FDIC Center for Financial Research Working Paper

No. 2006-01

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Desember 2005

FDIC CFR
Federal Deposit Insurance Corporation • Center for Financial Research

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June 2006

Abstract

I empirically examine the factors that determine whether firms use bank lines of credit or cash in corporate liquidity management. Bank lines of credit, also known as revolving credit facilities, are a viable liquidity substitute only for firms that maintain high cash flow. Firms with low cash flow are less likely to obtain a line of credit, and rely more heavily on cash in their corporate liquidity management. An important channel for this correlation is the use of cash flow-based financial covenants by banks that supply credit lines. Firms must maintain high cash flow to remain compliant with covenants, and banks restrict firm access to credit facilities in response to covenant violations. Using the cash flow sensitivity of cash as a measure of financial constraints, I provide evidence that lack of access to a line of credit is a more statistically powerful measure of financial constraints than traditional measures used in the literature.

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Bank lines of credit, or revolving credit facilities, are an instrumental component of corporate liquidity management. The "Liquidity and capital resources" section of firms' annual reports emphasize the importance of firms' access to lines of credit; likewise, research reports by credit rating agencies such as Moody's and Standard and Poor's (S&P) detail information on revolving credit facilities when discussing a firm's default risk. Despite the importance of lines of credit in the provision of liquidity in the economy, the absence of data has limited the existing empirical research on their role in corporate financing decisions. The analysis presented here represents one of the first empirical studies of lines of credit in the ongoing liquidity of public corporations.

While there is an extensive theoretical literature on bank lines of credit (Boot, Thakor, and Udell (1987), Holmstrom and Tirole (1998), Martin and Santomero (1997)), the extant empirical literature on corporate liquidity focuses mainly on the role of cash (Almeida, Campello, and Weisbach (2004), Faulkender and Wang (forthcoming), Opler, Pinkowitz, Stulz, and Williamson (1999)). The cash literature finds that cash plays an important liquidity role given that capital market frictions prevent firms from obtaining external sources of finance for valuable projects arising in the future.

The empirical finding that firms rely heavily on internal cash for liquidity is somewhat surprising, given hypotheses developed in the theoretical literature on lines of credit. This literature argues that lines of credit are motivated primarily by capital market frictions, and a committed line of credit overcomes these frictions by ensuring that funds are available for valuable projects. In other words, according to the theoretical literature, lines of credit should resolve precisely the capital market frictions that motivate firms to hold cash as a liquidity buffer. In addition, Kashyap, Rajan, and Stein (2002) and Gatev and Strahan (2006) argue that banks are the most efficient liquidity providers in the economy, which also suggests that firms should rely on lines of credit over internal cash. Despite the similarities in the literature on cash and lines of credit, there is a lack of interaction between the two areas of research. The extant literature on cash is largely silent on why firms may use cash in place of lines of credit in corporate liquidity management.

This paper attempts to bridge this gap. The central question of my analysis is: What governs the use of cash versus bank lines of credit in corporate liquidity management? I attempt to answer this question using a unique data set with two sets of variables collected directly from annual 10-K SEC filings. First, for the universe of public firms in Compustat from 1996 through 2003, the data set contains information on whether a firm has access to a line of credit. Second, for a random sample of 300 firms from this universe (1,913 firm-year observations), the data set contains information on the size of the line of credit, the portion of the line of credit drawn, and the unused availability. In addition, the data set for the random sample contains information on whether firms are in compliance or in violation of financial covenants associated with the line of credit. This data set is one of the first to contain detailed information on the use of lines of credit by a large sample of public firms.

I use this data set to explore why firms rely on cash versus lines of credit for liquidity. In the first set of results, I find evidence that maintenance of high cash flow levels is a key characteristic that governs firms' use of lines of credit relative to cash. Firms with high levels of cash flow rely on lines of credit, whereas firms with low levels of cash flow rely on cash. After controlling for a variety of variables including firm industry, size, asset tangibility, seasonal sales patterns, market to book ratio, and age, I find that increasing lagged cash flow from the 10^{th} to the 90^{th} percentile increases the likelihood of obtaining a line of credit by 20%. This result is robust to both between-firm and within-firm variation; in other words, when a given firm experiences a reduction in lagged cash flow, it is more likely to subsequently lose access to its line of credit.

Using the random sample of 300 firms which contains information on line of credit balances, I focus on the *bank liquidity to total liquidity ratio*. This ratio is defined as the ratio of lines of credit to the sum of lines of credit and cash; it represents the fraction of total liquidity available to the firm provided by bank lines of credit. While some firms may have higher demand for *total* liquidity due to seasonal product markets or better investment opportunities, this ratio isolates the *relative* attractiveness of lines of credit versus cash in corporate liquidity management. I find a positive effect of cash flow on the bank liquidity to total liquidity ratio. More specifically, an increase in lagged cash flow from the 10^{th} to 90^{th}

percentile increases the bank liquidity to total liquidity ratio by 19% at the mean. This positive relationship is robust when I isolate the intensive margin and examine *only* firms that have a line of credit, although the magnitudes and statistical significance are slightly weaker.

This result suggests that maintenance of high cash flows is a critical determinant of whether a firm uses lines of credit versus cash in corporate liquidity management. To help interpret this finding, I split the sample into firms with high and low default risk, as measured by Altman's *z-score* (1968). The positive relationship between the use of lines of credit and lagged cash flow is unique among firms with high default risk; there is no such correlation among firms with low default risk. In other words, when a firm has significant default risk, it more heavily uses lines of credit relative to cash only if it maintains high cash flow.

What explains the positive correlation between cash flow and the use of lines of credit? In the second set of results, I explore the importance of cash-flow based financial covenants on lines of credit. In particular, I find evidence that maintenance of cash flow is critical to avoiding financial covenant violations. Reductions in cash flow are a stronger predictor of financial covenant violations than changes in a firm's current ratio, net worth, or market to book ratio. In addition, I find that when a firm violates a covenant, it loses access to a substantial portion of its line of credit. In terms of magnitudes, a covenant violation is associated with a 15 to 25% drop in the availability of both total and unused lines of credit. It is also associated with a 10 to 20% decrease in the bank liquidity to total liquidity ratio.

This result helps explain why cash flow is an important determinant of a firm's use of lines of credit versus cash in corporate liquidity management. Given that lines of credit are contingent on maintenance of cash flow-based covenants, they represent a poor liquidity substitute for firms with low current or expected cash flows. Firms with low current or expected cash flow maintain cash balances as a liquidity buffer given that lines of credit may not be available when most needed. This result also shows that lines of credit are not totally committed liquidity insurance. The *contingent* lines of credit that exist in the marketplace are distinct from the *committed* lines of credit that are described in the theoretical literature.

In the third set of results, I provide evidence that access to lines of credit may be a superior measure of financial constraints than traditional measures used in the literature. Theoretical research suggests that lines of credit are critical in reducing future capital market frictions facing firms, yet they have not been considered in the extant literature on financial constraints. I follow Almeida, Campello, and Weisbach (2004), henceforth, ACW (2004), and examine the cash flow sensitivity of cash among firms with and without access to lines of credit. The ACW (2004) theoretical insight is that firms that face capital market frictions are likely to save cash out of cash flow, whereas firms that do not face frictions should show no systematic pattern of cash savings out of cash flow. They empirically explore the cash flow sensitivity of cash for constrained versus unconstrained firms, where they use four traditional measures of financial constraints: whether a firm is small, whether a firm has a low payout ratio, whether a firm does not have a corporate credit rating by S&P, and whether a firm does not have a commercial paper rating by S&P.

Instead of relying on these traditional measures, I explore the cash flow sensitivity of cash using a measure of constraints that relies on access to lines of credit. Theoretical research on credit lines suggests that line of credit access may be a superior measure of financial constraints than traditional measures used in the literature. I define as "unconstrained" firms that have two key characteristics. First, they have a line of credit in every year in which they are in the sample. Second, they maintain cash flows scaled by book assets above the median firm throughout the sample. Firms that do not meet this criteria are designated "constrained." The empirical results using this definition show that firms without access to a line of credit save cash out of cash flow, whereas firms with access to a line of credit do not save cash out of cash flow. In addition, I show evidence that the line of credit measure is more statistically powerful at explaining the pattern of cash flow sensitivities of cash than the traditional measures used in the literature. For example, consistent with ACW (2004), firms without an S&P corporate credit rating or commercial paper rating indeed show a higher sensitivity of cash holdings to cash flow. However, among firms without access to a rating, it is *only* the firms *without* access to a line of credit that show a positive

sensitivity. In general, my results show that firms that are small, have low payout ratios, or lack ratings *only* show positive cash flow sensitivities of cash *if* they lack access to a line of credit.

Overall, these results suggest that banks provide credit lines that are contingent on maintenance of cash flow. Reductions in cash flow lead to covenant violations, which in turn lead to a restriction in the availability of a line of credit. Lines of credit are therefore a poor liquidity substitute for firms that have low existing or expected cash flows. For these firms, cash is a more reliable source of liquidity. These firms rely more heavily on cash and save more cash out of cash flow.

In addition to these results, this paper documents several new facts regarding the use of bank lines of credit by public firms. For example, I find that lines of credit are a very large and important source of corporate finance in the economy. Almost 85% of firms in my sample obtained a line of credit between 1996 and 2003, and the line of credit represents an average of 16% of book assets. I also find that lines of credit are utilized among firms that are completely equity financed; 30% of firm-year observations where no outstanding debt is recorded on the balance sheet have an available unused line of credit. Firms with access to public debt do not cease using revolving credit facilities: 96% of firm-year observations that have corporate credit rating from S&P also have a bank line of credit, and line of credit borrowings represent 12% of total debt outstanding for these firms.

The rest of this paper proceeds as follows. In Section I, I describe lines of credit, the existing literature, the data, and summary statistics. In Section II, I describe the theoretical framework that motivates the paper. Sections III through V present the empirical analysis, and Section VI concludes.

I. Description, Existing Research, Data, and Summary Statistics

A. Description and existing research

A firm that obtains a line of credit receives a nominal amount of debt capacity against which the firm draws funds. Lines of credit, also referred to as revolving credit facilities or loan commitments, are almost always provided by banks or financing companies. They can be provided by one bank or multiple banks through syndication. The used portion of the line of credit is a debt obligation, whereas the unused portion remains off the balance sheet. In terms of pricing, the firm pays a commitment fee that is a

percentage of the unused portion, and a pre-determined interest rate on any drawn amounts. Pricing and maturity data are not always available directly from annual 10-K SEC filings; in a sample of 11,758 lines of credit obtained by 4,011 public firms between 1996 and 2003 in Loan Pricing Corporation's *Dealscan*, the median commitment fee is 25 basis points, the median interest rate on drawn funds is 150 basis points above LIBOR, and the median maturity is 3 years.

Corporations detail lines of credit in their annual 10-K SEC filings. Regulation S-K of the U.S. Securities and Exchange Commission requires firms to discuss explicitly their liquidity, capital resources, and result of operations (Kaplan and Zingales, 1997). All firms filing with the SEC therefore provide information on the used and unused portions of bank lines of credit, and whether they are out of compliance with financial covenants. For example, Lexent Inc., a broadband technology company, details their line of credit in their FY 2000 10-K filing as follows:

> At December 31, 2000, the Company had notes payable to banks aggregating $2.0 million under a $50 million collateralized revolving credit facility, which expires in November 2003. Borrowings bear interest at the prime rate or at a rate based on LIBOR, at the option of the Company. This credit facility is to be used for general corporate purposes including working capital. As of December 31, 2000, the prime rate was 9.5%.

In the 10-K filing, companies typically detail the existence of a line of credit and its availability in the liquidity and capital resources section under the management discussion, or in the financial footnotes explaining debt obligations.

Although information on credit lines is available in annual 10-K SEC filings, the existing empirical research on bank lines of credit relies on alternative data sources. Ham and Melnik (1987) collect data from a direct survey of 90 corporate treasurers. They find that draw downs on lines of credit are inversely related to interest rate cost and positively related to total sales. Agarwal, Chomsisengphet, and Driscoll (2004) examine the use of lines of credit for 712 privately-held firms that obtained loans from FleetBoston Financial Corporation. They also find that firms with higher profitability obtain larger credit lines, which is consistent with evidence presented here. Berger and Udell (1995) use data on lines of credit extended to small private businesses and show that firms with longer banking relationships pay

lower interest rates and are less likely to pledge collateral. Petersen and Rajan (1997) find that small private businesses without access to bank credit lines rely more heavily on trade credit. Shockley and Thakor (1997) focus on the contract structure of credit lines. This paper is the first, to my knowledge, to systematically analyze balances of used and unused bank lines of credit at public corporations. While Kaplan and Zingales (1997) and Houston and James (1996) present data on unused lines of credit collected from annual 10-K SEC filings, they do not explore the relationship between lines of credit and firm characteristics.

B. Data

I begin with a Compustat universe that contains non-financial U.S.-based firms with at least 4 consecutive years between 1996 and 2003 of positive data on total assets (*item 6*), and 4 consecutive years of non-missing data on total liabilities (*item 181*), total sales (*item 12*), a measure of EBITDA (*item 13*), share price (*item 199*), shares outstanding (*item 25*), preferred stock (*item 10),* deferred taxes (*item 35*), and convertible debt *(item 79*). These data limitations are governed by the necessity of these variables in constructing basic financial characteristics of the firm. I also require firms to have 4 consecutive years of book leverage ratios between 0 and 1. This yields a sample of 4,604 firms, which I follow from 1996 through 2003 (31,533 firm-year observations). I focus on the 1996 to 2003 period because annual 10-K SEC filings are available electronically for all firms in the years after 1995, which makes the costs of data collection much lower for this time period. I restrict the sample to firms with at least 4 consecutive years of data because I am particularly interested in how line of credit use evolves for a given firm over time. This sample, which I refer to as the "full" sample, forms the basis for the text searching program described below which provides information on whether firms have a line of credit.

I then form a smaller data set based on a random sample of 300 firms, which I refer to as the "random" sample. I randomly sample 300 firms from the 4,604 firms in the full sample, and I follow them from 1996 through 2003, for a total unbalanced panel of 2,180 firm-year observations. The random sample represents 6.5% of the firms in the full sample. The random sample forms the basis for manual examination of annual 10-K SEC filings described below.

In the rest of this section, I describe the data searching process that produces measures of firms' utilization of lines of credit. It is important to understand that the process is iterative. I first use the full sample of annual 10-K SEC filings to search for certain phrases that are indicative of a firm having a line of credit. I then use the random sample and manually read the annual 10-K SEC filings to assess whether the search terms are providing an accurate or inaccurate portrayal of the firms that have bank lines of credit. The search procedure described below is the final version of this iterative process

For the full sample, I link each firm-year observation from Compustat to the electronic version of its annual 10-K SEC filing. I then search each filing for 7 terms: "credit lines," "credit facility," "revolving credit agreement," "bank credit line," "working capital facility," "lines of credit," and "line of credit." In the initial pass through the text filings, I create a variable that is 1 if the annual 10-K SEC filing has any of the search terms in the document, and 0 if the search terms are not in the 10-K filing.

This search algorithm leads to some errors in classifying whether firms in reality have a bank line of credit or revolving credit facility. In terms of classifying the errors, the null hypothesis is that the firm-year observation in question *does not* have a line of credit. A Type I error occurs when the search program determines that the firm *does* have a bank line of credit (rejection of the null hypothesis) when it in fact *does not* have a bank line of credit. A Type II error occurs when the search program determines that the firm *does not* have a line of credit (acceptance of the null hypothesis) when it in fact *does* have a line of credit.

In order to limit Type I errors, the search program produces a document that, for every firm-year observation, contains the 10 lines of text before and after each occurrence of a search term in the 10-K filing. Using this document, I manually search for obvious Type I errors. More specifically, I find occurrences in which one of the search terms is directly proceeded with "no," "do not have a," "not have any," "retired our," "terminated our," and "equity." I also search for the following phrases that may occur right after one of the search terms: "expired," "terminated,", and "was terminated." I manually conduct this search for Type I errors, and make sure that it is in fact a Type I error before reclassifying the firm-

year observation as having no line of credit. This collection procedure results in a {0, 1} variable measuring whether or not every firm in the full sample has access to a line of credit.

For the random sample of 300 firms, I manually collect detailed data on used and unused lines of credit from annual 10-K SEC filings. It is important to emphasize that there is no search program used to collect line of credit data for the random sample; they are collected manually. I collect data on whether the firm has access to a line of credit and the used and unused portion of the line of credit. If a line of credit backs up a commercial paper program, any outstanding commercial paper is subtracted from the line of credit, but is not recorded as a used portion of the line of credit. Any balance of the back-up line of credit that does not support outstanding commercial paper is recorded as an unused part of the line of credit. This is consistent with the actual reporting done by firms. It is important to note that borrowers with a commercial paper back up line of credit draw down the portion of the line that does not back up outstanding commercial paper. Only 5 percent of firms in my sample have a commercial paper program, and all results are robust to the complete exclusion of these firms.

One advantage of the random sample data collection is that it allows me to directly assess the errors in the search program used for the full sample. In other words, by comparing the line of credit collection from manual inspection versus the search program in the random sample, I am able to assess the number of Type I and Type II errors associated with the search program. I find the search program produces Type I errors in 8.6 percent of all observations in the random sample, and Type II errors in 2.2 percent of all firm-year observations in the random sample.[1]

For the random sample, I also collect data on whether or not a firm is in violation of a financial covenant associated with the line of credit; these are covenants that require the maintenance of financial ratios.[2] The SEC requires firms to report when they are in violation of a financial covenant: "companies

[1] The relatively large number of type I errors in the full sample (8.6%) is a disadvantage of the data collection procedure. However, these errors are likely to be random. They are based only on slight variations in language used in the annual reports, and are not systematic in any way. Therefore, these errors should bias coefficients toward 0 in the regression analysis.

[2] The material adverse change clause (MAC) is also an important feature in bank loan agreements. However, I find little evidence from annual 10-K SEC filings that this clause is invoked with frequency.

that are, or are reasonably likely to be, in breach of such covenants must disclose material information about that breach and analyze the impact on the company if material (SEC (2003)).”

Core financial variables are calculated from Compustat and are defined as follows. Book debt is short term debt plus long term debt (*item 34 + item 9*), all divided by total assets (*item 6*). Balance sheet cash is measured using *item 1*. A measure of asset tangibility is tangible assets (*item 8*) divided by non-cash total assets. The market to book ratio is defined as total assets less the book value of equity plus the market value of equity less cash, all divided by non-cash total assets. The book value of equity is defined as the book value of assets (*item 6*) less the book value of total liabilities (*item 181*) and preferred stock (*item 10*) plus deferred taxes (*item 35*). The market value of equity is defined as common shares outstanding (*item 25*) multiplied by share price (*item 199*). The primary measure of cash flow is EBITDA (*item 13*) divided by non-cash total assets. Net worth—cash adjusted is defined as non-cash total assets less total liabilities, divided by non-cash assets.

As further described in Section III, I scale cash flow, asset tangibility, net worth, and the market to book ratio with *non-cash* book assets. I do so because firms are likely to jointly determine cash holdings and line of credit usage. This joint determination leads to a mechanical negative correlation between any measure scaled by total assets and the use of lines of credit. For example, suppose one constructs the measure of tangibility as tangible assets scaled by total assets. Given that cash is included in total assets, and given that firms without access to a line of credit hold higher cash balances, this classification of asset tangibility leads to a mechanical negative correlation with lines of credit. A disadvantage of using non-cash assets in place of total assets to scale cash flow and asset tangibility is that it leads to extreme outliers. In order to reduce the influence of outliers, I Winsorize all financial variables from Compustat at the 5^{th} and 95^{th} percentile.

I drop any firm-year observation for which any of the variables constructed above are missing. The final full sample contains 4,584 firms (28,805 firm-year observations) and the final random sample contains 300 firms (1,913 firm-year observations).

C. Summary statistics

[TABLE 1]

Table 1 contains summary statistics for the full sample (left panel) and the random sample (right panel). In the full sample, 81.5% of firm-years have a line of credit. As discussed above, this percent is overstated given the Type I errors associated with the search program. A more reliable estimate is 74.5%, which is the percent of firm-years that have a line of credit in the random sample. Overall, almost 85% of firms in the random sample have a line of credit at some point between 1996 and 2003. Using the hand-collected data on line of credit balances in the random sample, I construct a variety of measures to assess the magnitude of lines of credit in corporate liquidity management. On average, the total line of credit represents 16% of book assets; the unused portion represents 10% of book assets and the used portion represents 6%. Given total debt scaled by book assets is 21% in the random sample, this implies that used lines of credit on average represent more than a quarter of outstanding debt balances among public firms. These statistics suggests that lines of credit are widely used by public firms, and they represent large amounts of used and unused debt.

In order to assess the importance of lines of credit in corporate liquidity management, I create two measures of the *bank liquidity to total liquidity ratio*. The first measure is the total line of credit balance scaled by the sum of total lines of credit and cash. The second measure is the unused line of credit balance scaled by the sum of unused lines and cash. The second measure captures the fraction of liquidity available to the firm in the form of lines of credit. The first measure takes into account mechanical endogeneity concerns that certain types of firms consistently draw down heavily on existing lines of credit. By either measure, bank liquidity represents about 50% of total liquidity available to firms, which suggests that credit lines are an instrumental component of corporate liquidity.

[TABLE 2]

Table 2 provides additional evidence on the importance of credit lines. Firms from all major industries heavily utilize this financial product. The lowest fraction of firms with lines of credit is in the services industry, where 63% of firm-year observations have a line of credit. The highest use is in both wholesale and retail trade, with over 90% of firm-year observations maintaining a line of credit. The

industry patterns most likely reflect a seasonal sales component, something I further explore in the results below. A common measure of whether firms have access to public debt is whether they have a corporate credit rating by S&P (Faulkender and Petersen (2006)). Table 2 demonstrates that firms with access to public debt make extensive use of bank lines of credit. Almost 95% of firms with a corporate credit rating have access to a line of credit, and outstanding line of credit balances represent (0.255*0.185*100 =) 4.7% of total assets. Given that total debt is 40% of total assets for these firms, this implies that 12% of total debt outstanding for firms with a corporate credit rating is in the form of used lines of credit. In other words, lines of credit are an important part of debt policy even for firms that have access to public debt. Finally, the last two rows of Table 2 show that even firms that have no debt outstanding have access to lines of credit. Conditional on having no debt outstanding, 32% of firm-years have an unused line of credit available, and the unused line of credit represents 11% of total assets.

II. Theoretical Motivation

In this section, I motivate the empirical analysis by discussing the existing theoretical research in two areas: cash holdings and bank lines of credit. I focus on how an empirical analysis of lines of credit can help resolve unanswered questions in both of these areas.

ACW (2004) argue that cash holdings represent a safeguard against the inability to obtain financing when valuable opportunities arise in the future. They build a three period model, in which investment opportunities arrive in the first and second periods. Firms are either financially constrained or unconstrained; firms fall into one of these categories based on the level of cash flows and the value of collateral that the firm can pledge to creditors. In the initial period, unconstrained firms have no reason to save cash out of initial cash flows; they can reduce dividends or raise more external finance in the second period to pursue investment opportunities. Constrained firms, on the other hand, retain a portion of their first-period cash flows to "hedge" against the inability to raise external financing in the second period. The optimal level of saving out of cash flow weighs the cost of reducing investment in the first period with the benefit of more investment in the second period. Constrained firms should therefore save a higher proportion of their initial cash flows relative to unconstrained firms.

Empirical support for this framework is found in ACW (2004); Faulkender and Wang (forthcoming) (henceforth, FW); and Opler, Pinkowitz, Stulz, and Williamson (1999) (henceforth OPSW). ACW (2004) sort their sample based on observable measures of financial constraints (payouts, size, and the existence of third-party credit ratings), and find that more constrained firms save more cash out of cash flow. FW (forthcoming) find that shareholders place higher value on an additional dollar of cash within financially constrained firms, where the measures of financial constraints used are similar to those in ACW (2004). OPSW (1999) find that larger firms and those with credit ratings hold less cash.

While the theoretical literature on cash is instructive, there are two related shortcomings. First, the cash literature does not provide direct insight into the precise financing constraint that prevents firms from accessing external funds. The theoretical frameworks of ACW (2004) and FW (forthcoming) rely only on a non-specific "limitation in [the] capacity to raise external finance" (ACW, p 1781). They do not take an empirical stand on what the limitation is. Second, this literature does not discuss the importance of bank lines of credit. As demonstrated in Tables 1 and 2, bank lines of credit are widely used by public firms, yet the cash literature does not isolate how lines of credit and cash policy may be jointly determined.

This last shortcoming is especially important given that a large body of theoretical literature on lines of credit argues that this financial product is designed to overcome precisely the types of capital market frictions discussed in the cash literature. These papers include Berkovitch and Greenbaum (1991); Boot, Thakor, and Udell (1987); Duan and Yoon (1993); Holmstrom and Tirole (1998); Morgan (1994); and Shockley (1995).

I focus here on two of these papers that I believe demonstrate the core intuition of these models. The paper by Holmstrom and Tirole (1998) motivates the use of lines of credit by embedding a moral hazard problem within a three-period model where a liquidity shock is realized in the second period. When the liquidity shock is realized in the second period, the borrower must retain a large enough portion of the third period return to motivate her to be diligent; in other words, there a standard moral hazard problem that forces the borrower to retain a large stake in the project. Given this agency problem, the

first best is unattainable. If the liquidity shock is large enough, the borrower will not be able to obtain funds even if the project has positive NPV, given that she must retain enough of the project return to maintain diligence. In the second best solution, the borrower buys liquidity insurance. One mechanism is a line of credit.[3] In the first period, creditors provide a commitment to lend in the second period up to a certain point. When the liquidity shock is realized, the borrower has access to committed funds. In some states of the world, the creditors end up losing money in the second period, but they break even in expectation. This is the intuition of the liquidity insurance in the model.

Boot, Thakor, and Udell (1987) also use a basic agency problem to motivate corporate demand for lines of credit. They employ a three-period model with an agency problem, where borrowers select an effort level in the first period and choose whether to invest or not in the second period. The moral hazard problem arises because the effort decision is unobservable to creditors. In the Boot, Thakor, and Udell (1987) model, there is stochastic interest rate realized in the second period that serves a similar role as the liquidity shock in Holmstrom and Tirole (1998). If interest rates are too high in the second period, borrowers anticipate a low expected return from the project and thus choose low effort. In other words, high interest rates in the second period lower the return to effort, which leads managers at borrowing firms to shirk. In the second period, banks fully predict such behavior, and thus ration credit. A line of credit signed in the first period solves this problem by charging an up-front fee and guaranteeing a low rate of interest in the second period. Thus, the line of credit serves as interest rate protection which can guarantee that borrowers put in high effort initially.

According to the theoretical literature, lines of credit are committed liquidity insurance that should protect firms against future capital market frictions. In addition, Kashyap, Rajan, and Stein (2002) find that banks have natural cost advantages in the provision of liquidity given deposit-based financing.

[3] Holmstrom and Tirole (1998) emphasize that the line of credit must be irrevocable, and that the liquidity shock is verifiable. In other words, there is no possibility that borrowers misallocate the funds available under the line of credit. In addition, Holmstrom and Tirole (1998) emphasize that other types of financing arrangements may serve the purpose of a bank line of credit in their model, as long as the arrangement provides unconditional financing.

Likewise, Gatev and Strahan (2006) find that banks are better liquidity providers given that deposits flow into banks during aggregate financial crises.

The theoretical literatures on lines of credit and banks' advantages in liquidity provision suggest that firms should rely fully on bank lines of credit in their liquidity management. This, in some sense, is the null hypothesis that is rejected by the cash literature. Clearly, lines of credit do not provide sufficient liquidity insurance for all firms in the economy. The primary goal of this paper is to resolve empirically these two research areas by exploring what determines whether firms use cash or lines of credit in corporate liquidity management. More specifically, I examine whether low cash flow, low asset tangibility, small size, low firm net worth, or low market to book ratios make lines of credit difficult to obtain and maintain. This analysis should provide insight into the precise friction that makes lines of credit a poor liquidity substitute for cash for some firms.

There are three additional hypotheses from the line of credit theoretical literature that I examine in the empirical analysis. First, the models assume that basic agency problems due to information asymmetry motivate the use of lines of credit. In other words, firms where management actions are less transparent are more likely to use lines of credit. Second, a bank line of credit must provide some degree of "commitment" if it is to improve on spot market financing. If banks can fully renegotiate the line of credit in the interim period, the contract will not improve on spot-market financing. In the line of credit models described above, the optimal behavior for the bank in some states of the interim period is to restrict access to the line of credit. The empirical section of this paper attempts to quantify the extent to which lines of credit represent unconditional obligations of banks. The third main empirical hypothesis that comes from these models is that it can be difficult for firms to raise capital in spot markets when investment opportunities arrive or change. Lines of credit provide a particularly flexible source of debt financing that can be drawn upon with fewer difficulties. Lines of credit should therefore be used in industries with higher earnings or sales volatility.

III. Lines of Credit versus Cash

A. Empirical specification

In this section, I conduct a series of linear regressions to examine firm characteristics that influence the decision to utilize lines of credit as opposed to cash in corporate liquidity management. The core specification is:

$$Lines_{it} = \alpha_t + \beta X_{i,t-1} + \alpha_i + \varepsilon_{it} \quad (1)$$

There are three main dependent variables. First, I use a {0,1} variable of whether the firm has access to a line of credit. In this case, equation (1) represents a linear probability model.[4] Second, I use two different measures of the bank liquidity to total liquidity ratio, one based on total lines of credit and the other on unused lines of credit. When I examine the bank liquidity to total liquidity ratio, I also examine the pure intensive margin for which I isolate the sample to only firms that have a line of credit.[5] Given the panel nature of the data, I conduct both firm fixed effects regressions, where α_i is estimated explicitly, and pooled regressions where α_i is treated as part of the error term. I also conduct between, or firm-means regressions where each firm represents a single data point, and the variables used are means of the time-variant variables for a given firm. The goal is to understand whether between-firm (firm-means regressions) or within-firm variation (firm fixed effects regressions) are driving the correlations in the data. In the pooled and fixed effects regressions, standard errors are clustered at the firm level and all regressions include year and 1-digit SIC industry indicator variables.

The variables in the matrix *X* are motivated by the theoretical framework outlined in Section II. First, I examine firm characteristics likely to be associated with firms facing a high cost of external relative to internal finance. In other words, I attempt to explain why firms may be forced to rely on internal cash as opposed to using a bank line of credit. I use five measures. First, firm cash flow is measured as EBITDA scaled by non-cash total assets. I employ EBITDA because it is the most common measure of cash flow used by commercial banks when setting various types of covenants on lines of credit. All results are robust to a more common measure of cash flow: the sum of EBIAT and

[4] Alternatively, I use a maximum likelihood logit specification to estimate equation (1). Results are qualitatively similar and are reported in Appendix Table 1.
[5] Alternatively, I use a maximum likelihood tobit specification to simultaneously capture the extensive and intensive margin. Results are qualitatively similar and are reported in Appendix Table 1.

depreciation, all scaled by non-cash total assets. Second, asset tangibility is measured as tangible assets scaled by non-cash total assets. Third, firm size is measured as the natural logarithm of non-cash total assets. I also include net worth scaled by assets and the market to book ratio.

I employ non-cash total assets as opposed to total assets to scale variables. As mentioned in Section I, I scale by non-cash total assets because firms are likely to jointly determine cash balances and their utilization of lines of credit when setting corporate financial policy. The use of cash in the denominator of the variables in the matrix X will therefore lead to a mechanical negative correlation. For example, a key finding of the paper is that firms with low cash flow scaled by non-cash assets are less likely to utilize a line of credit. This negative correlation between cash flow and line of credit utilization would be *mechanical* if cash is included in the assets measure used to scale cash flow, as long as cash flows are positive on average. For the same nominal cash flow, firms without a line of credit will hold more cash than firms with a line of credit, which will mechanically lead to a lower level of cash flow scaled by total assets for the firms that do not have a line of credit. Consistent with this mechanical bias, the negative correlation between cash flow and the utilization of lines of credit is much stronger if I scale by total assets as opposed to non-cash assets.

In addition to determining what factors force firms to rely on cash instead of lines of credit, the empirical analysis also attempts to quantify the importance of information asymmetry and business variability on the use of lines of credit. I construct measures of information asymmetry that are consistent with measures in Faulkender and Petersen (2006) and Sufi (forthcoming). Firms with equity that is not traded on a major exchange receive less analyst coverage and media attention. Likewise, firms that are not in one of the three main S&P indices (the S&P 500, the S&P Midcap 400, and the S&P Smallcap 600) also receive less attention. I use an indicator variable for whether the firm's equity trades only over the counter and I use an indicator for whether the firm is NOT included in one of the main S&P indices to measure information asymmetry. Older firms are also more likely to be known to capital markets. I include the natural logarithm of 1 + the years since the firm's IPO as an additional measure of

information asymmetry. The year of the firm's IPO is approximated using the first year in Compustat that the firm's share price is available.

I use two variables to measure business variability. First, I include the median within-year standard deviation of sales for all firms in the given firm's 3-digit SIC code industry.[6] I refer to this variable as *seasonality*. Firms in 3-digit industries that show a larger degree of seasonality in sales may desire lines of credit to manage working capital and inventories. I also include a measure of the variability of cash flow, which is based on the measure used in Mackie-Mason (1990). It represents the standard deviation of annual changes in the level of EBITDA over a lagged 4 year period, scaled by average non-cash assets in the lagged period.

B. Results

[TABLE 3]

Table 3 reports coefficients from linear probability regressions relating the probability of having a line of credit to various firm characteristics. The left panel shows results from the full sample and the right panel shows results from the random sample. Firm cash flow has a strong positive effect on the probability a firm utilizes a line of credit. The coefficient estimate in column 1 suggests that moving from the 10^{th} to 90^{th} percentile of cash flow (0.9) leads to a (0.9*0.21*100 =) 19% increase in the probability of obtaining a line of credit. The results in columns 2 and 3 demonstrate a robust effect of cash flow in both fixed effects and between estimation, although the fixed effects estimates are smaller in magnitude. The coefficient estimates on cash flow are similar in the random sample, where measures of lines of credit are manually collected as opposed to using a search program. The fixed effects estimate is positive but not statistically distinct from 0 at a reasonable confidence level. In general, none of the fixed effects estimates in column 5 are statistically distinct from 0 at a reasonable level, which suggests that fixed effects estimation in a sample of 300 borrowers lacks the power to produce reliable estimates.

[6] This variable is constructed as follows: I use the entire set of firms with data available in the Compustat quarterly industrial files. For every firm-year, I calculate the standard deviation of the quarterly differences in sales, scaled by average assets over the year. I then obtain the median across all 3-digit SIC industries, for every given year. This variable is then merged onto each firm-year observation with the same 3-digit SIC code. This measure is similar to the earnings variance measure used in Mackie-Mason (1990).

Asset tangibility has a positive effect in the fixed effects specification for the full sample, but is not positive and statistically distinct from 0 in alternative specifications. Size is a strong statistical predictor of the use of bank lines of credit. The magnitude of the size effect is almost identical to the magnitude effect of cash flow: going from the 10^{th} to 90^{th} percentile in the natural logarithm of total assets (5.5) leads to a (5.5*0.036*100 =) 20% increase in the likelihood of obtaining a line of credit.

In terms of business variability, the coefficient estimates in the pooled regressions suggest that 3-digit SIC code within-year sales volatility has a positive effect on the use of lines of credit, although this result is only marginally statistically distinct from 0 in the between regressions. The effect of seasonality is statistically weak given that regressions include 1-digit SIC industry fixed effects. The exclusion of these industry fixed effects makes the effect of seasonality much stronger. There is mixed evidence on the effect of information asymmetry on the probability of utilizing a line of credit. While firms that are younger or not in an S&P index are more likely to use a line of credit, firms that are traded over the counter (as opposed to being traded on a major exchange) are less likely to obtain a line of credit. The information asymmetry results are not robust in the random sample.

[FIGURE 1]

The results in Table 3 suggest that firms with low levels of cash flow do not utilize bank lines of credit. Figure 1 shows that they use cash instead. It maps both the fraction of firms that have a line of credit and the mean cash scaled by total assets across the cash flow distribution. There is strong evidence of a negative correlation of line of credit use and cash holdings across the cash flow distribution, especially at the low end. Moving from the lowest decile to the 5^{th} decile of cash flow leads to a monotonic increase in the probability of obtaining a line of credit from 40% to over 90%. Alternatively, cash balances decline from over 55% of total assets to less than 10% of total assets.

Interestingly, there is an opposite trend at the very high end of the cash flow distribution in the 9^{th} and 10^{th} decile, where firms on average become less likely to use a line of credit and more likely to hold cash balances. This trend is driven by firms like Microsoft. They are much more likely to be in services industries, much less likely to use debt financing, and have much higher market to book ratios than firms

in the high cash flow deciles that use lines of credit. The opposite pattern at the high end of the cash flow distribution is captured by the market to book and industry controls in the regression results, which is why they do not influence the positive effect of cash flow on line of credit utilization.

[TABLE 4]

Figure 1 suggests that there is an explicit trade-off across the cash flow distribution in firms' utilization of bank lines of credit versus cash in corporate liquidity management. Table 4 examines the bank liquidity to total liquidity ratio and presents coefficient estimates that are consistent with this evidence. The first two columns use total lines of credit scaled by the sum of total lines of credit and cash balances, whereas the second two columns use unused lines of credit scaled by the sum of unused lines of credit and cash balances. Consistent with Figure 1, columns 1 and 3 show a positive correlation between lagged cash flow and the bank liquidity to total liquidity ratio. The magnitude of the coefficient in column 1 suggests that moving from the 10^{th} to 90^{th} percentile of the cash flow distribution leads to an (0.9*0.11*100/0.51 =) 19% increase in the bank liquidity to total liquidity ratio at the mean. Size also is a strong predictor of the use of lines of credit versus cash by firms. The coefficient estimate on cash flow volatility is negative and statistically distinct from 0 at the 1 percent level in column 1, and 5 percent in column 3. This suggests that firms with high cash flow volatility rely more on cash in their liquidity management. This evidence is consistent with the notion that firms with high cash flow volatility may prefer to avoid cash-flow based financial covenants associated with lines of credit, something I explore further in the next section.

These results mitigate concerns that omitted variables correlated with a firm's demand for overall liquidity are influencing the positive correlation between line of credit usage and cash flow. The bank liquidity to total liquidity ratio isolates the relative attractiveness of lines of credit versus cash, while controlling for overall liquidity. Firms with low cash flow may have higher or lower demand for liquidity, but the important result in Table 4 is that they prefer to hold cash balances relative to lines of credit.

One key question is whether the results in columns 1 and 3 are driven uniquely by the extensive margin. In other words, are these results robust when one examines only firms that have a line of credit? Columns 2 and 4 suggest that, conditional on having a line of credit, firms with higher cash flow and larger firms rely more heavily on lines of credit in their liquidity management. The coefficients are weaker, both statistically and in magnitude. However, they suggest that the positive effect of cash flow on the use of lines of credit is robust when isolating only the intensive margin of use.

[TABLE 5]

There is an economically meaningful and statistically robust correlation between a firm's lagged cash flow and its use of a line of credit. Table 5 presents results that help to explain this correlation. The first two columns report coefficient estimates from regressions that relate whether or not a firm has a line of credit in the full sample to firm characteristics. Columns 3 and 4 report coefficients from a similar regression in the random sample. Columns 5 and 6 report coefficient estimates of the effect of cash flow on the bank liquidity to total liquidity ratio in the random sample. They key innovation in Table 5 is to split the sample into firms with high and low default risk, as measured by Altman's *z-score* (1968).[7] The results in columns 2, 4, and 6 demonstrate that the positive correlation between the use of lines of credit and cash flow is unique among firms with high default risk. In other words, when a given firm has high default risk, lagged cash flow has strong predictive power of whether the firm obtains a line of credit, and whether the firm more heavily uses lines of credit versus cash in liquidity management. There is no correlation between lagged cash flows and lines of credit among firms with low default risk.

IV. The Importance of Cash-Flow Based Financial Covenants

A. Large sample evidence

[7] I follow Mackie-Mason (1990) and calculate the *z-score* excluding leverage, given that leverage is a direct function of the proportion of used and unused lines of credit. More specifically, *z-score* is calculated as:

$$ZSCORE = 3.3*\frac{EBIT}{totalassets} + 1.0*\frac{sales}{totalassets} + 1.4*\frac{retainedearnings}{totalassets} + 1.2*\frac{workingcapital}{totalassets}$$

where retained earnings is *item 36* and working capital is *item 179* from Compustat. ZSCORE has a mean of 1.23 and a standard deviation of 2.76.

There is a robust and economically significant positive correlation between a firm's cash flow and its use of lines of credit versus cash. In this section, I explore how cash-flow based financial covenants on lines of credit help explain this correlation. Violations of financial covenants are an important part of understanding why firms may or may not use lines of credit. Overall, of the 254 firms in the random sample that have a line of credit, 91 experience a covenant violation. In other words, 36% of firms that obtain a line of credit experience a covenant violation.

Financial covenants on a line of credit require the maintenance of financial ratios. Financial ratios are specified in the initial contract, and the borrower is in default of the loan agreement if a ratio is not satisfied. These violations are referred to as "technical defaults," and the lender has the legal right to accelerate the loan in response to the violation. While most covenant violations are renegotiated, the terms of the loan can change significantly.

[TABLE 6]

Table 6 presents evidence from LPC's *Dealscan* on financial covenants. The sample includes 11,758 sole lender and syndicated lines of credit obtained by non-financial public corporations (firms with a ticker) from 1996 to 2003. Almost 72% of all lines of credit in the sample have covenants based on financial ratios. Coverage covenants, which are written on a measure of cash flow divided by an interest, debt service, or fixed charge expense, are the most common type of financial covenant, occurring on 70% of lines that have financial covenants. The second most common type of covenant is a debt to cash flow covenant, which is on 49% of lines that have financial covenants, followed by net worth covenants. Current ratio and leverage ratio-based covenants are less common. In fact, only 25% of lines of credit that have a financial covenant *do not* have a cash-flow based covenant. The evidence from Table 6 suggests that maintenance of cash flow is critical to avoiding non-compliance with financial covenants on lines of credit.[8]

[8] In Table 6, I report data on covenants from *Dealscan* because the SEC does not require firms to report their covenants. The SEC does, however, require firms to report whether they are in violation of a covenant. Dichev and Skinner (2001) argue that actual covenant violations represent situations in which firms were unable to obtain an

[TABLE 7]

Why do firms violate covenants? Unfortunately, the SEC does not require firms to disclose why they are in violation of covenants. Previous studies using data from the 1980s examine SEC filings and find evidence that net worth and current ratio covenant violations are the most common (Beneish and Press (1993), Chen and Wei (1993)). However, both of these studies report that large numbers of violators do not report why the violation occurs (almost 25% in Beneish and Press (1993) and almost 50% in Chen and Wei (1993)). Consistent with these earlier studies, a large fraction of firms in the random sample do not report exactly which covenant is violated.[9] Selective reporting by firms may lead to systematic bias if, for example, firms are less likely to disclose information when cash-flow based covenants are violated as opposed to current-ratio based covenant violations. Instead of relying on self-reporting, I conduct a statistical analysis to determine what financial factors have the strongest power in predicting a covenant violation. More specifically, Table 7 reports coefficient estimates from the following firm fixed effects linear specification:

$$Violation_{it} = \alpha_i + \alpha_t + \beta X_{it} + \varepsilon_{it} \qquad (2)$$

In this specification, X_{it} is a matrix that includes measures on which banks write covenants: cash flow, the leverage ratio, net worth, and the current ratio. Given the influence of size on the utilization of lines of credit, I also include firm size in X. The vector of coefficient estimates of β describes whether reductions in cash flow, reductions in net worth, increases in leverage, or decreases in current ratios lead to credit line covenant violations. The sample for the estimation of (2) includes only firm-years where a line of credit is present, and standard errors are clustered at the firm level.[10]

Column 1 of Table 7 shows that a drop in cash flow leads to a large increase in the probability of violating a covenant. The firm fixed effects coefficient estimate has a *t-statistic* above 5, where standard

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amendment to avoid violation. The violations tracked in my data represent violations that could not be avoided. To that degree, they represent more serious violations than those that can be avoided.

[9] In results available from the author, I use data collected directly from 10-K filings to explain why firms violate financial covenants. Only 47% of covenant violations are explained, and, for these violations, a cash flow based covenant is violated more often than any other type of covenant (74%).

[10] I also estimate equation (2) using fixed effects in a maximum likelihood logit specification; these results are in Appendix Table 2, and are qualitatively similar to the linear regression results.

errors are clustered at the firm and there are 254 firms in the sample. The magnitude suggest that a firm that moves from the 90th to the 10th percentile of cash flow scaled by lagged assets has an increase in the probability of default by (0.32*0.57*100 =) 18%. Considering that the mean if the left hand side variable is 11% in this sample, this represents an increase in the probability of default of 160% at the mean. Drops in cash flow strongly predict financial covenant violations.

In column 2, I include other measures on which banks place covenants. The only other variable that affects the probability of a covenant violation is the leverage ratio. The magnitude of the coefficient suggests that going from the 10th to the 90th percentile in leverage has an increase in the probability of default by (0.47*0.59*100=) 27%, which is stronger than the effect of cash flow. However, the effect of leverage is not as statistically reliable, given that the effect is only significant at the 5% level with a *t-statistics* of 2.42. The *t-statistic* for the negative coefficient on cash flow in column 2 is -4.31. Other measures on which covenants are placed, including net worth, the current ratio, the market to book ratio, and total assets, have no statistically significant effect on the probability of a covenant violation when included with cash flow and the leverage ratio. This evidence is consistent with data from *Dealscan* in Table 6: cash flow and leverage ratios are the most common component of financial covenants, and they are also the most powerful predictors of covenant violations.

[FIGURE 2]

What happens to the availability of the line of credit when a firm defaults on its covenants? Figure 2 focuses on the 91 firms in the sample that violate a financial covenant during the sample period. It maps the total, used, and unused lines of credit to lagged total assets ratios relative to the default year. The data are "default-time scaled" so that *t=0* is the year that the firm initially defaults on a financial covenant in its credit agreement. Figure 2 shows that the used portion of the line of credit increases directly before the firm defaults on a covenant. When a firm defaults, there is a subsequent reduction in the availability of the total, used, and unused line of credit at *t+1*. The unconditional means suggest that the bank reduces the availability of the total line of credit from 0.259 to 0.197, or about 25 percent, in the year after a covenant violation. From the year before the violation to the year after the violation, the

unused portion of the line of credit goes from 0.165 to 0.086, a reduction of almost 50%. The results in Figure 2 suggest that the availability under a line of credit is conditional on the maintenance of covenants.

Columns 3 through 6 of Table 7 present coefficient estimates showing the effect of a covenant violation on the available balances of lines of credit. More specifically, I estimate:

$$Line_{it} = \alpha_i + \alpha_t + \beta X_{i,t-1} + \gamma * Violation_{i,t-1} + \varepsilon_{it} \quad (3)$$

The sample includes only those firm-year observations where a line of credit was present at *t-1*. Standard errors are clustered at the firm level. The results in columns 3 and 4 demonstrate that a default at *t-1* leads to a reduction in the total and unused line of credit scaled by lagged assets of 0.042 and 0.036, which is 18 and 26 percent at the mean of the left hand side variable, respectively. The coefficient estimates in columns 5 and 6 demonstrate a comparable reduction in the bank liquidity to total liquidity ratios of between 10 and 20%. It is important to note that the regression specification controls for all variables that are shown in columns 1 and 2 of Table 7 to predict covenant violations. In other words, even controlling for the financial factors leading to covenant violations, a covenant violation has an independently large and statistically significant effect on the availability of lines of credit.

These findings help explain why firms with low cash flow are less likely to use lines of credit, and why firms with low cash flow and high cash flow volatility rely more heavily on cash in corporate liquidity management. Firms with low cash flow are more likely to violate financial covenants, and violations of covenants lead to a restriction in the availability of the line of credit.

These results also empirically quantify the degree to which lines of credit represent unconditional liquidity available to the firm in all future states. Lines of credit are not totally unconditional obligations of banks; banks use covenant violations to restrict the availability of the line of credit. The evidence is consistent with Rajan and Winton (1995) and Park (2000) who argue that covenants facilitate bank monitoring. Banks appear to use covenant violations to reassess their lending position with a borrower.

B. Anecdotal evidence

In this section, I present anecdotal evidence based on quotations from the annual 10-K SEC filings that complement the large-sample statistical evidence presented above.

First, companies often stress the importance of cash flow in their ability to maintain compliance with line of credit covenants. For example, Pioneer Companies, in their FY 2003 annual 10-K SEC filing, notes with respect to its bank line of credit:

> If the required Lender-Defined EBITDA level under the Revolver is not met and the lender does not waive our non-compliance, we will be in default under the terms of the Revolver. Moreover, if conditions constituting a material adverse change occur, our lender can refuse to make further advances. Following any such refusal, customer receipts would be applied to our borrowings under the Revolver, and we would not have the ability to reborrow *(sic)*. This would cause us to suffer a rapid loss of liquidity, and we would lose the ability to operate on a day-to-day basis.

The language in Pioneer's filing implies that cash flow is the key to avoiding a covenant violation, and it emphasizes how serious a potential default on the line of credit is to the company. Mace Security makes a similar point in their FY 2002 annual 10-K SEC filing with respect to its bank line of credit arrangements:

> The Company's ongoing ability to comply with its debt covenants under its credit arrangements and refinance its debt depends largely on the achievement of adequate levels of cash flow. Our cash flow has been and can continue to be adversely affected by weather patterns and the economic climate.

Banks often condition the availability of the line of credit on cash flow, and a drop in cash flow makes the violation of bank covenants more likely. The anecdotal evidence suggests that, even among firms that have access to lines of credit, management understands the pressure to maintain high cash flow to allow for additional bank financing. Metretek, Inc. discusses the revolving credit facility of one of its subsidiaries in its FY 2001 filing:

> Our current Credit Facility has a number of financial covenants that Southern Flow must satisfy. Southern Flow's ability to satisfy those covenants depends principally upon its ability to achieve positive operating performance. If Southern Flow is unable to fully satisfy the financial covenants of the Credit Facility, it will breach the terms of the Credit Facility … Any breach of these covenants could result in a default under the Credit Facility and an acceleration of payment of all outstanding debt owed, which would materially and adversely affect our business.

This language is very common when management discusses covenants on bank lines of credit in the annual report.

The coefficient estimates in the previous section show that violations of covenants on lines of credit have a material effect on the availability of a line of credit. Anecdotal evidence provides complementary evidence of this fact. Here are 3 separate examples from Catalyst Semiconductor, in their FY 1997 filing, Total Renal Care Holdings, in their FY 1999 filing, and SBE, Inc., in their FY 1996 filing:

> At April 30, 1998, the Company was in default under various provisions of the loan agreement entitling the Bank to terminate the loan agreement and declare the loans immediately due and payable. As a result of noncompliance with the terms of the loan, the Company cannot currently borrow any additional funds under the line (Catalyst, 10-K filing, FY 1997).
>
> When measured as of December 31, 1999, the company was not in compliance with certain formula-based covenants in the credit facilities. If the lenders do not waive this failure to comply, a majority of the lenders could declare an event of default, which would allow the lenders to accelerate payment of all amounts due under the credit facilities. Additionally, this noncompliance will result in higher interest costs, and the lenders may require additional concessions from the company before giving a waiver … Under these conditions, the company is currently unable to draw additional amounts under the credit facilities (Total Renal Care Holdings, 10-K filing, FY 1999).
>
> As of October 31, 1996 the Company was in default on the minimum profitability covenant of its $2.0 million credit line, as amended. The Company received a letter of forbearance from the bank that provided for a revised credit limit of $1.0 million with borrowings limited to 65 percent of adjusted accounts receivable balances and for other revised covenants. These revised covenants specified minimum monthly profitability levels, a minimum tangible net worth of $4.0 million and a minimum debt ratio of 1.0:1.0. (SBE Inc., 10-K filing, FY 1996)

In all 3 examples, firms lose full access to a line of credit in response to a covenant violation. While I urge caution in interpreting these anecdotes in isolation, I believe they provide complementary evidence when viewed in relation to the large sample statistical evidence presented above.

V. Access to a Line of Credit and Financial Constraints

In this section, I examine whether access to a line of credit is a more statistically powerful measure of financial constraints than measures previously used in the literature. In particular, I relate my findings with the empirical findings of ACW (2004). Their important theoretical insight, described above in Section II, is that firms facing capital market frictions are more likely to save cash out of cash flow.

They empirically examine their model by sorting a firm into financially constrained and unconstrained categories based on four measures: the payout ratio of the firm, the size of the firm, whether the firm has a bond rating, or whether it has a commercial paper rating.[11] In this section, I use access to lines of credit as a measure of financial constraints: a firm is considered unconstrained if it (a) has access to a line of credit in every year of the sample, and (b) maintains cash flow above the median in every year of the sample. The latter part of the definition reflects the fact that firms with low cash flow are at risk of violating a covenant, and thus face potential capital market frictions. A firm that does not satisfy either part of the definition is considered constrained. Given that theoretical research emphasizes the importance of bank lines of credit in reducing potential financial constraints and providing liquidity, this categorization is a natural extension of ACW (2004).

[TABLE 8]

Table 8 presents the unconditional correlations between the measures of financial constraints used in ACW (2004) and the measure based on access to lines of credit. As the first column demonstrates, the measures are positively correlated. In terms of magnitudes, the credit line access measure is most correlated with the size measure of financial constraints. While there is a positive correlation between having access to a line of credit and other measures of financial constraints, it is smaller than the correlations of the other measures with each other. This suggests that access to a line of credit may provide additional statistical power beyond the traditional measures used in the literature.

[TABLE 9]

Table 9 examines the cash flow sensitivity of cash for various sub-samples based on measures of financial constraints used in ACW (2004). More specifically, the coefficient estimates presented in Table 9 are the outcome of firm fixed effects regressions relating the difference in cash holdings from *t-1* to *t* on cash flow, a measure of investment opportunities (*Q)* and the natural logarithm of total assets, all

[11] For details, see ACW (2004), pages 1789-1790. The only discrepancy in my categorization is to split firms into size groups based on whether they are above or below the median in every year. ACW (2004) split firms into size groups based on whether they are in the top 3 deciles or bottom 3 deciles. I change the definition because there are almost no "unconstrained" firms by the line of credit measure in the smallest 3 size deciles.

measured at time *t*. The estimations replicate the estimations that generate results reported in Table III of ACW (2004). Each coefficient estimate in Table 9 represents the effect of cash flow on cash holdings from a separate regression for a different sub-sample.

Column 1 reports the coefficient estimates on cash flow for the various measures of financial constraints. Column 1, row 1 shows that constrained firms based on the credit line access measure save a positive amount of cash out of cash flow, a result that is statistically distinct from 0 at the 1 percent level. There is no such effect for firms that have access to bank lines of credit. The coefficient estimates for the two samples are statistically distinct from one another at the 1 percent level. The coefficient estimates in column 1, rows 2 through 5 replicate the procedure using the ACW (2004) measures of financial constraints. The ordering of the point estimates is consistent with their findings in every category except the payout ratio categorization. Smaller firms, firms without an S&P corporate credit rating, and firms without an S&P commercial paper rating save cash out of cash flow. At the same time, large firms and firms with credit ratings do not save cash out of cash flow. Interestingly, the magnitudes of the coefficients are almost identical for all financial constraints categorizations except the payout ratio.

In columns 2 and 3 of Table 9, I examine whether the availability of lines of credit adds statistical power to the measures used in ACW (2004). For each of *their* measures of financial constraints, I split the "constrained" sample further based on whether the firm is constrained or unconstrained by the credit line access measure. As the reported estimates in columns 2 and 3 demonstrate, the positive effect of cash flow on cash holdings among *their* constrained firms is driven exclusively by firms that do not have access to lines of credit. In other words, firms that ACW (2004) classify as constrained but have access to a line of credit show no statistically significant positive relationship between cash flow and cash holdings. The results suggest that firms that have access to a line of credit are not financially constrained, even if they are classified as constrained by the ACW (2004) measures.

Theoretical research suggests that firms with access to lines of credit are able to overcome financial market frictions. This suggests that access to a line of credit is a superior measure of financial constraints than traditional measures used in the literature. Overall, the results in columns 2 and 3 suggest

that the measures of financial constraints used in ACW (2004) are accurate measures of financial constraints on average. However, a measure of the availability of bank lines of credit adds important information that improves the cash-cash flow sensitivity estimates.

VI. Conclusion

Bank lines of credit, or revolving credit facilities, are an instrumental component of corporate liquidity management. Theoretical research on credit lines argues that this financial instrument should resolve future capital market frictions facing firms. Existing research also suggests that banks can provide liquidity to firms more efficiently than reliance on internal cash. However, empirical findings from the cash literature suggest that cash plays an important liquidity role for certain firms in the economy. While these two areas are related, there has been very little interaction between the two. Extant research does not discuss why some firms utilize lines of credit while others rely on cash for liquidity. This paper attempts bridge the gap between these two areas. In particular, I examine the factors that lead firms to utilize bank lines of credit versus cash in corporate liquidity management.

The principal finding of the paper is that firm cash flow is a strong predictor of whether a firm uses bank lines of credit or cash in corporate liquidity management. Firms with low cash flow or high cash flow volatility rely more heavily on cash. The positive correlation between lagged cash flow and the use of lines of credit is robust to between-firm and within-firm analysis. It is also robust to both the extensive margin of use (whether a firm obtains a line of credit), and the intensive margin (conditional on having a line of credit, how large a fraction is the credit line in firm liquidity). Finally, the positive correlation exists only among firms with high default risk; in other words, if a firm has high default risk, then high cash flow is critical to obtaining a line of credit.

I document that an important channel for this correlation is banks' use of cash-flow based financial covenants on the lines of credit they supply. Cash-flow based covenants are more common than any other type of covenant. Decreases in cash flow are a strong predictor of covenant violations, and a firm that violates a covenant loses access to 15 to 30 percent of its line of credit capacity. This finding

suggests that lines of credit are a poor liquidity substitute for cash for firms that have existing or expected low cash flow. In turn, these firms rely on cash as for liquidity.

Theoretical research suggests that lines of credit help alleviate capital market imperfections facing firms. Using this insight, I propose an alternative measure of financial constraints based on access to a line of credit. I provide evidence that this measure is a more statistically powerful measure of financial constraints than traditional measures used in the literature. More specifically, I show that the cash flow sensitivity of cash is *only* positive among "constrained" firms using traditional measures such as size, payout ratio, or access to public debt market *if* they do not have access to a line of credit. Access to a line of credit is a theoretically justified and statistically powerful measure of whether a firm faces capital market imperfections.

This paper represents one of the first empirical examinations of the use of bank lines of credit among a large sample of public firms. There are several avenues for future research, two of which I outline here. First, researchers could explore the time-series of the data to explore how corporate liquidity varies through business cycles and how it is correlated with alternative measures of liquidity. There are interesting macroeconomic questions regarding how lines of credit may affect credit crunches and the transmission of monetary policy (Holmstrom and Tirole (1998), Morgan (1994)). Second, lines of credit may play an instrumental role in firm investment policy. Firms with lines of credit may face lower investment costs and a lower cost of external finance. Using properly identified shocks to the supply of available financing, researchers may be able examine how credit lines affect investment policy when firms face high costs of raising new external finance.

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Figure 1
Use of Lines of Credit versus Cash Holdings across Cash Flow Distribution

This figure maps the mean cash to total assets ratio and the fraction of firms that have a line of credit by lagged cash flow decile. Going from left to right is going from firms in the lowest cash flow decile to firms in the highest cash flow decile

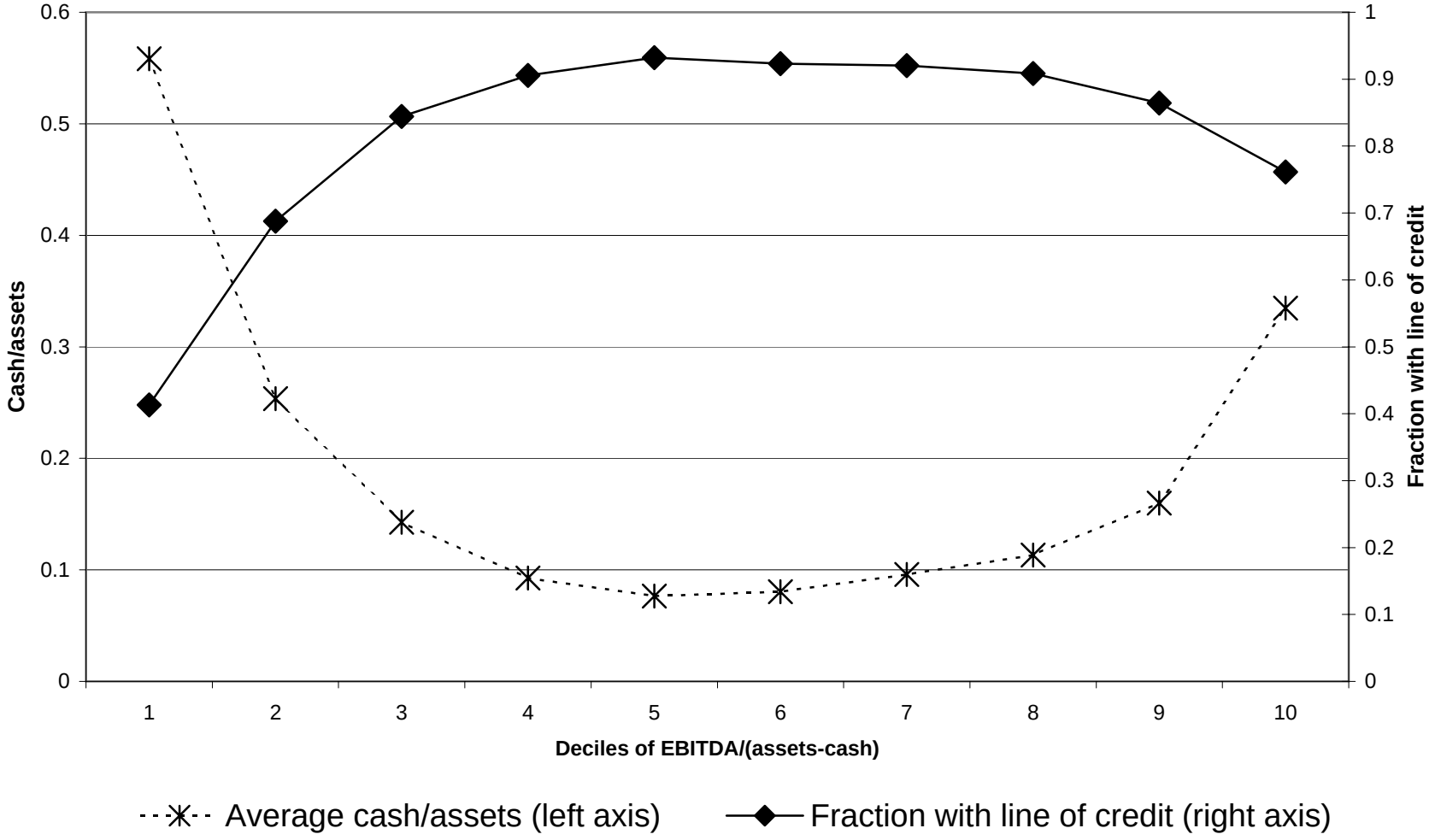

Figure 2
The Effect of a Covenant Violation on Availability of Line of Credit

This figure maps the availability of lines of credit around a covenant violation. Time t = 0 is the year in which the covenant violation takes place, and the *x axis* represents the availability of the line in years before and after the covenant violation

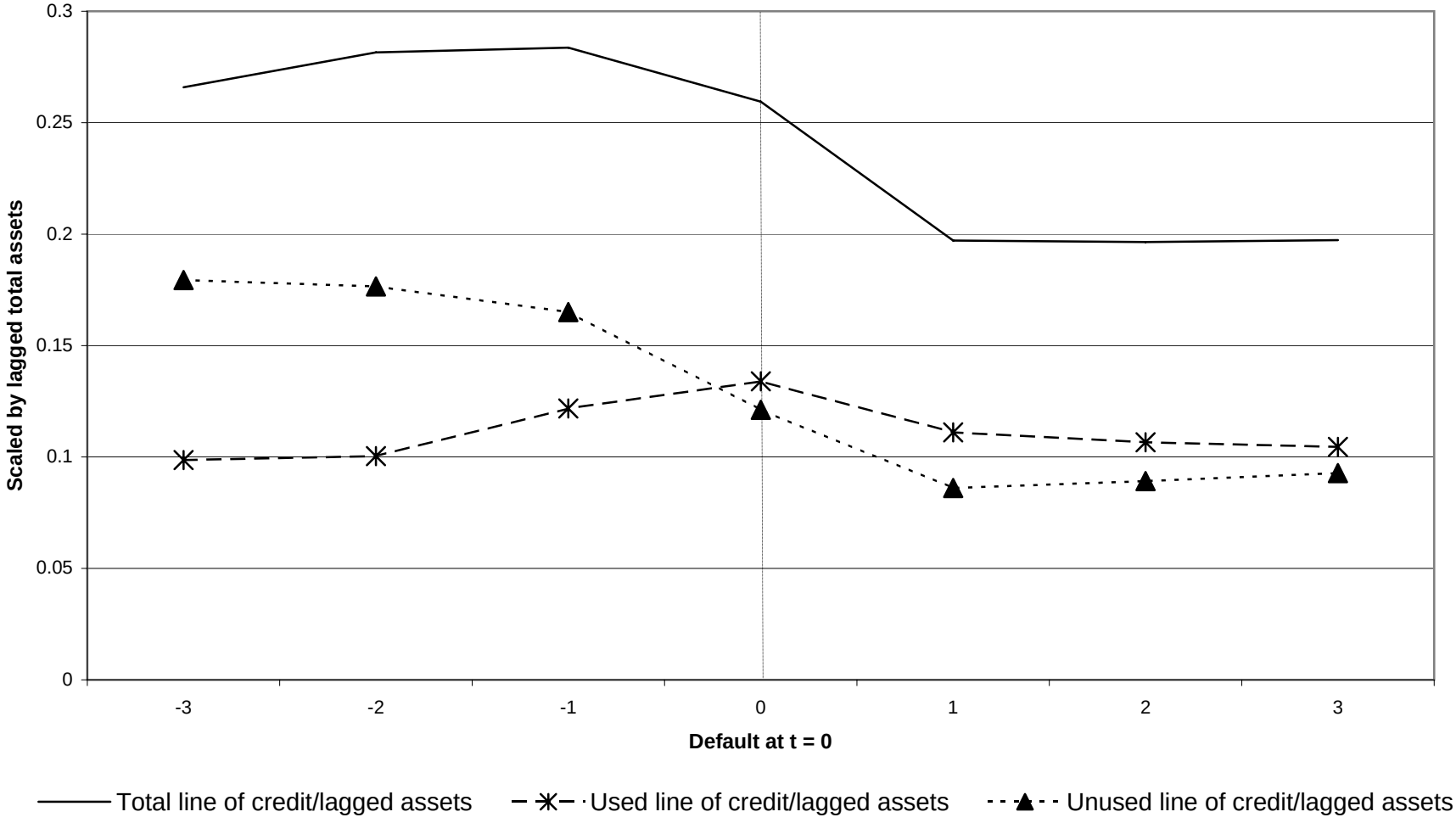

Table 1
Summary Statistics

This table presents summary statistics for two samples of non-financial firms from 1996 through 2003. The left panel describes the full sample of 4,584 firms (28,805 firm-year observations), and the right panel describes the random sample of 300 firms (1,913 firm-year observations). *Market to book, cash adjusted*, is the market value of equity less cash balances divided by the book value of equity less cash balances. *Net worth, cash adjusted*, is the net worth less cash divided by book assets less cash.

	Full Sample				Random sample		
Variable	Mean	Median	St. Dev.	Variable	Mean	Median	St. Dev.
Line of credit variables				*Line of credit variables*			
Has line of credit {0,1}	0.815	1.000	0.388	Has line of credit {0,1}	0.745	1.000	0.436
				Total line of credit/assets	0.157	0.110	0.169
				Unused line of credit/assets	0.101	0.067	0.124
				Used line of credit/assets	0.057	0.000	0.097
				Total line/(Total line + cash)	0.510	0.568	0.388
				Unused line/(Unused line + cash)	0.447	0.452	0.373
				Violation of financial covenant {0,1}	0.079	0.000	0.271
Firm characteristics				*Firm characteristics*			
Book debt/assets	0.205	0.173	0.191	Book debt/assets	0.207	0.172	0.198
EBITDA/(assets – cash)	0.026	0.124	0.358	EBITDA/(assets – cash)	0.029	0.126	0.359
Tangible assets/(assets – cash)	0.341	0.278	0.240	Tangible assets/(assets – cash)	0.332	0.273	0.226
Net worth, cash adjusted	0.435	0.443	0.238	Net worth, cash adjusted	0.448	0.457	0.237
Assets – cash	1639	105	11434	Assets – cash	1568	115	7858
Market to book, cash adjusted	2.926	1.523	3.445	Market to book, cash adjusted	2.814	1.498	3.348
Industry sales volatility	0.043	0.035	0.033	Industry sales volatility	0.044	0.036	0.035
Cash flow volatility	0.091	0.052	0.109	Cash flow volatility	0.092	0.053	0.110
Not in an S&P index {0,1}	0.694	1.000	0.461	Not in an S&P index {0,1}	0.685	1.000	0.465
Traded over the counter {0,1}	0.123	0.000	0.329	Traded over the counter {0,1}	0.141	0.000	0.348
Firm age (years since IPO)	15	10	13	Firm age (years since IPO)	14	9	13

Table 2
Which Firms Utilize Bank Lines of Credit?

This table presents data on the use of lines of credit by firms in the random sample of 300 firms (1,913 firm-year observations). It reports cell means for sub-samples by industry, by having a corporate credit rating, and by having debt outstanding.

			Conditional on having line of credit		
	Line of credit {0,1}	Some debt {0,1}	Debt/assets	Total line/assets	Used line/total line
Industry					
Agriculture, Minerals, Construction	0.761	0.862	0.303	0.306	0.490
Manufacturing	0.728	0.811	0.207	0.214	0.267
Transportation, Communications, and Utilities	0.867	0.911	0.375	0.160	0.349
Trade—Wholsale	0.927	0.909	0.249	0.224	0.309
Trade—Retail	0.916	0.935	0.295	0.192	0.299
Services	0.630	0.701	0.245	0.204	0.304
Corporate credit rating					
No S&P corporate credit rating	0.692	0.764	0.195	0.220	0.318
S&P corporate credit rating	0.945	0.995	0.394	0.185	0.255
Debt outstanding					
No debt outstanding	0.321	0.000	0.000	0.111	0.000
Debt outstanding	0.843	1.000	0.270	0.220	0.328

Table 3
Having a Bank Line of Credit and Firm Characteristics

This table presents coefficient estimates from regressions relating the probability of having a bank line of credit to various lagged firm characteristics. The left panel reports coefficient estimates from regressions using the full sample, and the right panel reports coefficients from the random sample. *Market to book, cash adjusted*, is the market value of equity less cash balances divided by the book value of equity less cash balances. Regressions include year and 1-digit industry indicator variables; standard errors are clustered at the firm level.

Sample:	Full sample			Random sample		
	(1)	(2)	(3)	(4)	(5)	(6)
Regression type	Pooled	Fixed effects	Between	Pooled	Fixed effects	Between
[EBITDA/(assets – cash)]$_{t-1}$	0.207**	0.069**	0.209**	0.203**	0.015	0.181*
	(0.015)	(0.017)	(0.017)	(0.063)	(0.064)	(0.079)
[Tangible assets/(assets – cash)]$_{t-1}$	0.008	0.095**	-0.020	0.048	0.096	-0.038
	(0.017)	(0.034)	(0.020)	(0.077)	(0.102)	(0.096)
[Ln(assets – cash)]$_{t-1}$	0.036**	0.033**	0.033**	0.044**	0.035	0.041**
	(0.003)	(0.006)	(0.003)	(0.013)	(0.019)	(0.012)
[Net worth, cash adjusted]$_{t-1}$	-0.092**	-0.012	-0.124**	-0.014	-0.002	-0.020
	(0.018)	(0.019)	(0.022)	(0.076)	(0.065)	(0.097)
[Market to book, cash adjusted]$_{t-1}$	-0.019**	0.003*	-0.032**	-0.026**	0.006	-0.044**
	(0.001)	(0.001)	(0.002)	(0.006)	(0.004)	(0.008)
[Industry sales volatility]$_{t-1}$	0.461**	0.425**	0.243	1.240**	0.412	1.031
	(0.112)	(0.127)	(0.160)	(0.351)	(0.239)	(0.692)
[Cash flow volatility]$_{t-1}$	-0.034	-0.018	0.055	-0.262	-0.176	-0.259
	(0.046)	(0.052)	(0.052)	(0.153)	(0.200)	(0.234)
[Not in an S&P index {0,1}]	0.036*		0.024*	0.050		0.013
	(0.010)		(0.012)	(0.043)		(0.050)
[Traded over the counter {0,1}]	-0.029**		-0.037**	-0.039		-0.036
	(0.015)		(0.013)	(0.057)		(0.054)
Ln[Firm age (years since IPO)]$_{t-1}$	-0.012**		-0.015*	-0.013		-0.021
	(0.005)		(0.006)	(0.019)		(0.027)
Number of observations	28.805	28.805	28.805	1,913	1,913	1,913
Number of firms	4,584	4,584	4,584	300	300	300
R^2	0.21	0.14	0.18	0.29	0.16	0.19

**,* statistically distinct from 0 at the 1 and 5 percent level, respectively

Table 4
Bank Liquidity to Total Liquidity Ratio and Firm Characteristics

This table presents coefficient estimates from regressions relating two measures of the bank liquidity to total liquidity ratio to various lagged firm characteristics for the random sample of 300 firms. The left panel reports coefficients from regressions using the total line divided by the sum of the total line and cash as the bank liquidity measure, and the right panel reports coefficients using the unused line divided by the sum of unused line and cash. Columns (2) and (4) present estimates from regressions which use only observations that have a bank line of credit present (intensive margin). Regressions include year and 1-digit industry indicator variables; standard errors are clustered at the firm level.

Dependent variable:	Total line/(Total line + cash)		Unused line/(Unused line + cash)	
	(1)	(2)	(3)	(4)
Sample:	Total	With line of credit	Total	With line of credit
[EBITDA/(assets – cash)]$_{t-1}$	0.110**	0.091	0.086*	0.126*
	(0.041)	(0.055)	(0.038)	(0.056)
[Tangible assets/(assets – cash)]$_{t-1}$	0.049	0.025	0.033	0.006
	(0.072)	(0.063)	(0.068)	(0.067)
[Ln(assets – cash)]$_{t-1}$	0.054**	0.033**	0.054**	0.041**
	(0.010)	(0.008)	(0.010)	(0.009)
[Net worth, cash adjusted]$_{t-1}$	-0.030**	-0.036**	-0.025**	-0.029**
	(0.004)	(0.005)	(0.004)	(0.006)
[Market to book, cash adjusted]$_{t-1}$	-0.110	-0.133*	-0.055	-0.037
	(0.059)	(0.052)	(0.054)	(0.054)
[Industry sales volatility]$_{t-1}$	0.975*	0.069	1.052**	0.341
	(0.382)	(0.320)	(0.402)	(0.367)
[Cash flow volatility]$_{t-1}$	-0.363**	-0.376*	-0.274*	-0.274
	(0.124)	(0.178)	(0.116)	(0.182)
[Not in an S&P index {0,1}]	0.063	0.047	0.033	0.026
	(0.040)	(0.034)	(0.039)	(0.035)
[Traded over the counter {0,1}]	0.076	0.131**	0.021	0.031
	(0.047)	(0.036)	(0.042)	(0.044)
Ln[Firm age (years since IPO)]$_{t-1}$	-0.025	-0.035*	-0.012	-0.022
	(0.018)	(0.016)	(0.017)	(0.016)
Number of observations	1,913	1,424	1,913	1,424
Number of firms	300	254	300	254
R^2	0.40	0.31	0.36	0.24

**,* statistically distinct from 0 at the 1 and 5 percent level, respectively

Table 5
Use of Bank Lines of Credit, by Default Risk

This table presents coefficient estimates from regressions relating the use of bank lines of credit to various lagged firm characteristics, by default risk as measured by Altman's *z-score* (1968). Regressions include year and 1-digit industry indicator variables; standard errors are clustered at the firm level.

Dependent variable, sample:	Line of credit {0,1}, full sample		Line of credit {0,1}, random sample		Total line/(total line + cash), random sample	
	(1)	(2)	(3)	(4)	(5)	(6)
Default risk:	Low	High	Low	High	Low	High
[EBITDA/(assets – cash)]$_{t-1}$	-0.053	0.221**	-0.164	0.202**	-0.346*	0.156**
	(0.075)	(0.017)	(0.206)	(0.065)	(0.151)	(0.043)
[Tangible assets/(assets – cash)]$_{t-1}$	-0.011	0.022	0.087	0.095	0.185	0.042
	(0.030)	(0.023)	(0.135)	(0.100)	(0.126)	(0.081)
[Ln(assets – cash)]$_{t-1}$	0.035**	0.040**	0.051*	0.036*	0.064**	0.044**
	(0.005)	(0.003)	(0.020)	(0.014)	(0.015)	(0.011)
[Net worth, cash adjusted]$_{t-1}$	-0.048	-0.121**	-0.020	-0.021	-0.035**	-0.018**
	(0.030)	(0.022)	(0.012)	(0.006)	(0.008)	(0.004)
[Market to book, cash adjusted]$_{t-1}$	-0.022**	-0.014**	0.052	-0.117**	-0.141	-0.151*
	(0.003)	(0.002)	(0.131)	(0.095)	(0.097)	(0.069)
[Industry sales volatility]$_{t-1}$	0.149	0.984**	0.443	2.010**	0.062	1.782**
	(0.146)	(0.167)	(0.373)	(0.635)	(0.472)	(0.670)
[Cash flow volatility]$_{t-1}$	-0.079	0.041	-0.271	-0.213	-0.543*	-0.247*
	(0.087)	(0.051)	(0.308)	(0.188)	(0.229)	(0.125)
[Not in an S&P index {0,1}]	0.021	0.048**	0.067	0.004	0.077	0.038
	(0.013)	(0.015)	(0.051)	(0.060)	(0.050)	(0.056)
[Traded over the counter {0,1}]	-0.010	-0.037*	0.078	-0.072	0.187**	0.033
	(0.025)	(0.018)	(0.070)	(0.070)	(0.064)	(0.053)
Ln[Firm age (years since IPO)]$_{t-1}$	-0.024**	-0.012	-0.025	-0.015	-0.068**	-0.019
	(0.006)	(0.007)	(0.028)	(0.029)	(0.023)	(0.026)
Number of observations	13,974	13,955	967	893	967	893
Number of firms	2,733	3,168	199	199	181	199
R^2	0.08	0.24	0.19	0.34	0.38	0.45

**,* statistically distinct from 0 at the 1 and 5 percent level, respectively

Table 6
Financial Covenants, from LPC's *Dealscan*

This table presents data from LPC's *Dealscan* on the use of covenants among public corporations. The total sample includes 11,758 loan deals by 4,011 public firms. *Coverage covenant* includes fixed charge coverage, interest coverage, cash interest coverage, and debt service coverage covenants. *Net worth covenant* includes net worth and tangible net worth covenants.

Loans with financial covenant {0,1}	0.716
Conditional on having financial covenant, loans with:	
Coverage covenant {0,1}	0.700
Debt to cash flow covenant {0,1}	0.485
Net worth covenant {0,1}	0.461
Debt to net worth {0,1}	0.130
Current ratio covenant {0,1}	0.114
Leverage ratio covenant {0,1}	0.201
No cash flow-based covenant {0,1}	0.249

Table 7
The Causes and Consequences of Financial Covenant Violations

Columns 1 and 2 present regression coefficients from firm fixed effects regressions relating the probability of a covenant violation to firm characteristics. Columns 3 through 6 present regression coefficients from firm fixed effects regressions relating line of credit balances to a covenant violation in the previous year. The sample used for columns 1 and 2 includes only firms that have a line of credit. The sample used for columns 3 through 6 includes only firms that have a line of credit in the previous year. Regressions include year indicator variables, and standard errors are clustered at the firm level.

	Covenant violation$_t$ {0,1}		Total line $_t$/ assets $_{t-1}$	Unused line $_t$/ assets $_{t-1}$	[Total line/ (Total line+cash)] $_t$	[Unused line/ (Unused line+cash)] $_t$
	(1)	(2)	(3)	(4)	(5)	(6)
EBITDA$_t$/assets$_{t-1}$	-0.572**	-0.480**				
	(0.104)	(0.111)				
[Debt/assets]$_t$		0.593*				
		(0.245)				
[Net worth/assets]$_t$		-0.005				
		(0.241)				
Current ratio$_t$		-0.007				
		(0.010)				
Market to book ratio$_t$		-0.003				
		(0.008)				
Ln(total assets) $_t$		0.031				
		(0.029)				
Covenant violation $_{t-1}$ {0,1}			-0.042*	-0.036**	-0.070**	-0.122**
			(0.018)	(0.011)	(0.027)	(0.038)
EBITDA$_{t-1}$/assets$_{t-2}$			0.067	0.059	0.073	0.089
			(0.046)	(0.039)	(0.054)	(0.065)
[Debt/assets]$_{t-1}$			0.004	-0.013	0.385*	0.176
			(0.164)	(0.109)	(0.192)	(0.212)
[Net worth/assets]$_{t-1}$			0.010	0.013	0.264	0.157
			(0.141)	(0.095)	(0.168)	(0.173)
Current ratio$_{t-1}$			-0.001	0.002	-0.022**	-0.018*
			(0.004)	(0.004)	(0.008)	(0.008)
Market to book ratio$_{t-1}$			0.010*	0.002	-0.002	-0.010
			(0.005)	(0.004)	(0.005)	(0.006)
Ln(total assets) $_{t-1}$			-0.115**	-0.086**	0.010	-0.015
			(0.025)	(0.018)	(0.025)	(0.030)
Number of observations	1,426	1,385	1,173	1,173	1,173	1,173
Number of firms	254	248	245	245	245	245
R^2	0.21	0.24	0.61	0.57	0.73	0.64

**,* statistically distinct from 0 at the 1 and 5 percent level, respectively

Table 8
Correlation with Other Measures of Financial Constraints

This table presents correlations between various measures of financial constraints used in the literature. *Line of credit* takes on the value 1 if the firm (a) has access to a line of credit in every year of the sample, and (b) maintains cash flows above the median firm in every year of the sample. *Bond rating* and *commercial paper rating* take on the value 1 if the firm ever has an S&P corporate credit rating and commercial paper rating through the sample, respectively.

	Line of credit	Payout decile	Size decile	Bond rating
Payout ratio decile	0.09			
Size decile	0.20	0.45		
Bond rating	0.18	0.29	0.68	
CP rating	0.27	0.33	0.48	0.52

*Note: All correlations are statistically distinct from 0 at the 1 percent level.

Table 9
Availability of Bank Lines of Credit and the Cash Flow Sensitivity of Cash

This table presents coefficient estimates from regressions relating the change in cash holdings to cash flow. The estimation follows that of Almeida, Campello, and Weisbach (2004), which they describe in their equation (8) and Table III. Each reported coefficient is the effect of cash flow on cash holdings from a separate regression. All estimations include year and firm fixed effects. Standard errors are heteroskesticity-robust, clustered at the firm.

Dependent variable Δ Cash Holdings	(1)	(2)	(3)
1. Lines of credit			
Access to lines of credit	-0.063		
	(0.045)		
No access to lines of credit	0.083**,+		
	(0.010)		
		Splitting constrained firms by:	
		No access to lines of credit	Access to lines of credit
2. Payout ratio			
Highest 3 deciles	0.110**		
	(0.025)		
Lowest 3 deciles	0.088**	0.089**	-0.078
	(0.014)	(0.014)	(0.123)
3. Firm size (assets)			
Largest 5 deciles	-0.024		
	(0.027)		
Smallest 5 deciles	0.094**,+	0.094**	0.012
	(0.011)	(0.012)	(0.084)
4. Bond ratings			
Has a rating	0.004		
	(0.029)		
Does not have a rating	0.086**,+	0.088**	-0.042
	(0.011)	(0.011)	(0.064)
5. Commercial paper ratings			
Has a rating	-0.044		
	(0.046)		
Does not have a rating	0.081**,+	0.084**	-0.051
	(0.010)	(0.010)	(0.052)

**,* distinct from 0 at 1 and 5 percent, respectively; + distinct from unconstrained sample at 10 percent or better

Appendix Table 1
Maximum Likelihood for Tables 3 and 5

Maximum Likelihood Type:	Logit			Tobit	
Analogous regression in text:	Table 3, (1)	Table 3, (2)	Table 3, (3)	Table 5, (1)	Table 5, (3)
Dependent variable	Line of credit {0,1} Pooled	Line of credit {0,1} Fixed effects	Line of credit {0,1} Between effects	Total line/ (total line+cash) Pooled	Unused line/ (unused line+cash) Pooled
[EBITDA/(assets – cash)]$_{t-1}$	0.777**	0.575**	0.564**	0.266**	0.261**
	(0.083)	(0.117)	(0.052)	(0.038)	(0.039)
[Tangible assets/(assets – cash)]$_{t-1}$	0.122	1.134**	0.439**	0.048	0.022
	(0.154)	(0.263)	(0.104)	(0.046)	(0.047)
[Ln(assets – cash)]$_{t-1}$	0.337**	0.348**	0.302**	0.068**	0.071**
	(0.025)	(0.048)	(0.017)	(0.006)	(0.006)
[Net worth, cash adjusted]$_{t-1}$	-0.761**	-0.171	-0.362**	-0.049**	-0.043**
	(0.132)	(0.159)	(0.072)	(0.004)	(0.004)
[Market to book, cash adjusted]$_{t-1}$	-0.095**	0.031**	-0.014**	-0.112**	-0.041
	(0.008)	(0.010)	(0.005)	(0.043)	(0.044)
[Industry sales volatility]$_{t-1}$	6.172**	11.023**	7.390**	1.201**	1.316**
	(1.724)	(2.994)	(1.090)	(0.291)	(0.295)
[Cash flow volatility]$_{t-1}$	-0.064	-0.109	-0.226	-0.526**	-0.429**
	(0.270)	(0.365)	(0.162)	(0.115)	(0.118)
[Not in an S&P index {0,1}]	0.294**		0.089	0.085**	0.056*
	(0.103)		(0.092)	(0.024)	(0.024)
[Traded over the counter {0,1}]	-0.081		-0.059	0.058	-0.014
	(0.095)		(0.085)	(0.030)	(0.031)
Ln[Firm age (years since IPO)]$_{t-1}$	-0.018		-0.008	-0.044**	-0.028*
	(0.042)		(0.036)	(0.012)	(0.012)

**,* statistically distinct from 0 at the 1 and 5 percent level, respectively

Appendix Table 2
Maximum Likelihood for Table 7

Maximum Likelihood Type:	Logit	
Analogous regression in text:	Table 7, (1)	Table 7, (2)
Dependent variable	Violation {0,1} Fixed effects	Violation {0,1} Fixed effects
$EBITDA_t/assets_{t-1}$	-8.811**	-7.973**
	(1.503)	(1.735)
$[Debt/assets]_t$		6.058*
		(2.544)
$[Net\ worth/assets]_t$		-2.871
		(2.485)
$Current\ ratio_t$		-0.064
		(0.139)
$Market\ to\ book\ ratio_t$		-0.453
		(0.263)
$Ln(total\ assets)_t$		0.220
		(0.430)

**,* statistically distinct from 0 at the 1 and 5 percent level, respectively