crisis period (2008:Q3 and Q4). [12] Key

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[12] Tightened credit condition in the commercial paper market can also be seen from the changes in the maturity structure of newly issued commercial papers (Shrivastava, 2008). As shown in Figure 6(a), the maturity of financial

variables to measure the effect in the post-crisis period are indicators for the third and fourth

quarter, which are one if an observation is taken from the third and fourth quarter, respectively,

and are zero otherwise. We expect negative coefficients if there was a decrease in commercial

paper borrowings in the post-crisis period, and zero if there were no changes in commercial

paper borrowings after the crisis. In order to account for borrowers' heterogeneity, we control

for firm size, leverage, market-to-book asset ratio, cash flow, net property plant and equipment,

and net worth. Following prior work, corporate liquidity, cash flow, net property plant and

equipment, and net worth are divided by non-cash assets instead of total assets to avoid spurious

mechanical correlations (Sufi, 2009; Yun, 2009). Also, the use of control variables is motivated

by prior work (e.g., Sufi, 2009), and is expected to influence tradeoffs among different liquidity

instruments (e.g., cash, commercial paper, and lines of credit). For example, Sufi (2009) finds

that high cash flows are often required for access to lines of credit, and therefore influence firms'

choice among different liquidity instruments. Standard errors are clustered at the firm level to

account for the serial correlation within each firm.

The first column of Table 3 shows the result of the changes in commercial paper

borrowings divided by non-cash assets after the Lehman crisis. The parameter estimate on the

2008:Q3 indicator is statistically insignificant and on the 2008:Q4 indicator is negative and

marginally significant at 10% significance level. There was a 0.8% decline in commercial paper

divided by assets in the fourth quarter of 2008. Since the mean commercial paper divided by

assets is 3.3% in the second quarter of 2008, an estimated 0.4% (0.8%) average decline amounts

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commercial papers significantly shortened from mid-September until the end of October. After mid-September, 80%–90% of the newly issued financial commercial papers have a maturity of less than 4 days. However, as shown in Figures 6(b), the maturity of nonfinancial commercial papers did not exhibit any tendency toward shorter maturity. The relatively stable maturity composition of commercial paper issued by nonfinancial firms lends additional support to our focus on the quantity effect as opposed to the composition effect on corporate liquidity policy.

to a 12% (24%) decline from the pre-crisis level in the third quarter (fourth quarter). Clearly, in both cases, the economic magnitude of such decline is noticeable though the point estimates are imprecise.

Using the *lagged* expected default frequency (EDF) estimated from past quarter's average monthly EDFs, past quarter's stock return volatilities, and past year's quarterly earnings volatilities as measures of a firm's risk, we classify a firm as a high risk firm if the value of risk measure EDF, stock return volatilities, and earnings volatilities are among the upper quartile of all firms with a commercial paper rating and with commercial paper outstanding by the end of the second quarter of 2008. If a firm belongs to the high risk quartile, the corresponding high risk indicator takes the value of one, and zero otherwise. To distinguish between high and low risk borrowers, we interact the post-crisis indicators (indicators for 2008:Q3 and Q4) with various measures of each firm's risk.

It turns out that the decline of commercial paper borrowing activities were primarily concentrated among a subset of high risk firms. The second to fourth columns show the incremental impact of a firm's risk on decline in commercial paper borrowings in the post-crisis period. As shown in Table 3, the parameter estimates on the interaction of post-crisis and high risk indicators are negative and statistically significant (except for earnings volatility in 2008:Q3). In contrast, the post-crisis indicators are statistically insignificant. While commercial paper divided by assets remains unchanged after the crisis, that of high EDF firms experienced a 3% decline in the fourth quarter of 2008. This implies that commercial paper borrowings divided by assets decreased 91% of the pre-crisis level (sample mean of 2008:Q2 is 3.3%) for CP-rated firms with high EDF, while those of CP-rated firms with low EDF remained unchanged. We find similar results for other specifications that use past quarter's stock return

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volatility (the third column) and past year's earnings volatility (the fourth column) for measures of a firm's risk.

These results are consistent with active screening by investors in the commercial paper market. For example, investors' appetite for risk diminished after the default of Lehman Brothers and they pulled out from risky commercial paper borrowers, while they remained in the safe firms. Also, commercial paper divided by assets further declined from the third to the fourth quarter.

4.2. Use of lines of credit: Substitution of external financing or excessive draws on lines?

The previous section shows that the direct impact of adverse shock in the nonfinancial commercial paper market was concentrated among high risk firms. Based on Figure 2, the decline in the commercial paper market after the bankruptcy of Lehman Brothers was largest in the financial sector, which may indirectly impact nonfinancial firms due to weakened lending capacity. In this section, we explore how the weakened banking sector impacted lending to manufacturing firms, and also the degree to which manufacturing firms drew on their existing lines of credit to make up for the reduction in commercial paper borrowings during the financial crisis.

For CP-rated firms, the amounts of used lines of credit are determined by Equation (1). If firms perfectly substitute commercial paper with lines of credit, we expect

$$\Delta UsedLines_{it} + \Delta CommercialPaper_{it} = 0,$$

where $\Delta UsedLines_{it}$ indicates change of used lines of credit from the second quarter to post-crisis quarters, and $\Delta CommercialPaper_{it}$ indicates change of commercial paper borrowings from the second quarter to post-crisis quarters. From Equation (1), we have

$$\Delta UnusedLines_{it} = \Delta TotalLines_{it},$$

(i.e., $\Delta UnusedLines_{it} = \beta \cdot \Delta TotalLines_{it}, and\ \beta = 1$), where $\Delta UnusedLines_{it}$ indicates

change of unused lines of credit from the second quarter to post-crisis quarters, and

$\Delta TotalLines_{it}$ indicates change of total lines of credit from the second quarter to post-crisis

quarters. If firms draw on existing lines of credit in excess of the amount reduced from

commercial papers, we expect

$$\Delta UsedLines_{it} + \Delta CommercialPaper_{it} > 0,$$

and from Equation (1), we get $\Delta UnusedLines_{it} < \Delta TotalLines_{it}$ (i.e., $\Delta UnusedLines_{it} = \beta \cdot$

$\Delta TotalLines_{it}, and\ \beta < 1$),. Finally, if firms draw on existing lines of credit in less than the

amount reduced from commercial papers, we expect

$$\Delta UsedLines_{it} + \Delta CommercialPaper_{it} < 0,$$

and from Equation (1), we get $\Delta UnusedLines_{it} > \Delta TotalLines_{it}$ (i.e., $\Delta UnusedLines_{it} = \beta \cdot$

$\Delta TotalLines_{it}, and\ \beta > 1$),. We can test excessive drawdown of lines as

$$\frac{\Delta UnusedLines_{it}}{Non\text{-}cash\ Assets_{it-1}} = \alpha + \beta \cdot \frac{\Delta TotalLines_{it}}{Non\text{-}cash\ Assets_{it-1}} + \gamma \cdot X_{it} + \epsilon_{it}, \qquad (2)$$

where X_{it} are controls to account for firm heterogeneity, and ϵ_{it} are random noises. We scale

changes in unused lines and total lines by each firm's non-cash assets. In this specification,

$\beta = 1$ when firms perfectly substitute for the reduction in commercial paper with lines of credit,

$\beta < 1$ when firms draw more from lines than the reduction in commercial paper, and $\beta > 1$

when firms draw less from lines than the reduction in commercial paper.

In order to examine the effect of the riskiness of borrowers, we interact $\Delta TotalLines/$

$Non\text{-}cash\ Assets$ with the high EDF indicator. In this specification, $\beta_1 = 1$ when firms with

low EDFs perfectly substitute for the reduction in commercial paper with lines of credit, $\beta_1 < 1$

when firms with low EDFs draw more from lines than the reduction in commercial paper, and

$\beta_1 > 1$ when firms with low EDFs draw less from lines than the reduction in commercial paper. The coefficient on the interaction of $\Delta TotalLines/Non\text{-}cash\ Assets$ with the high EDF indicator, β_2, represents the incremental impact of having high risk (i.e., high EDF) on utilization of lines of credit. That is, the sum of β_1 and β_2 is the sensitivity of $\Delta UnusedLines/$ $Non\text{-}cash\ Assets$ on $\Delta TotalLines/Non\text{-}cash\ Assets$. In this specification, $\beta_2 < 0$ when firms with high EDFs draw more from lines than low EDF firms, $\beta_2 > 0$ when firms with high EDFs draw less from lines than low EDF firms, and $\beta_2 = 0$ when there are no significant differences in utilization of lines of credit between high and low EDF firms.

$$\frac{\Delta UnusedLines_{it}}{Non\text{-}cash\ Assets_{it-1}} = \alpha + \beta_1 \cdot \frac{\Delta TotalLines_{it}}{Non\text{-}cash\ Assets_{it-1}} + \beta_2 \cdot \frac{\Delta TotalLines_{it}}{Non\text{-}cash\ Assets_{it-1}} \cdot HighEDF + \gamma \cdot X_{it} + \epsilon_{it}, \quad (3)$$

Panel A of Table 4 shows the use of lines of credit and cash holdings for CP-rated firms. The first column of panel A tests the degree of drawdown from lines of credit. The parameter estimate on $\Delta TotalLines/Non\text{-}cash\ Assets$ is 0.588, and the interaction with $\Delta TotalLines/$ $Non\text{-}cash\ Assets$ and the high EDF indicator is significantly negative, -0.353. This suggests that firms with high EDF drew more from lines than those with low EDF. One reason for this result is that high EDF firms experienced the most reduction in commercial paper borrowings and hence used more cash to make up for the shortfall in liquidity needs.

The second column tests whether total lines of credit divided by non-cash assets changed in the post-crisis periods. The parameter estimates on post-crisis indicators (indicators for 2008:Q3 and Q4) are statistically insignificant, and those of interactions with the high EDF indicator are also statistically insignificant. This implies that the total committed lines provided by banks remained unchanged after the crisis.

In the third column, we examine the changes in cash holdings after the crisis. The parameter estimates on post-crisis indicators are insignificant, but the parameter estimate on the

interaction of 2008:Q3 indicator and the high EDF indicator is 0.11 and statistically significant. This implies that the cash holdings of low EDF firms with a CP rating remain unchanged while that of high EDF firms with a CP rating increased immediately after the crisis. However, such cash hoarding behavior by CP-rated firms with high EDF disappeared after Fed's intervention.

The fourth column tests whether the total liquidity measured by the sum of cash and unused lines of credit changed after the crisis. The parameter estimate on the 2008:Q4 indicator is 0.014 and statistically significant while the interactions of post-crisis indicators with the high EDF indicator are statistically insignificant. This implies that total liquidity divided by non-cash assets increased 1.4% after Fed's intervention, but there were no significant differences post-crisis between high and low EDF firms with CP-ratings.

In Panel B, we examine the changes in the liquidity of non CP-rated firms. The post-crisis indicators (2008:Q3 and Q4 indicators) measure the change in the post-crisis periods, and the interactions of post-crisis indicators with the high EDF indicator measure the incremental change of high EDF firms (relative to low EDF firms) in the post-crisis periods. The first column shows the results on unused lines of credit divided by assets. The parameter estimate on the 2008:Q3 indicator is statistically insignificant but that on the 2008:Q4 indicator is positive and statistically significant. These results suggest that firms' bank liquidity (unused lines) did not change immediately after the crisis but increased after Fed's intervention. The parameter estimates on the interaction of post-crisis indicators and the high EDF indicator are positive and statistically significant, which implies that high EDF firms had more unused lines of credit than low EDF firms after the crisis. For example, the increase in unused lines of credit divided by non-cash assets after Fed's intervention in the fourth quarter of 2008 for non-CP-rated firms with high EDF was 2.7% larger than that of non-CP-rated firms with low EDF. This is possible if

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high EDF firms expect greater uncertainties than low EDF firms in accessing external funds in the post-crisis period, and therefore secured extra bank liquidity for precautionary purposes.

The second column shows total lines of credit divided by total assets. The parameter estimate on the 2008:Q3 indicator is statistically insignificant but on the 2008:Q4 indicator is positive and statistically significant. Total lines of credit committed by banks did not change immediately after the crisis but for non-CP-rated firms with low EDF increased by 1.0% after Fed's intervention. The parameter estimates on the interaction of post-crisis indicators and the high EDF indicator are positive and statistically significant, which implies that banks provided more commitments after the crisis to high EDF firms than low EDF firms. For example, total committed lines divided by non-cash assets increased 2.6% more in the fourth quarter of 2008 for non-CP-rated firms with high EDF than those with low EDF. This is consistent with informed bank lending: banks knew better than the outside market about borrowers and were able to provide more liquidity after the crisis.

The third column shows results for cash divided by non-cash assets. The parameter estimates on post-crisis indicators and on the interaction with the high EDF are statistically insignificant. The cash balance of non-CP-rated firms did not change significantly after the crisis.

Finally, the fourth column shows results for total liquidity, which is the sum of cash and unused lines of credit. The parameter estimates on post-crisis indicators and on the interaction with high EDF are statistically insignificant. The total liquidity of non-CP-rated firms did not change significantly after the crisis. This is consistent with prior findings by Sufi (2009) and Yun (2009), who find that firms jointly determine cash and unused lines of credit to maintain optimal size of total liquidity reserves.

In summary, evidence on the uses of lines of credit suggests that high risk firms, who expect more hardships in access to external funds in times of crisis, secured more commitments from banks after the crisis. During the crisis, these firms maintained their cash balance and increased total committed lines of credit for precautionary purposes.

4.3. Corporate liquidity and real effects of the crisis

Prior literature on financing constraints notes the importance of access to external funds on various firm policies (Fazzari, Hubbard, and Petersen, 1988). Sufi (2009) suggests that access to lines of credit provides a good measure of financing constraint, and shows that firms with access to lines of credit exhibit less sensitivity of cash balances to cash flows. In this section, we investigate the real effects of the freeze of the commercial paper market (starting from the collapse of Lehman Brothers) and the incremental impact of the crisis on firms with access to liquidity and external financing.

Table 5 shows the results for the impact of the crisis and incremental impact of access to liquidity. Similar to regressions in the preceding sections, post-crisis indicators (2008:Q3 and 2008:Q4 indicators) measure the changes in the post-crisis period, and their interactions with a high pre-crisis liquidity indicator measure the incremental impact for having access to liquidity. The high pre-crisis liquidity indicator is one if total liquidity (sum of cash and unused lines of credit) at 2008:Q2 divided by lagged non-cash assets is above median, and is zero otherwise. We intentionally chose to measure the liquidity level prior to the crisis to mitigate the endogeneity and reverse causality concerns. This choice is effective if (1) the commercial paper market freeze after Lehman's bankruptcy was unexpected by the end of second quarter 2008; and

(2) Lehman's bankruptcy does not significantly affect our sample of firms. It seems to us that these two assumptions are reasonable.

The first three columns show results for investments. The first measure of a firm's investment activities is the asset growth rate between quarters $(Asset_t - Asset_{t-1})/Asset_{t-1}$ (Fama and French, 2006). Results for asset growth in the first column show that the parameter estimates on post-crisis indicators are negative and statistically significant. In contrast, the estimates on the interaction terms between the post-crisis indicators and the high (pre-crisis) liquidity indicators are positive and statistically significant. For example, the asset growth of low pre-crisis liquidity firms declined 8.1% in the fourth quarter of 2008, but the incremental impact on high liquidity firms was 5.5% less than that of low pre-crisis liquidity firms.

In earlier sections, we show firms may increase cash holdings for precautionary saving purposes. Thus, including cash and cash equivalents in the calculation of asset growth rate may overstate the firm's investment activities. To overcome this potential mechanical relation, we consider the second measure of investment activities, non-cash asset growth, $(Non\text{-}cash\ Assets_t - Non\text{-}cash\ Assets_{t-1})/Non\text{-}cash\ Assets_{t-1}$. The results are reported in the second column. We find stronger results when using non-cash asset growth than when using asset growth. For example, the non-cash asset growth of low pre-crisis liquidity firms declined 9.4% in the fourth quarter of 2008, but the incremental impact on high liquidity firms was 6.0% less than on the low liquidity firms. This suggests that there was a significant decline in the non-cash component of assets for firms that had low liquidity before the crisis, while those with high liquidity before the crisis did not experience significant changes in the non-cash portion of assets.

In the third column, we examine changes in firms' investment activities by looking at capital expenditures scaled by the lagged total assets (Opler, Pinkowitz, Stulz, and Williamson, 1999). This is a direct but slightly narrower definition of investment activities. The parameter estimate on the 2008:Q4 indicator is negative and statistically significant, whereas on the interaction between the 2008:Q4 indicator and the high pre-crisis liquidity indicator, it is positive and statistically significant. Again the capital expenditures of firms with low pre-crisis liquidity experienced a 3% decline in capital expenditures scaled by lagged total assets, while those with high total liquidity before the crisis did not experience any significant changes in capital expenditures scaled by lagged total assets.

Prior studies on inventories suggest that credit constrained firms cut back on inventories to reduce the cost of carrying them (Kashyap, Lamont, and Stein, 1994). The fourth column shows results for changes in inventories after the crisis. The parameter estimates on post-crisis indicators are negative and statistically significant while those on the interactions of post-crisis indicators and the high pre-crisis liquidity indicator are positive and statistically significant. The inventory for firms that had a low level of liquidity right before the crisis declined 2.7% in the third quarter and 6.2% in the fourth quarter of 2008. In contrast, the inventory for firms with high total liquidity right before the crisis increased 2.0% (i.e., -2.7%+4.7%; t-statistics = 0.98) in the third quarter and 3.2% (i.e., -6.2%+9.4%; t-statistics = 1.25) in the fourth quarter. Though the economic magnitudes of these estimates are large, they are rather imprecisely estimated.

The fifth column shows results for changes in accounts receivables divided by lagged total assets. Love, Preve, and Sarria-Allende (2007) examine the use of trade credit, measured by accounts receivables, during the 1997 Asian crisis, and find that bank credit is redistributed via trade credit from financially stronger firms to financially constrained firms. We find trade

credit patterns that are consistent with Love, Preve, and Sarria–Allende (2007). For example, the parameter estimate on the 2008:Q4 indicator is -0.101 and statistically significant, and the interaction of the 2008:Q4 and high pre-crisis total liquidity is 0.069 and statistically significant. That is, the accounts receivables (trade credits) divided by lagged total assets declined by 10.1% in the fourth quarter for firms that had low levels of total liquidity before the crisis, where as those with high pre-crisis liquidity remained unchanged (i.e., -0.101+0.069= 0.032 and standard error is 0.031).

We also examine the profitability of the sample of manufacturing firms before and after the crisis, which is shown in the sixth and the seventh columns. The sixth column reports quarterly Generally Accepted Accounting Principles (GAAP) earnings scaled by the lagged total assets as the dependent variable. The seventh column reports the quarterly Standard & Poor's (S&P) core earnings scaled by the lagged total assets as the dependent variable. The reason we include a separate regression on S&P core earnings is because there is a concern that the GAAP earnings ("as reported" earnings) are not clean and are subject to manipulations (Blitzer, Friedman, and Silverblatt, 2002). The S&P core earnings, to a large extent, through a series of adjustments, more accurately reflect the operating performance of the company. The S&P core earnings are available since 2002 for a subset of companies. The parameter estimates on 2008:Q4 indicators for earnings scaled by the lagged total assets regression and core earnings scaled by the lagged total assets regression are both negative and significant: firms with low pre-crisis liquidity experienced a 3.7% decline in earnings scaled by the lagged total assets and a 1.7% decline in core earnings scaled by the lagged total assets after the crisis. Furthermore, the parameter estimates on the interaction with high liquidity indicators are positive, which suggest that the decrease in profitability was less for firms with access to liquidity: the incremental

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change in profitability after the crisis for high liquidity firms was 2.9% higher in terms of earnings scaled by the lagged total assets and 2.2% higher in terms of core earnings scaled by the lagged total assets.[13]

Overall, evidence from this section suggests that the disruption in the financial sector had real consequences on nonfinancial firms, but such negative real effects were smaller for firms with access to liquidity.

5. Conclusions

This paper provides empirical evidence on the impact of the recent financial crisis on corporate short-term borrowings and corporate policies of publicly-listed nonfinancial firms. Using firm-level quarterly data on commercial paper, we show that there was a significant decline in commercial paper borrowings by nonfinancial firms, but the declines were concentrated primarily among high risk firms. These high risk firms responded by drawing down their existing lines of credit and cash balances. In contrast to the contraction of the commercial paper market, total bank commitments and total liquidity (sum of cash and unused lines of credit) remained stable throughout the period of this study. The disruption in the credit market also had real effects in the manufacturing sector: firms without access to liquidity (e.g., cash and lines of credit) decreased their business activities, such as investment, and experienced declines in profitability. In contrast, firms with access to liquidity maintained their level of business activities.

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[13] We attempted to investigate the decisions on dividends and wages. However, the values of these variables are missing from Compustat quarterly files. Although not reported, we also attempted to examine changes in quarterly R&D expenses, but did not find any significant results. One possible reason for this insignificant result may by the large number of missing values of R&D expenditures reported in Compustat quarterly files.

Firm-level disaggregate evidence provided in this paper sheds light on the importance of accounting for the heterogeneous attributes of individual firms when assessing the impact of the recent financial crisis. Despite the severe decline in aggregate commercial paper outstanding after the crisis, average outstanding commercial paper, when scaled by firms' assets, did not change significantly. Instead, the decline was mostly concentrated in high risk firms. This heterogeneous impact of commercial paper borrowing based on borrowers' risk profiles is consistent with active screening by commercial paper market investors, whose risk appetite shifts upon major disruption in the credit market. These consequences of the crisis are consistent with the view that market forces screened borrowers and allocated scarce resources (liquidity) to creditworthy borrowers.

The objective of this paper is to provide a timely and comprehensive study of the real and short-term impact of a commercial market freeze on corporate finance decisions at the micro-level. As the financial market turmoil has yet to settle, we are unable to trace out the long-term impact of such market dynamics. Further research along this line is clearly warranted.

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Table 1: Summary Statistics

Panel A: liquidity and borrower characteristics (2008:Q2, for each firm)

	Observations without S&P CP rating				Observations with S&P CP rating				No-CP vs. CP rating sample	
	N	Median	Mean	Std. Dev.	N	Median	Mean	Std. Dev.	Difference in means	t-stat
Liquidity characteristics:										
Commercial paper / non-cash assets	826	0.000	0.000	0.000	112	0.017	0.033	0.0405	-0.033	-8.65
Total lines / non-cash assets	826	0.143	0.183	0.1824	112	0.147	0.154	0.0855	0.0298	2.90
Undrawn lines / non-cash assets	826	0.090	0.125	0.1350	112	0.100	0.110	0.1729	0.0158	1.89
Drawn lines / non-cash assets	826	0.010	0.055	0.0879	112	0.028	0.044	0.0506	0.0111	1.95
Cash / non-cash assets	826	0.116	0.319	0.4682	112	0.050	0.079	0.0681	0.2404	13.73
(Cash+undrawn lines) / non-cash assets	826	0.263	0.449	0.4882	112	0.169	0.189	0.0944	0.4594	13.53
Financial characteristics:										
Assets ($ million)	826	459.4	1,562	3,050	112	10,950	25,708	44,509	-24146	-15.38
Leverage	825	0.161	0.209	0.221	112	0.241	0.264	0.130	-0.055	-2.58
Market-to-book	815	1.417	1.838	1.286	112	1.644	1.785	0.649	0.0531	0.43
Cash flow / non-cash assets	813	0.019	0.003	0.066	111	0.027	0.024	0.030	-0.021	-2.58
PPE / non-cash assets	825	0.199	0.236	0.164	112	0.212	0.248	0.131	-0.012	-0.76
Net worth / non-cash assets	826	0.469	0.279	0.901	112	0.372	0.346	0.162	-0.067	-0.79
Expected default frequency	661	0.000	0.069	0.167	112	0.000	0.011	0.045	0.058	3.65

Sample from SEC−Compustat intersection (2008:Q2−Q4) for manufacturing firms (SIC codes 2000−3999). Commercial paper, total committed lines, and undrawn lines of credit data are obtained from 10-K and 10-Q filings. Cash (CHEQ), non-cash assets (ATQ-CHEQ), leverage (DLTTQ + DLCQ divided by ATQ), market-to-book asset (ATQ + PRCCQ times CSHOQ − CEQQ divided by ATQ), cash flow (IBQ + DPQ − DVTQ), PPE (PPENTQ), and net worth (ATQ − LTQ) are obtained from Compustat. Expected default frequency (EDF) is computed by the method provided by Bharath and Shumway (2006) using CRSP daily stock returns. Standard errors are significant at the 1% (***), 5% (**), and 10% (*) levels.

Panel B: Liquidity and borrower characteristics (2008:Q3, for each firm)

	Observations without S&P CP rating				Observations with S&P CP rating				No-CP vs. CP rating sample	
	N	Median	Mean	Std. Dev.	N	Median	Mean	Std. Dev.	Difference in means	t-stat
Liquidity characteristics:										
Commercial paper / non-cash assets	826	0.000	0.000	0.000	112	0.009	0.030	0.0407	-0.03	-7.75
Total lines / non-cash assets	826	0.150	0.185	0.1786	112	0.149	0.152	0.0805	0.0324	3.3
Undrawn lines / non-cash assets	826	0.089	0.122	0.1256	112	0.098	0.106	0.0667	0.0162	2.1
Drawn lines / non-cash assets	826	0.012	0.060	0.0943	112	0.028	0.046	0.0512	0.0141	2.4
Cash / non-cash assets	826	0.122	0.317	0.464	112	0.060	0.082	0.0733	0.2356	13.41
(Cash+undrawn lines) / non-cash assets	826	0.267	0.441	0.4662	112	0.166	0.187	0.0934	0.254	13.75
Financial characteristics:										
Assets ($ million)	826	462.9	1,562	3,132	112	10,822	24,799	41,610	-23238	-15.78
Leverage	825	0.172	0.218	0.227	112	0.248	0.265	0.132	-0.047	-2.14
Market-to-book	817	1.324	1.714	1.208	112	1.546	1.739	0.655	-0.024	-0.21
Cash flow / non-cash assets	813	0.018	-0.001	0.072	111	0.029	0.027	0.025	-0.048	-3.11
PPE / non-cash assets	825	0.200	0.237	0.166	112	0.217	0.252	0.138	-0.016	-0.95
Net worth / non-cash assets	826	0.458	0.269	0.898	112	0.364	0.343	0.163	-0.074	-0.87
Expected default frequency	668	0.001	0.094	0.200	112	0.000	0.024	0.094	-0.01	-0.29

Panel C: Liquidity and borrower characteristics (2008:Q4, for each firm)

	Observations without S&P CP rating				Observations with S&P CP rating				No-CP vs. CP rating sample	
	N	Median	Mean	Std. Dev.	N	Median	Mean	Std. Dev.	Difference in means	t-stat
Liquidity characteristics:										
Commercial paper / non-cash assets	823	0.000	0.000	0.000	112	0.009	0.027	0.0405	-0.027	-6.98
Total lines / non-cash assets	823	0.151	0.197	0.1948	112	0.158	0.160	0.0839	0.0366	3.5
Undrawn lines / non-cash assets	823	0.094	0.128	0.1344	112	0.105	0.113	0.0717	0.0154	1.87
Drawn lines / non-cash assets	823	0.013	0.068	0.1125	112	0.029	0.047	0.0547	0.0211	3.26
Cash / non-cash assets	823	0.135	0.318	0.4201	112	0.062	0.086	0.0777	0.2314	14.09
(Cash+undrawn lines) / non-cash assets	823	0.297	0.450	0.4335	112	0.180	0.201	0.1049	0.2489	13.74
Financial characteristics:										
Assets ($ million)	826	419.9	1,465	2,981	112	10,047	23,145	37,470	-21681	-16.28
Leverage	825	0.183	0.237	0.263	112	0.263	0.286	0.140	-0.049	-1.93
Market-to-book	817	1.120	1.431	1.071	112	1.414	1.581	0.555	-0.15	-1.46
Cash flow / non-cash assets	813	0.011	-0.038	0.128	111	0.022	0.005	0.066	-0.073	-3.35
PPE / non-cash assets	825	0.210	0.252	0.172	112	0.227	0.269	0.154	-0.017	-1.01
Net worth / non-cash assets	826	0.435	0.246	0.829	112	0.312	0.287	0.191	-0.041	-0.52
Expected default frequency	669	0.007	0.123	0.226	112	0.000	0.046	0.151	0.0776	3.51

Table 2: Summary Statistics of Key Variables: Aggregate Sum and Average

Panel A: Summary statistics of key variables, CP-rated manufacturing firms

	Sum (levels, $million)			Mean (level)			Mean (fraction of non-cash asset)		
	2008:Q2	2008:Q3	2008:Q4	2008:Q2	2008:Q3	2008:Q4	2008:Q2	2008:Q3	2008:Q4
Liquidity :									
Commercial paper	70,940.0	60,264.0	68,968.8	639.1	538.1	615.8	0.033	0.030	0.027
Total lines	283,189.4	273,832.7	267,985.7	2,528.5	2,444.9	2,392.7	0.154	0.152	0.160
Undrawn lines	174,089.8	160,704.4	147,416.1	1,554.4	1,447.8	1,316.2	0.110	0.106	0.113
Drawn lines	109,099.6	112,621.6	120,569.6	974.1	1,014.6	1,076.5	0.044	0.046	0.047
Cash	285,907.3	282,062.9	268,933.3	2,552.7	2,518.4	2,401.2	0.079	0.082	0.086
Cash & Undrawn lines	459,997.1	442,673.8	416,349.4	4,107.1	3,988.1	3,717.4	0.189	0.187	0.201
Exposure to Lehman	–	2,048.5	2,048.5	_	18.3	18.3	_	_	_
Assets	2,880,250.7	2,791,159.9	2,601,506.0	25,716.5	24,921.1	23,227.7	_	_	_

Sample from SEC–Compustat intersection (2008:Q2–Q4) for manufacturing firms (SIC codes 2000–3999). Commercial paper, total committed lines, and undrawn lines of credit data are obtained from 10-K and 10-Q filings. Non-cash total assets (ATQ - CHEQ) are obtained from Compustat.

Panel B: Summary statistics of key variables, Non CP-rated manufacturing firms

	Sum (levels, $million)			Mean (level)			Mean (fraction of non-cash asset)		
	2008:Q2	2008:Q3	2008:Q4	2008:Q2	2008:Q3	2008:Q4	2008:Q2	2008:Q3	2008:Q4
Liquidity :									
Total lines	156,941.0	159,868.3	155,868.0	190.0	193.5	189.2	0.183	0.185	0.197
Undrawn lines	108,669.6	108,147.7	103,980.3	131.7	131.1	126.2	0.125	0.122	0.128
Drawn lines	48,171.5	51,620.7	51,887.7	58.4	62.6	63.0	0.055	0.060	0.068
Cash	166,530.1	173,748.4	175,721.5	201.6	210.3	214.8	0.319	0.317	0.318
Cash+undrawn lines	275,199.7	281,896.1	279,572.2	333.6	341.7	342.2	0.449	0.441	0.450
Exposure to Lehman	_	288.2	288.2	_	0.3	0.3	_	_	_
Assets	1,371,501.6	1,364,290.5	1,269,558.5	1,660.4	1,651.7	1,542.6	_	_	_

Table 3: Impact of crisis on commercial paper borrowings (CP-rated firms only)

Dependent variable:	CP_t / Non-cash assets$_{t-1}$			
Crisis indicators:				
2008:Q3 indicator ×HighEDF		-0.018** (0.008)		
2008:Q4 indicator ×HighEDF		-0.030** (0.012)		
2008:Q3 indicator ×HighReturnVolatility			-0.016* (0.009)	
2008:Q4 indicator × HighReturnVolatility			-0.029** (0.012)	
2008:Q3 indicator ×HighEarningsVolatility				-0.015 (0.010)
2008:Q4 indicator × HighEarningsVolatility				-0.032*** (0.011)
2008:Q3 indicator	-0.004 (0.003)	0.001 (0.004)	0.000 (0.004)	-0.000 (0.004)
2008:Q4 indicator	-0.008* (0.004)	-0.000 (0.006)	-0.001 (0.006)	0.001 (0.006)
HighEDF		0.005 (0.010)	0.009 (0.009)	0.006 (0.009)
Borrower characteristics:				
Firm size$_{t-1}$	-0.002 (0.003)	-0.003 (0.003)	-0.003 (0.003)	-0.003 (0.003)
Leverage$_{t-1}$	0.172*** (0.042)	0.175*** (0.042)	0.168*** (0.043)	0.167*** (0.041)
Market-to-book$_{t-1}$	0.018*** (0.007)	0.016** (0.008)	0.017** (0.007)	0.017** (0.007)
PPE$_{t-1}$/Non-cash assets$_{t-1}$	-0.031 (0.027)	-0.028 (0.026)	-0.028 (0.027)	-0.029 (0.027)
Cash flow$_{t-1}$/Non-cash assets$_{t-1}$	0.107 (0.172)	0.073 (0.172)	0.120 (0.183)	0.086 (0.176)
Net worth$_{t-1}$/Non-cash assets$_{t-1}$	0.042 (0.029)	0.037 (0.031)	0.037 (0.030)	0.032 (0.030)
Adjusted R^2	0.276	0.299	0.291	0.299
Number of firms	72	72	72	72
Observations	216	216	216	216

Sample from SEC−Compustat intersection (2008:Q2−Q4) for manufacturing firms (SIC codes 2000–3999). Dependent variable is outstanding commercial paper divided by lagged non-cash assets. Key variables are 2008:Q3, 2008:Q4, and their interaction with high EDF, high return volatility and with high earnings volatility indicators. The number of CP-rated firms in this regression is less than that of the summary statistics due to the availability of EDF data. Standard errors are clustered at the firm level (shown in parentheses). Significant at the 1% (***), 5% (**), and 10% (*) levels.

Table 4: Impact of crisis on corporate liquidity

Panel A: Impact of crisis on corporate liquidity, CP-rated firms

Dependent variables:	ΔUnused lines$_t$ / non-cash assets$_{t-1}$	Total lines$_t$ / non-cash assets$_{t-1}$	Cash$_t$ / non-cash assets$_{t-1}$	(Cash + unused lines)$_t$ / non-cash assets$_{t-1}$
ΔTotal lines$_t$ / Non-cash assets$_{t-1}$	0.588***			
	(0.141)			
ΔTotal lines$_t$ / Non-cash assets$_{t-1}$ $\times$HighEDF	-0.353**			
	(0.170)			
Crisis indicators:				
2008:Q3$\times$HighEDF		0.090	0.110**	0.091
		(0.070)	(0.045)	(0.055)
2008:Q4$\times$HighEDF		-0.002	0.042	-0.018
		(0.071)	(0.040)	(0.045)
2008:Q3 indicator		-0.004	-0.000	-0.001
		(0.004)	(0.004)	(0.007)
2008:Q4 indicator		0.004	0.002	0.014*
		(0.005)	(0.006)	(0.008)
HighEDF	-0.022	0.083	-0.024	-0.002
	(0.015)	(0.066)	(0.029)	(0.034)
Borrower characteristics:				
Firm size$_{t-1}$	-0.001	-0.034***	0.012**	-0.013
	(0.002)	(0.006)	(0.006)	(0.008)
Leverage$_{t-1}$	-0.017	0.140**	-0.119**	-0.104
	(0.027)	(0.060)	(0.052)	(0.073)
Market-to-book$_{t-1}$	-0.006	0.002	0.026**	0.025*
	(0.005)	(0.009)	(0.011)	(0.014)
PPE$_{t-1}$/Non-cash assets$_{t-1}$	-0.053**	-0.031	-0.099**	-0.093
	(0.024)	(0.050)	(0.041)	(0.061)
Cash flow$_{t-1}$/Non-cash assets$_{t-1}$	-0.036	0.280	0.436*	0.447
	(0.115)	(0.228)	(0.239)	(0.376)
Net worth$_{t-1}$/Non-cash assets$_{t-1}$	0.001	-0.028	-0.060	-0.108*
	(0.023)	(0.042)	(0.048)	(0.056)
Adjusted R^2	0.161	0.410	0.300	0.170
Number of firms	72	72	72	72
Observations	144	216	216	216

Sample from SEC−Compustat intersection (2008:Q2−Q4) for manufacturing firms (SIC codes 2000−3999). Dependent variables are changes in unused lines divided by lagged non-cash assets, total lines divided by lagged non-cash assets, cash divided by lagged non-cash assets, and sum of cash and unused lines divided by lagged non-cash assets. Key variables are changes in total lines divided by lagged non-cash assets, 2008:Q3 and 2008:Q4 indicators, and their interactions with high EDF (expected default frequency) indicators. Standard errors are clustered at the firm level (shown in parentheses). Significant at the 1% (***), 5% (**), and 10% (*) levels.

Panel B: Impact of crisis on corporate liquidity, Non CP-rated firms

Dependent variables:	Unused lines$_t$ / non-cash assets$_{t-1}$	Total lines$_t$ / non-cash assets$_{t-1}$	Cash$_t$ / non-cash assets$_{t-1}$	(Cash + unused lines)$_t$ / non-cash assets$_{t-1}$
Crisis indicators:				
2008:Q3×HighEDF	0.016**	0.025***	-0.010	-0.005
	(0.006)	(0.009)	(0.021)	(0.024)
2008:Q4×HighEDF	0.027***	0.026**	-0.017	-0.019
	(0.009)	(0.011)	(0.027)	(0.030)
2008:Q3 indicator	0.001	-0.003	0.001	-0.006
	(0.002)	(0.003)	(0.009)	(0.009)
2008:Q4 indicator	0.007**	0.010***	0.008	0.012
	(0.003)	(0.004)	(0.010)	(0.011)
HighEDF	0.023***	0.015	-0.109***	-0.107***
	(0.008)	(0.013)	(0.032)	(0.033)
Borrower characteristics:				
Firm size$_{t-1}$	-0.003	-0.009***	-0.067***	-0.077***
	(0.002)	(0.003)	(0.008)	(0.008)
Leverage$_{t-1}$	0.014***	0.039***	-0.276***	-0.262***
	(0.005)	(0.007)	(0.050)	(0.051)
Market-to-book$_{t-1}$	-0.003**	-0.005*	0.012	0.011
	(0.001)	(0.002)	(0.014)	(0.015)
PPE$_{t-1}$/Non-cash assets$_{t-1}$	0.007	0.013	-0.047	-0.040
	(0.020)	(0.033)	(0.083)	(0.085)
Cash flow$_{t-1}$/Non-cash assets$_{t-1}$	-0.000	0.015*	-0.045	-0.040
	(0.007)	(0.009)	(0.046)	(0.045)
Net worth$_{t-1}$/Non-cash assets$_{t-1}$	0.008**	0.026***	-0.182***	-0.171***
	(0.003)	(0.005)	(0.032)	(0.031)
Adjusted R^2	0.044	0.048	0.335	0.332
Number of firms	799	799	799	799
Observations	2384	2384	2384	2384

Sample from SEC−Compustat intersection (2008:Q2–Q4) for manufacturing firms (SIC codes 2000–3999). Dependent variables are unused lines divided by lagged non-cash assets, total lines divided by lagged non-cash assets, cash divided by lagged non-cash assets, and the sum of cash and unused lines divided by lagged non-cash assets. Key variables are 2008:Q3 and 2008:Q4 indicators, and their interactions with high EDF (expected default frequency) indicators. Standard errors are clustered at the firm level (shown in parentheses). Significant at the 1% (***), 5% (**), and 10% (*) levels.

## Table 5: Corporate Liquidity and Real Effects Around the Crisis

Dependent variables:	Asset Growth	Non-cash Asset Growth	CapEx$_t$ /Total Assets$_{t-1}$	Inventory$_t$ /Sales$_{t-1}$	Recivables$_t$ /Sales$_{t-1}$	Earnings$_t$ /Total Assets$_{t-1}$	Core Earnings$_t$ /Total Assets$_{t-1}$
Crisis indicators:							
2008:Q3	0.033**	0.071***	0.002	0.047**	0.043*	-0.001	0.005
× high liquidity	(0.016)	(0.019)	(0.002)	(0.021)	(0.026)	(0.005)	(0.005)
2008:Q4	0.055***	0.060***	0.003**	0.094***	0.069**	0.029***	0.022**
× high liquidity	(0.012)	(0.017)	(0.001)	(0.029)	(0.031)	(0.007)	(0.008)
2008:Q3indicator	-0.016***	-0.025***	-0.002***	-0.027***	-0.037***	-0.001	-0.000
	(0.004)	(0.005)	(0.001)	(0.007)	(0.009)	(0.002)	(0.001)
2008:Q4indicator	-0.081***	-0.094***	-0.003***	-0.062***	-0.101***	-0.037***	-0.017***
	(0.005)	(0.006)	(0.001)	(0.010)	(0.011)	(0.003)	(0.002)
High liquidity	-0.022**	-0.028**	-0.002**	-0.248***	-0.070**	-0.002	-0.005
indicator	(0.009)	(0.013)	(0.001)	(0.037)	(0.032)	(0.006)	(0.006)
Borrower attributes:							
Firm size$_{t-1}$	-0.001	-0.002	0.001***	-0.052***	-0.002	0.006***	0.005***
	(0.001)	(0.001)	(0.000)	(0.006)	(0.006)	(0.001)	(0.001)
Leverage$_{t-1}$	-0.000	-0.032***	-0.000	0.114***	-0.046	0.006	0.000
	(0.007)	(0.012)	(0.000)	(0.029)	(0.046)	(0.007)	(0.006)
Market-to-book$_{t-1}$	0.012***	0.012***	0.001***	0.017	0.028*	-0.001	-0.000
	(0.003)	(0.004)	(0.000)	(0.014)	(0.015)	(0.003)	(0.002)
PPE$_{t-1}$/assets$_{t-1}$	0.012	0.035*	0.026***	-0.412***	-0.507***	0.006	0.002
	(0.015)	(0.019)	(0.003)	(0.074)	(0.062)	(0.012)	(0.009)
Cash flow$_{t-1}$/assets$_{t-1}$	0.007	0.007	0.002	-0.126	-0.140	0.050**	0.094***
	(0.019)	(0.029)	(0.001)	(0.092)	(0.118)	(0.021)	(0.029)
Net worth$_{t-1}$/assets$_{t-1}$	0.012**	-0.011	0.001***	0.114***	-0.000	0.005	0.001
	(0.005)	(0.008)	(0.000)	(0.024)	(0.035)	(0.005)	(0.004)
Adjusted R^2	0.121	0.124	0.100	0.131	0.091	0.204	0.281
Number of firms	914	914	912	914	902	913	707
Observations	2,733	2,728	2,696	2,682	2,677	2,726	1,867

Sample from SEC–Compustat intersection (2008:Q2–Q4) for manufacturing firms (SIC codes 2000–3999). Dependent variables are asset growth, non-cash asset growth, capital expenditure divided by lagged total assets, inventory divided by lagged total assets, accounts receivables divided by lagged total assets, earnings divided by lagged total assets, and core earnings divided by lagged total assets. Key variables are 2008:Q3 and 2008:Q4 indicators, and their interactions with a high liquidity indicator, which is one if the total liquidity (sum of cash and unused lines of credit) at 2008:Q2 divided by lagged non-cash assets is above median, and is zero otherwise. Standard errors are clustered at the firm level (shown in parentheses). Significant at the 1% (***), 5% (**), and 10% (*) levels.

Figure 1. 3-month LIBOR, Financial Firm Commercial Paper, and Non-Financial Firm Commercial Paper Spreads over T-Bill

The solid square-dotted line shows the spreads between 3-month LIBOR and 3-month T-bill rates, the solid line show the spreads between 3-month financial firm commercial paper (FCP) and 3-month T-bill rates, and dash-dotted line shows the spreads between 3-month nonfinancial firm commercial paper (NFCP) and 3-month T-bill rates, for the period of January 2000 to April 2009. Commercial paper and T-bill rates are obtained from the Board of Governors of the Federal Reserve H15 release, and LIBOR rates are obtained from the British Bankers' Association.
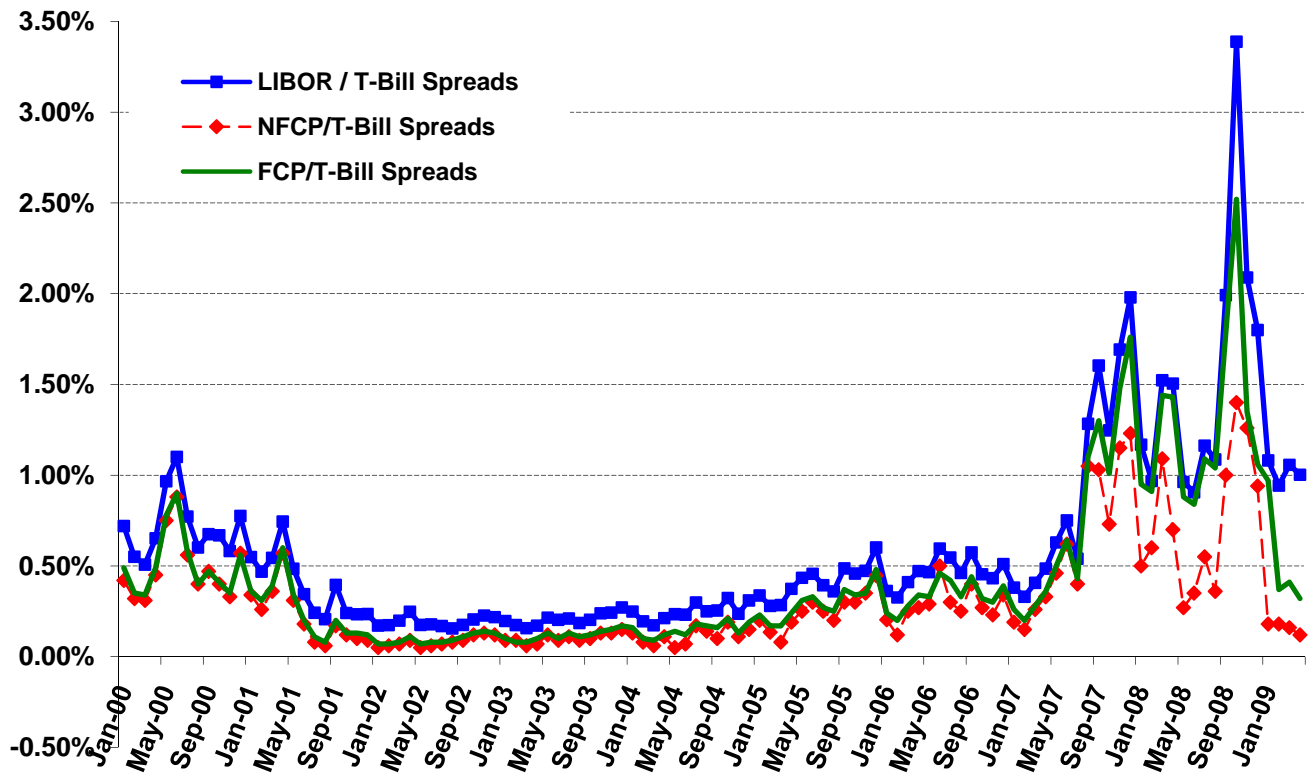
Figure 2. Total commercial papers outstanding for U.S. nonfinancial firms ($billion)

Commercial paper outstanding for domestic nonfinancial firms in the United States. Data are obtained from the Board of Governors of the Federal Reserve System (http://www.federalreserve.gov/releases/cp).
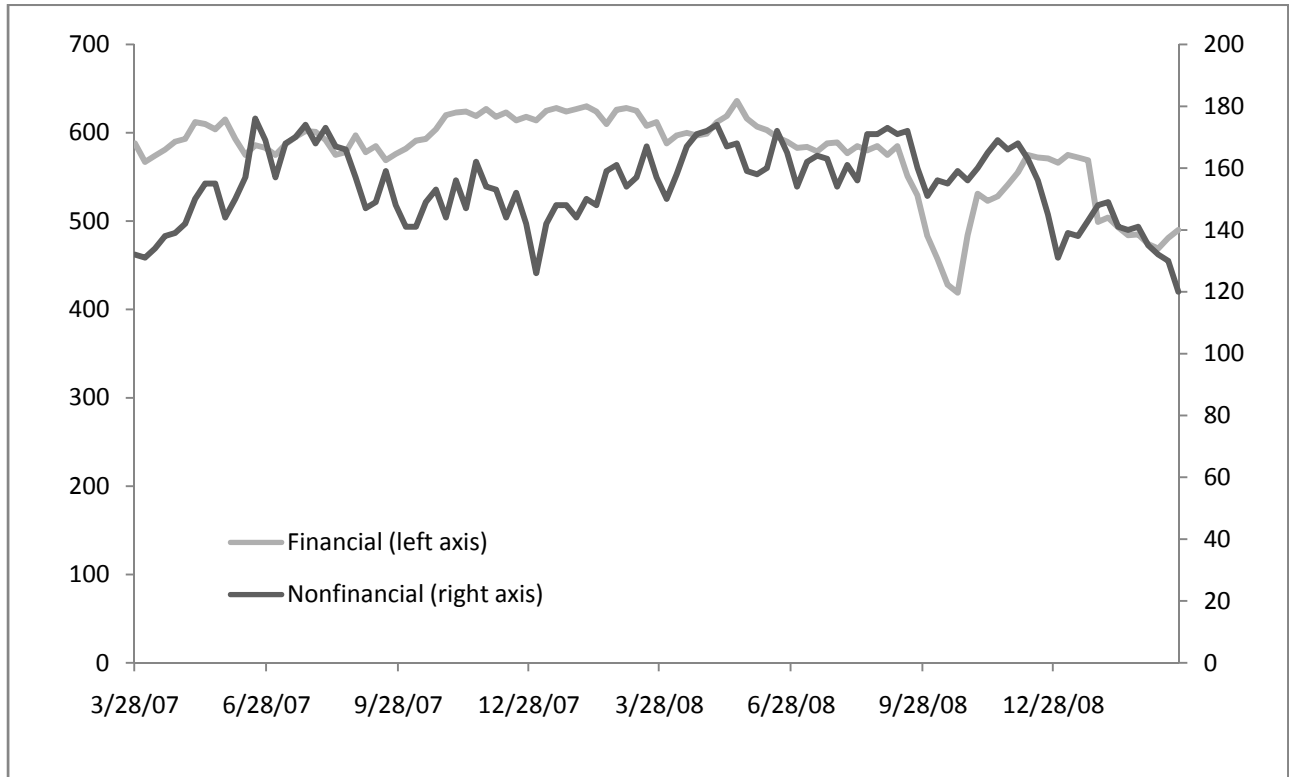
Figure 3. Event timeline
This figure shows the event timeline around the announcement of bankruptcy by Lehman Brothers. Commercial paper outstanding, total committed lines of credit, and unused amount of lines of credit are recorded in 10-K/10-Q filings on June 30 (period 1), September 30 (period 2), and December 31, 2008 (period 3).
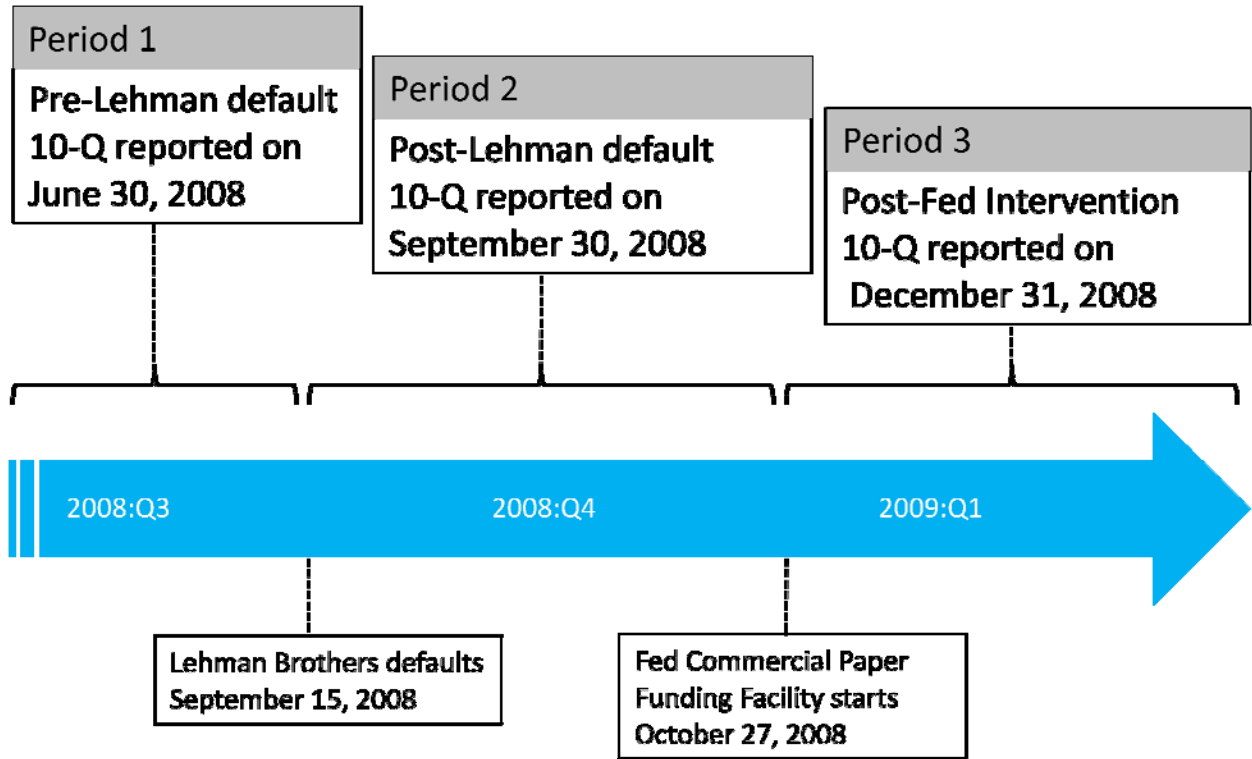
Figure 4. Number of Performance Related Delisting Events, 2001:Q1 – 2008:Q4
Figure shows the number of performance related delisting for nonfinancial firms (all SIC codes except 6000–6999) and manufacturing firms (SIC codes 2000–3999) during 2001:Q1–2008:Q4. Data are obtained from CRSP.

Number of Performance Related Delisting: 2001Q1 to 2008Q4

Legend:
- Number of Performance Related Delisting (All)
- Number of Performance Related Delisting (Manufacturing Sample)
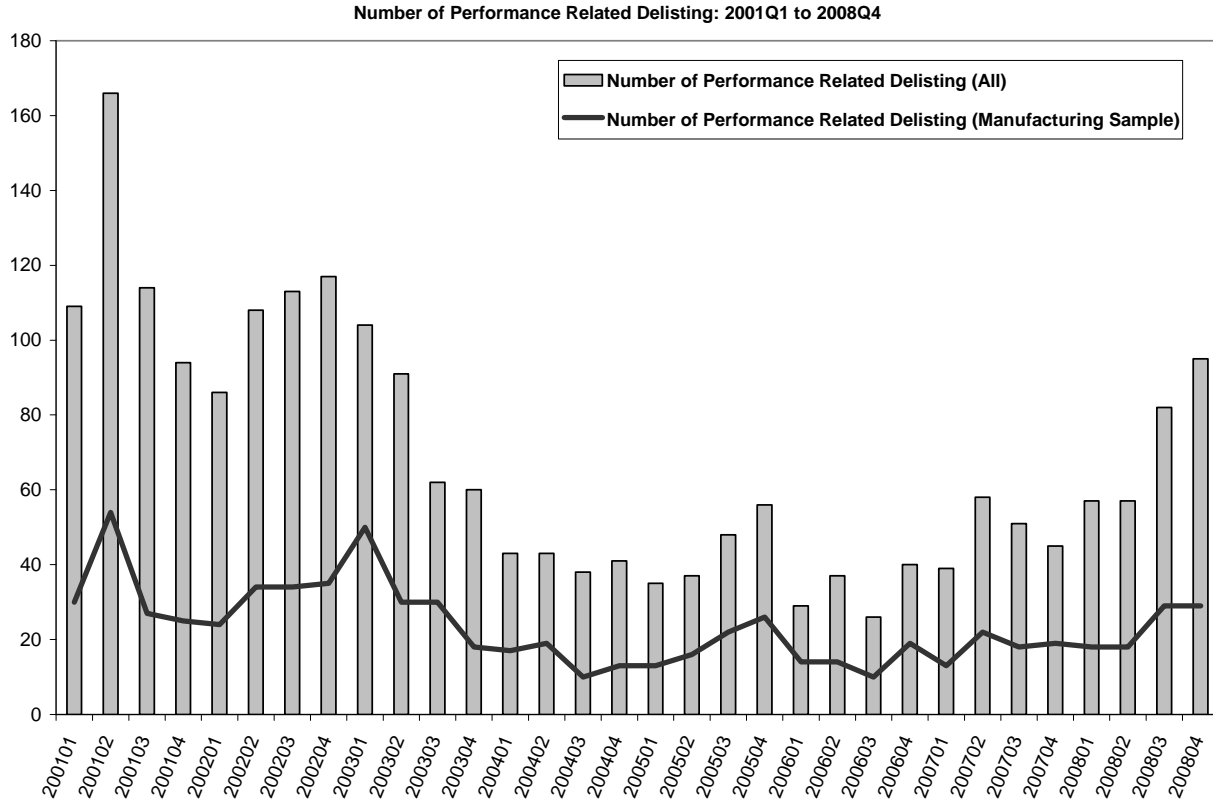
**Figure 5. Average expected default frequency (EDF)**
Manufacturing firms (SIC codes 2000–3999) during 2001–2008. The EDF is computed based on the methods proposed by Bharath and Shumway (2008), which use daily stock return data from CRSP and outstanding debt amount from Compustat.

Time Series Average Default Likelihood
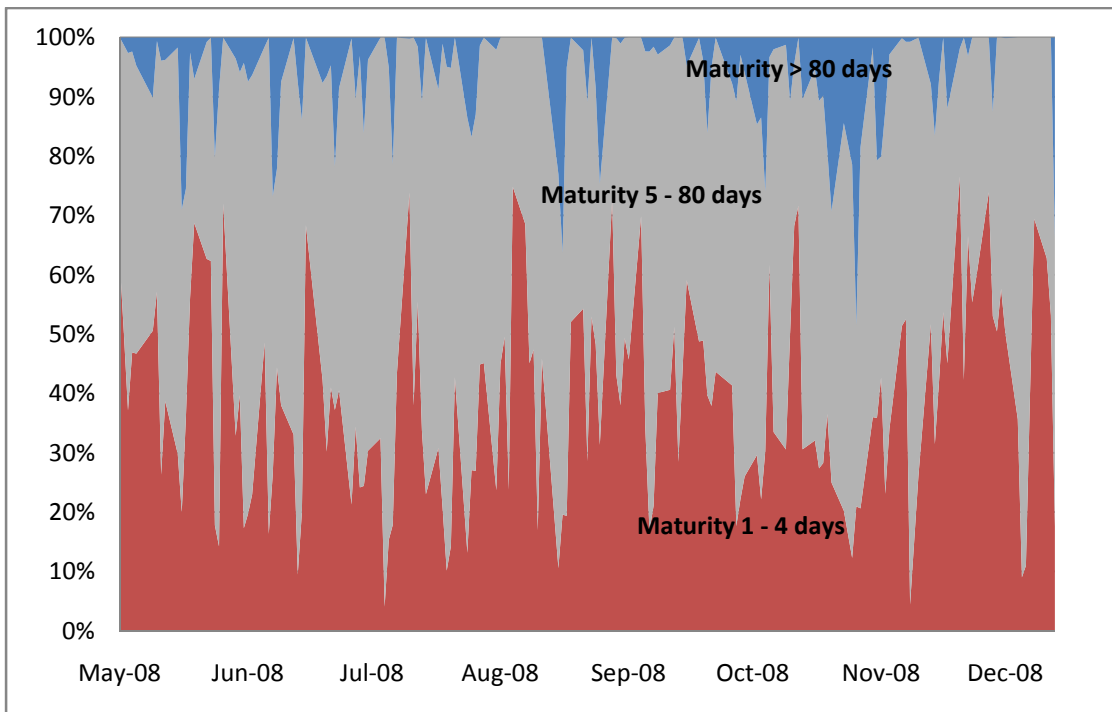**(All CRSP-COMPUSTATA Non-Financial Firms vs. Manufacturing Firms)**
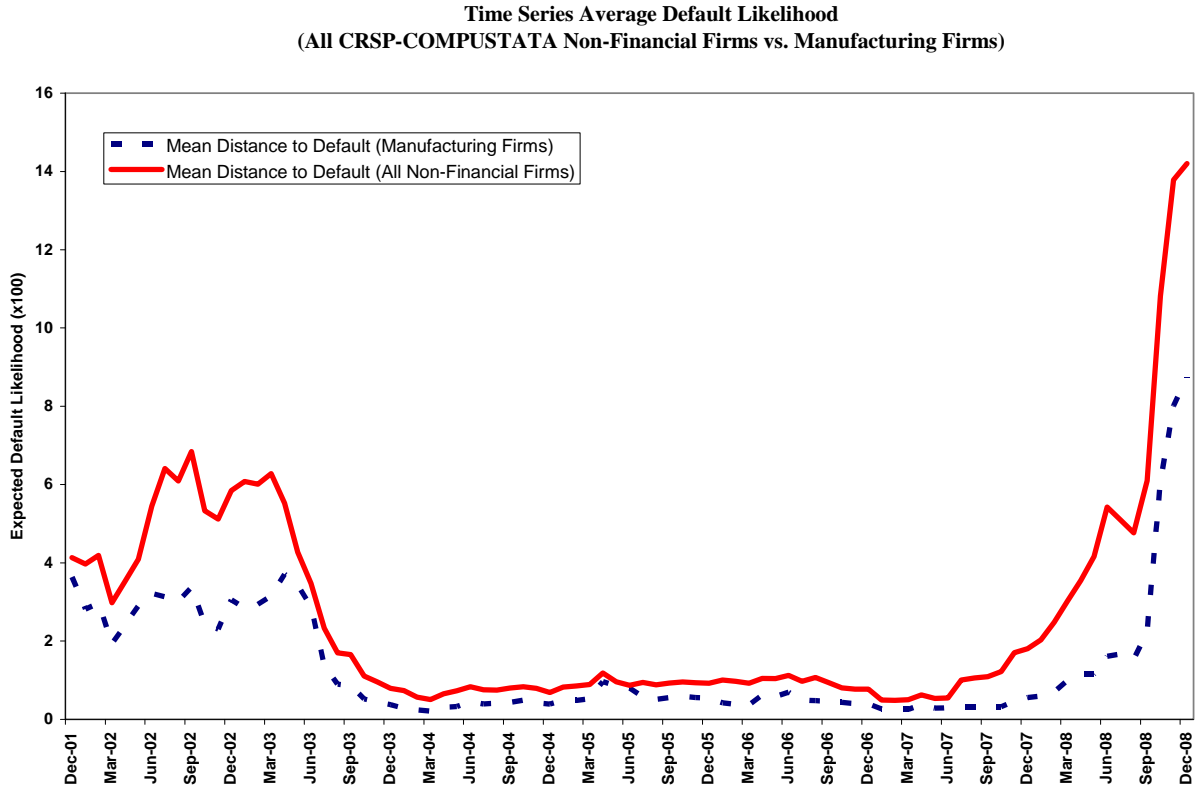
Figure 6.   Commercial paper issuance by maturity
The figure shows fraction of newly issued commercial papers (based on dollar amount) during May–December, 2008. Based on their maturity, newly issued commercial papers are classified into 3 groups: 1–4 days, 5–80 days, longer than 80 days for (a) financial firms, and (b) nonfinancial firms.
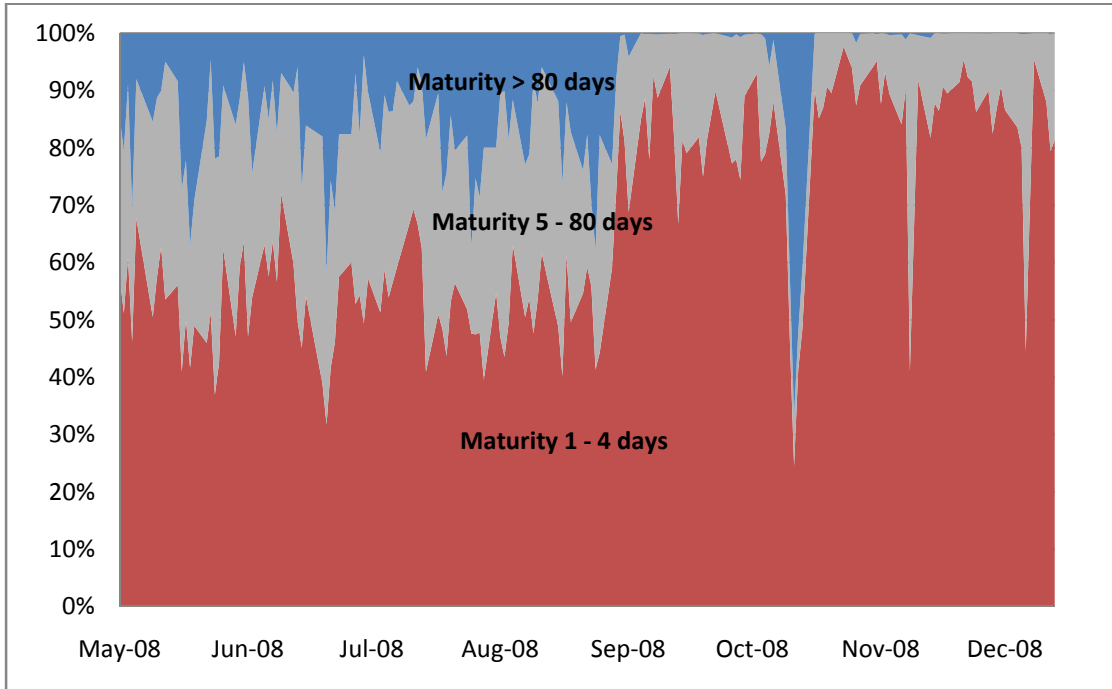
(a) Financial firms

(b) Nonfinancial firms