Credit Lines as Monitored Liquidity Insurance: Theory and Evidence*

Viral Acharya
New York University
CEPR & NBER
vacharya@stern.nyu.edu

Heitor Almeida
University of Illinois
& NBER
halmeida@illinois.edu

Filippo Ippolito
Universitat Pompeu Fabra
& Barcelona GSE
filippo.ippolito@upf.edu

Ander Perez
Universitat Pompeu Fabra
& Barcelona GSE
ander.perez@upf.edu

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Abstract

We propose and test a theory of corporate liquidity management in which credit lines provided by banks to firms are a form of monitored liquidity insurance. Bank monitoring and resulting credit line revocations help control illiquidity-seeking behavior by firms. Firms with high liquidity risk are likely to use cash rather than credit lines for liquidity management because the cost of monitored liquidity insurance increases with liquidity risk. We exploit a quasi-experiment around the downgrade of General Motors (GM) and Ford in 2005 and find that firms that experienced an exogenous increase in liquidity risk due to the GM-Ford downgrade (specifically, firms that were rated and that relied on bonds for financing in the pre-downgrade period) moved out of credit lines and into cash holdings in the aftermath of the downgrade. We also find support for the model's other novel empirical implication that firms with low hedging needs (high correlation between cash flows and investment opportunities) are more likely to use credit lines relative to cash, and are also less likely to require covenants and revocations when using credit lines.

Key words: Liquidity management, cash holdings, liquidity risk, hedging, covenants, loan commitments, credit line revocation
JEL classification: G21, G31, G32, E22, E5.

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1 Introduction

There is a growing empirical literature on the role of credit lines in corporate finance (Sufi (2009), Yun (2009), Acharya, Almeida and Campello (2007), Lins, Servaes, and Tufano (2010), Campello, Giambona, Graham, and Harvey (2010), and Disatnik, Duchin, and Schmidt (2010)). This recent empirical literature takes advantage of the growing availability of data to test some of the implications of earlier theories of credit lines (e.g., Holmstrom and Tirole (1997, 1998) and Shockley and Thakor (1997)). Yet, there seems to be a disconnect between these earlier theories and recent empirical findings.

Theory suggests that the main difference between a credit line and standard debt is that a credit line allows the firm to access pre-committed debt capacity. This pre-commitment creates value for credit lines as a corporate liquidity management tool, in that it helps insulate the corporation from negative shocks that may hinder access to capital markets. In particular, credit lines can be an effective, and likely cheaper substitute for corporate cash holdings as a liquidity management tool. Nevertheless, the results in Sufi (2009) challenge the notion that credit lines have perfect commitment. Access to credit lines is often restricted precisely when the firm needs it most, that is, following negative profitability shocks that cause contractual covenant violations. In addition, the survey evidence in Lins, Servaes and Tufano (2010) suggests that CFOs do not always use credit lines as precautionary savings, but rather to finance future growth opportunities. Finally, the large literature on corporate cash holdings shows that cash is a very prevalent liquidity management tool, and does not appear to be universally dominated by credit lines (e.g., Opler, Pinkowitz, Stulz, and Williamson (1999), Almeida, Campello, and Weisbach (2004), Duchin (2010), and Campello et al. (2010)).

In this paper, we propose and test a theory of corporate liquidity management that bridges the gap between theory and empirical evidence on credit lines. There are two key insights underlying our theory.

First, a corporate credit line can be understood as a form of monitored liquidity insurance. A fully committed credit line (that is, full and irrevocable liquidity insurance) may not be optimal because it induces illiquidity-seeking behavior by firms once the credit line has been contracted. In presence of such potential firm behavior, modeling the revocability of credit lines helps understand why covenants are present in credit line contracts in the first place. Specifically, the role of covenants is to facilitate monitored liquidity insurance, where the need for bank monitoring of firms arises precisely due to the problem of illiquidity-seeking behavior by firms. Second, our model explicitly incorporates the possibility that firms may demand liquidity not only to withstand negative liquidity shocks, but also to help fund future growth opportunities.

In detail, bank monitoring arises as a solution to a tension that is natural in a liquidity insurance context. While liquidity insurance protects firms from value-destroying liquidity shocks, once such insurance is in place firms may gain incentives to engage in risky investments that increase the risk of liquidity shocks ("illiquidity transformation"). Bank-provided credit lines can help eliminate the incentive for illiquidity transformation, because the bank retains the right (through credit line covenants) to deny access to the credit line if it obtains a signal that the firm might have engaged in such transformation. Thus, bank monitoring and ensuing credit line revocation provides incentives for the firm to avoid illiquidity transformation.

However, credit lines do not always dominate cash holdings, despite the presence of a liquidity premium to be incurred while retaining cash. The cost of credit line-provided liquidity insurance arises from direct monitoring costs, and due to the equilibrium need to revoke credit lines of even those firms that face genuine liquidity shocks that do not arise from illiquidity transformation. In order to maintain the bank's incentives to monitor in equilibrium, the bank must be allowed to deny credit line access to a fraction of firms that face a liquidity shock, even if these firms did not engage in illiquidity transformation in the first place (otherwise the bank would not be willing to spend resources on monitoring). Such possibility of credit line revocation creates a cost of credit line-provided liquidity insurance. In equilibrium, firms may then choose to switch to cash holdings if the cost of credit lines is too high.

In particular, the model points out to an important determinant of the choice between cash and credit lines - the firm's total liquidity risk. Firms with greater liquidity risk must be monitored more often, causing direct and indirect monitoring costs (i.e., expected credit line revocation) to increase. Thus, firms with higher liquidity risk are particularly likely to forego monitored liquidity insurance and to switch to self-insurance (cash holdings).

In addition, we extend the model to allow firms to demand liquidity not only to survive liquidity shocks, but also to pursue additional investment opportunities. The financing of future investments interacts with liquidity shock insurance through two channels. First, the cost of credit line revocation increases because the firm also loses access to new opportunities upon revocation. Second, future growth opportunities may provide incentives for firms to avoid illiquidity transformation independently of monitoring. The first channel is particularly relevant for firms that tend to have investment opportunities in states with low cash flows (in which credit lines are likely to be revoked), while the second channel is particularly relevant for firms that tend to have investment opportunities in high cash flow states (whose probability decreases with illiquidity transformation). This set up generates two implications. First, firms with low hedging needs (high correlation between cash flows and investment opportunities) are less likely to use cash relative to credit lines. Second, firms with low hedging needs are less likely to require credit line covenants and revocation when using credit line for liquidity insurance.

Our model provides two sets of empirical predictions, one set dealing with the relationship between liquidity risk and liquidity management, and another set dealing with the relationship between hedging needs, liquidity management, and credit line covenants. Besides providing a theoretical foundation to existing empirical regularities, our empirical analysis extends the existing literature by considering the model's new implications and by introducing a new, large dataset that contains detailed information on credit lines. The credit line data come from Capital IQ (CIQ), and cover a large sample of firms for the period of 2002 to 2008. CIQ compiles detailed information on capital structure and debt structure by going through financial footnotes contained in firms' 10K Securities and Exchange Commission (SEC) filings. Most importantly for our purposes, firms provide detailed information on the drawn and undrawn portions of their lines of credit in the liquidity and capital resources section under the management discussion, or in the financial footnotes explaining debt obligations, and CIQ compiles these data.

We find evidence that supports the empirical implications of the model. Three pieces of our evidence are most striking.

First, consistent with existing empirical evidence that is based on alternative datasets (notably Sufi (2009)), the Capital IQ data suggest that profitable, safer, low Q and high tangibility firms are more likely to have credit lines and less likely to use cash for liquidity management. Also, credit line users tend to have higher bond ratings, and are more likely to have a rating to begin with when compared to firms that use cash for liquidity management. In addition, we show novel evidence that credit line drawdowns tend to occur following declines in profitability, suggesting that credit lines do provide liquidity insurance to firms. Still, we find that credit line drawdowns are relatively infrequent relative to cash reductions in situations in which firms are likely to have a liquidity need, which we define as a year in which profitability is negative.[1] This evidence suggests that credit line users have lower liquidity risk, when compared to firms that use cash for liquidity management.

Second, we present new empirical evidence that liquidity risk has a *causal* effect on firms' choice between cash and credit lines by exploiting a quasi-experiment: the downgrade of General Motors (GM) and Ford in 2005. Acharya, Schaefer and Zhang (2008) examine the

[1] In particular, the likelihood of a credit line drawdown to fund a liquidity shock (among credit line users) is close to 10 times lower than the likelihood of a reduction in cash holdings to fund a similar liquidity shock among cash users.

GM-Ford downgrade in detail, and show that it led to a market-wide sell-off of the corporate bonds issued by these two firms. The downgrade had a significant impact on inventory risk faced by financial intermediaries that operated as market makers for the securities issued by the two automakers. The effect of the downgrade went beyond the bond markets of GM and Ford and of other producers in the auto sector.

The downgrade of GM and Ford offers an opportunity to strengthen identification of the link between liquidity risk and cash versus credit lines usage, because the downgrade generated a widespread increase in liquidity risk which affected a subset of firms particularly strongly, those for which publicly-traded bonds constitute an important source of financing. Also, the downgrade of GM-Ford came as an exogenous and unexpected shock, especially for firms not in the auto sector. Consistent with model's predictions, we find that "treated" firms that experienced an exogenous increase in liquidity risk due to the GM-Ford downgrade – specifically, firms that were rated and that relied on bonds for financing in the pre-downgrade period – moved out of credit lines and into cash holdings in the aftermath of the downgrade, relative to the set of "control" firms. A placebo test in a period outside of the downgrade episode reveals no such difference. Further, we find that consistent with the theoretical channel in our model, both cash increases and credit line usage decreases for the "treated" firms.

Third, we provide novel evidence linking corporate hedging needs to liquidity management and credit line contracting. Following existing literature (Acharya, Almeida and Campello (2007) and Duchin (2010)), we measure hedging needs by correlating firm cash flows with investment opportunities. We measure investment opportunities using two alternative industry-level proxies, median industry annual investment activities and median industry Tobin's Q. In addition we collect information from LPC Dealscan on covenants attached to new credit lines issued to the firms in our sample and from Nini, Smith and Sufi (2010) on covenant violations.

In line with the predictions of our model, we find that low-hedging needs firms (those with the highest correlations between cash flows and investment opportunities) are the most likely to use credit lines. Depending on the measure chosen, the low hedging-needs firms are between 8% and 26% more likely to have a line of credit than high hedging-needs firms. The credit lines of low hedging-needs firms are also less likely to contain covenants, and these covenants are less likely to be violated. These findings support the model's implications that credit lines are less costly for low-hedging needs firms, and that the credit line provider (the bank) is less likely to retain revocation rights through covenants.

Overall, the evidence suggests that cross-sectional variation in liquidity risk and hedging needs have an important role to play in explaining the corporate demand for credit lines and corporate liquidity management. Our results help bridge the gap between theory and existing empirical work on corporate credit lines, and contain new findings that link credit line usage and contracting features (such as the usage of covenants, their ex-post violation, and revocation of credit lines) to the specific type of liquidity management that is important for corporations (precautionary savings to manage liquidity risk or the financing of future growth opportunities).

We start in the next section by introducing the benchmark model in which credit line revocation works as an incentive device for the firm to pre-commit to a liquid investment choice. The basic model (Section 2.1) assumes that firms demand liquidity for bad states of the world, to survive liquidity shocks. In Section 2.3 we extend the model to consider the financing of future investment opportunities, and how this interacts with liquidity insurance provision. Section 3 summarizes the empirical implications of the model. Section 4 introduces and presents our empirical analysis, and Section 5 concludes the paper.

2 The model

Our model introduces two innovations to the standard liquidity management model of Holmstrom and Tirole (1998). First, we allow the firm to engage in illiquidity-seeking behavior after acquiring insurance against liquidity shocks, to explore the role of credit line revocation as a monitoring mechanism. Second, we introduce a future investment opportunity whose financing must be planned for. The correlation between the probability of arrival of this investment opportunity and short-term cash flow varies across firms. This innovation allows us to characterize the impact of hedging needs on the firm's liquidity policy.

2.1 Basic structure

The timing of the model is depicted in Figure 1. At the initial date (date 0), each firm has access to an investment project that requires fixed investment I at date 0 and an additional investment at date 1, of uncertain size (the firm's liquidity need). The date-1 liquidity need can be either equal to ρ, with probability $\widehat{\lambda}$, or 0, with probability $(1-\widehat{\lambda})$. We can interpret state $\widehat{\lambda}$ $(1-\widehat{\lambda})$ as a state in which the firm produces low (high) cash flow at date-1.[2]

FIGURE 1 ABOUT HERE

[2] To see this, let the date-0 investment produce a date-1 cash flow equal to $\widetilde{r}$, which is random. The cash flow $\widetilde{r}$ can be either equal to r, with probability $(1-\widehat{\lambda})$, or 0, with probability $\widehat{\lambda}$. The required date-1 investment is equal to I_1. If we let $r = I_1$, we obtain the set up above with $\rho = I_1$.

In state $\widehat{\lambda}$, a firm will only continue its date-0 investment until date 2 if it can meet its date-1 liquidity need. Otherwise the firm is liquidated and the project produces nothing. If the firm continues, it produces total expected date-2 cash flow equal to $\widehat{\rho_1}$ from the original project. As in Holmstrom and Tirole (1998), the basic friction in this model is that some of this expected cash flow is not pledgeable to outside investors. In short, we assume that conditional on continuation, the original project produces pledgeable income equal to $\widehat{\rho_0} < \widehat{\rho_1}$. In the appendix we describe a basic moral hazard structure (identical to that in Holmstrom and Tirole) that generates limited pledgeability.

If the firm continues, it also has access at date-1 to an additional investment opportunity that arrives with probability υ. This date-1 investment requires an investment of τ and produces a date-2 cash flow of ρ^{τ}. For simplicity, we assume that this date-2 cash flow generates zero pledgeable income (this assumption can be easily relaxed). The probability of arrival of the new investment opportunity depends on the date-1 state. It is equal to $\upsilon = \upsilon^H$ in state $(1-\widehat{\lambda})$, and $\upsilon = \upsilon^L$ in state $\widehat{\lambda}$. This set up allows us to characterize a firm's hedging needs. A firm has low hedging needs if υ^H is high and υ^L is low (investment opportunities tend to arrive in high cash flow states).

The probability $\widehat{\lambda}$ is endogenous. Specifically, $\widehat{\lambda}$ is either equal to λ, or equal to $\lambda^{'} > \lambda$. The manager chooses the probability $\widehat{\lambda}$ after the initial investment has been made. The choice of probability is unobservable to outside parties at date-1, who can only observe whether or not the firm has a liquidity need at date-1 (that is, ρ is observable). There is no discounting.

2.2 Credit line revocation as a monitoring mechanism

In this section, we show how credit line revocation by banks can be modeled as an optimal monitoring mechanism when the firm may engage in illiquidity-seeking behavior after acquiring insurance through a credit line against its liquidity risk. In order to do so, we assume that firms have no additional investment opportunity at date 1 and focus on the usage of credit lines to manage the date-1 liquidity shock. That is, we assume for now that $\upsilon = 0$.

2.2.1 Illiquidity transformation and bank monitoring

Since there is no additional investment opportunity at date-1, the only role of liquidity management is to ensure that the firm can fund its liquidity need at date-1. In order to generate a role for liquidity management we assume that:

$$\widehat{\rho_0} < \rho < \widehat{\rho_1}. \tag{1}$$

Since $\widehat{\rho_0} < \rho$, the firm does not generate enough pledgeable income in the bad state of the world to fund the liquidity shock, though continuation is positive NPV ($\rho < \widehat{\rho_1}$).

The manager's choice of $\widehat{\lambda}$ impacts the project's cash flows and pledgeable income in the following way. If the manager chooses $\widehat{\lambda} = \lambda^{'}$, the date-2 cash flow $\widehat{\rho_1}$ is equal to $\rho_1^{'}$. If the manager chooses $\widehat{\lambda} = \lambda < \lambda^{'}$, the date-2 cash flow is $\rho_1 < \rho_1^{'}$. This structure allows us to interpret the choice of $\widehat{\lambda} = \lambda^{'}$ as the "illiquidity transformation" by the manager, since it results in a high date-2 cash flow conditional on continuation, but also on a greater probability of a liquidity shock at date-1. We make the following additional assumptions:

$$(1-\lambda)\rho_1 < I < \rho_1 - \lambda\rho, \tag{2}$$

$$(1-\lambda')\rho_1^{'} < I < \rho_1^{'} - \lambda^{'}\rho, \tag{3}$$

$$\rho_0 = \rho_0^{'}, \text{ and} \tag{4}$$

$$\rho_0 - \lambda^{'}\rho > I. \tag{5}$$

The first and second assumptions mean that both the illiquid and the liquid projects have positive NPV, but only if the firm can continue the projects with positive probability in the liquidity state at date 1. The third assumption is made for simplicity and to economize on notation. It says that both the liquid and the illiquid project produce the same ex-post pledgeable income ρ_0.[3] Recall that since the liquid project requires a liquidity infusion with lower probability, *ex-ante* pledgeable income is larger for the liquid project. The fourth assumption then means that even the illiquid project generates enough pledgeable income to fund the initial investment (and thus the illiquid project is also feasible).

The firm can manage its liquidity either using a bank credit line or cash holdings. As in Holmstrom and Tirole (1998), the firm holds cash by buying a riskless security (such as a Treasury bond) at date-0. The price of the bond is equal to q, which we take as exogenous and assume to be greater than one. Thus, to transfer cash across time the firm must pay a given liquidity premium, which is equal to $q - 1 > 0$. The credit line works similarly to an insurance contract. The firm pays a commitment fee y to the bank in the states in which it does not need additional liquidity (state $1-\widehat{\lambda}$) in exchange for the right to draw on additional funds (up to a maximum equal to w) in state $\widehat{\lambda}$.

[3] In the moral hazard framework of the appendix, this condition is a consequence of the assumption that illquidity transformation increases both the project's verifiable cash flow and private benefit in a way that leaves pledgeble income constant. Please refer to the appendix.

In order to understand the role for credit line revocation as a monitoring mechanism, consider a specific case in which the firm would ideally like to choose the liquid investment (that is, $\rho_1 - \lambda\rho > \rho_1^{'} - \lambda^{'}\rho$). And suppose that the firm opened a credit line with the bank to achieve this goal. The problem that the firm faces in this case is that, once it has written the initial contract to fund the investment and insure liquidity, the firm will generally have incentives to shift the funds into the illiquid investment ("illiquidity transformation") because the illiquid project produces higher payoff conditional on success, $\rho_1^{'} > \rho_1$. Because the firm is fully insured against the liquidity shock, this gain in expected payoff comes at the expense of the bank.

Thus, to avoid illiquidity transformation the firm may need a commitment device. This creates a role for *monitored* liquidity insurance. We assume that the monitor (the bank) can pay a cost c at date-1 to receive a signal s that gives information about the probability chosen by the manager. Specifically we have that:

$$\begin{aligned} \text{Prob}(s &= s^{'}/\widehat{\lambda} = \lambda) = \mu < 1 \\ \text{Prob}(s &= s^{'}/\widehat{\lambda} = \lambda^{'}) = 1. \end{aligned} \tag{6}$$

That is, if the firm chooses $\widehat{\lambda} = \lambda^{'}$, bank monitoring will reveal that the firm made the wrong choice. But the bank receives an imperfect signal in case the firm makes the correct choice.

This signal s is verifiable, so the bank can write contracts that are contingent on s. In particular, the bank can deny additional funding at date-1 if it observes a signal $s = s^{'}$, but still provide it if does not observe $s = s^{'}$. This suggests the following strategy. Conditional on the firm reporting a liquidity shock ρ, the bank can monitor to verify that the firm made the correct choice of λ.[4] If the bank draws a signal $s = s^{'}$, then it will be optimal for the bank to deny additional funding since the firm's pledgeable income is $\rho_0 < \rho$. If the bank does not monitor or if it does not draw a negative signal $s = s^{'}$, then it provides funding for the liquidity shock ρ (this commitment can be guaranteed by a contract that binds the bank to finance the date-1 investment unless it obtains the negative signal $s = s^{'}$). Figure 2 depicts the decision tree for the bank, assuming that the firm has chosen $\widehat{\lambda} = \lambda$.

FIGURE 2 ABOUT HERE

In order to make sure that both the bank and the firm have the correct incentives under the monitored credit line we make the following assumptions:

$$\mu(\rho - \rho_0) > c, \tag{7}$$

[4]It does not make sense for the bank to monitor in the good state $(1 - \lambda)$ since in that case the project produces a positive conditional payoff for both the firm and the bank.

and

$$[1-\lambda+\lambda(1-\mu)]\,(\rho_1-\rho_0) > (1-\lambda^{'})(\rho_1^{'}-\rho_0)\ . \tag{8}$$

We can now state our first result in the following proposition, which we prove in the Appendix:

Proposition 1 *Given assumptions 1 to 8, the firm can implement the liquid investment ($\widehat{\lambda}=\lambda$) by opening a monitored credit line of size $\rho-\rho_0$ and commitment fee equal to $y=\lambda\frac{(1-\mu)(\rho-\rho_0)+c}{(1-\lambda)}$ with the bank. In addition, the firm raises enough external financing at date-0 to fund the initial investment I. The bank can revoke access to the credit line at date-1 if it monitors the firm (at a cost c) and obtains a signal $s=s^{'}$. The firm's payoff under the monitored credit line is $U^{LC}=\rho_1-\lambda\rho-I-\lambda\,[c+\mu(\rho_1-\rho)]$.*

The proof is in the appendix. Notice that in the absence of credit line revocation, the firm's payoff under the illiquid project after the initial contract is sunk would be $(\rho_1^{'}-\rho_0)$ which is greater than the payoff under the liquid investment $(\rho_1-\rho_0)$. Thus, revocation is essential to induce the choice of the liquid investment.[5] Given assumption 7, the bank has incentives to monitor in equilibrium. In words, it is incentive compatible for the bank to monitor even when the bank anticipates that the firm has made the correct choice and picked $\widehat{\lambda}=\lambda$. Incentive compatibility is preserved because of the "negative NPV" feature of the date-1 loan. In other words, the bank loses money when the firm draws on the credit line. Thus, the optimal contract can rely on the bank's incentives to deny access to liquidity insurance (the credit line) in order to induce good behavior by the firm. Given that the firm expects monitoring, condition 8 ensures that firm has incentives to make the correct choice of $\widehat{\lambda}$. Figure 3 depicts the firm's choice of $\widehat{\lambda}$, given the bank's monitoring strategy:

FIGURE 3 ABOUT HERE

The firm's payoff under the monitored credit line is then:

$$U^{LC}=\rho_1-\lambda\rho-I-\lambda\,[c+\mu(\rho_1-\rho)]\,. \tag{9}$$

The term $\lambda\,[c+\mu(\rho_1-\rho)]$ captures the effect of monitoring on the firm's payoff. The direct monitoring costs reduce the firm's ex-ante payoff. In addition, the firm is liquidated in state $\lambda\mu$ resulting in a loss of value $(\rho_1-\rho)$. As it is clear from this expression, the loss in value created by monitoring increases with the probability of the liquidity shock λ. U^{LC}

[5] In particular, this result implies that the firm cannot use cash to implement liquidity management for the liquid project choice.

is the firm's maximum possible payoff if it chooses to manage its liquidity using a monitored credit line. Given the analysis above, the only possible alternative for the firm is to pick the illiquid investment instead. In that case, we have the following result:

Proposition 2 *If the cost of holding cash is not too large, that is, if $\rho_0 - \lambda^{'}\rho - I > (q-1)(\rho - \rho_0)$, the firm can implement the illiquid investment ($\widehat{\lambda} = \lambda^{'}$) by holding an amount of cash equal to $(\rho - \rho_0)$. The firm raises enough external financing at date-0 to fund the initial investment I and the cash balance, and continues the project at date 1 with probability equal to 1. The firm's payoff under cash management is $U^C = \rho_1^{'} - \lambda^{'}\rho - I - (q-1)(\rho - \rho_0)$.*

The proof is in the appendix. While cash is not a good option to implement the liquid project choice, it allows the firm to implement the illiquid one if pledgeable income is high enough (the condition that $\rho_0 - \lambda^{'}\rho - I > (q-1)(\rho - \rho_0)$). In particular, cash is a better alternative for the firm in this case than a *non-monitored* credit line despite the liquidity premium. The problem with the credit line alternative in this case is that monitoring is conditionally efficient for the bank ($\mu(\rho - \rho_0) > c$). Thus, the bank will always have incentives to monitor when the firm reports a liquidity shock. Thus, unless the bank can perfectly commit not to monitor, the firm risks being liquidated with probability one in state $\lambda^{'}$. By condition 3, it is then not worth investing in the project. Thus, the firm pays the liquidity premium as a way of self-insuring against a liquidity shock that happens with high probability at date 1.

The next result follows from Propositions 1 and 2:[6]

Corollary 1 *The firm chooses the monitored credit line when $U^{LC} > \max(0, U^C)$ and it chooses cash holdings when $U^C > \max(0, U^{LC})$. If $\max(U^{LC}, U^C) < 0$, the project never starts.*

This corollary suggests that cash-based liquidity management will tend to be associated with illiquid projects that require frequent liquidity infusions. Firms that endogenously choose to invest in projects with high liquidity risk will find it optimal to self-insure against such shocks, while firms that choose to invest in projects with low liquidity risk manage liquidity through a monitored credit line to ensure that they do not engage in illiquidity transformation after the bank has provided liquidity insurance. In this sense, the model generates an equilibrium relationship between liquidity risk and liquidity management - firms with high liquidity risk manage liquidity through cash holdings. We next show that the link between liquidity

[6] Notice that we cannot guarantee that U^{LC} and U^C will be positive, net of the costs of liquidity management. If they are negative then the project does not start, since by assumptions 2 and 3 the projects have negative NPV unless they can be continued with positive probability in the liquidity state in date 1.

risk and liquidity management extends to a case in which firms are ex-ante heterogeneous with respect to liquidity risk.

2.2.2 Introducing heterogeneity in liquidity risk

Suppose that there are now two types of firms that we call L and H. Firm L has lower liquidity risk than firm H irrespective of project choice, that is, $\widehat{\lambda}_L < \widehat{\lambda}_H$ (which is equivalent to saying that $\lambda_L < \lambda_H$ and $\lambda_L^{'} < \lambda_H^{'}$). This difference in liquidity risk can be interpreted as arising from firm characteristics such as the risk of the underlying business and the correlation between cash flows and investment needs. Specifically we make the following assumption:

$$\lambda_j^{'} = \lambda_j + t, \text{ for } j = L, H \ . \tag{10}$$

This assumption means that the effect of illiquidity transformation on the probability of the liquidity shock is the same for both types of firm. As we show below, this assumption is sufficient but not necessary for our results - all that is needed is that the potential increase in illiquidity risk is not much larger for firms of type H.

Given this assumption, the following result (which is proved in the appendix) follows from the analysis in the previous section:

Proposition 3 *Firms with low liquidity risk (type L) are more likely to choose credit lines for liquidity management, while firms with high liquidity risk (type H) are more likely to choose cash.*

The intuition for this result is straightforward. As the probability of the liquidity shock increases, monitoring becomes increasingly expensive due to the direct monitoring cost and the necessary revocation of credit line access (which provides incentives for the firm to not engage in illiquidity transformation). Thus, firms with high liquidity risk prefer to avoid monitored liquidity insurance and use cash for liquidity management.

2.2.3 Variable date-0 investment

The model above assumes a fixed investment level I. We will now show that allowing firms to also choose the level of the date-0 investment gives rise to additional empirical implications.

In order to do so, we assume that firms can choose an investment level $I \in (0, \infty)$ at date 0. The project produces cash flows that are proportional to the level of investment, such that the project's pledgeable income is $\widehat{\rho}_0 I$, and the expected payoff is $\widehat{\rho}_1 I$. The date-1 liquidity shock is also a multiple of the date-0 investment level, $\widehat{\rho} I$. The structure of the model is very similar to that above, with the following changes. Firms are now endowed with initial wealth A (as we will see investment is a multiple of initial wealth). We maintain assumptions 1, 4, 6, 7 and 8. In addition, we make the following assumptions:

$$\rho_1 - \lambda\rho - 1 - \lambda\left[c + \mu(\rho_1 - \rho)\right] > 0 \ , \tag{11}$$

$$\rho_1^{'} - \lambda^{'}\rho - 1 - (q-1)(\rho - \rho_0) > 0 \ , \text{and} \tag{12}$$

$$1 - \rho_0 + \lambda\rho + \lambda\left[c - \mu(\rho - \rho_0)\right] > 0 \ . \tag{13}$$

Assumptions 11 and 12 mean that both the liquid and the illiquid investment have positive NPV per unit of investment, net of monitoring costs (in the case of the liquid investment) and the liquidity premium (the illiquid investment). Assumption 13 will assure that investment levels are finite, as we will see. It basically says that the pledgeable income per unit of liquid investment is lower than one. Since the pledgeable income of the illiquid investment is lower than that of the liquid one, this assures that both investment levels remain finite.[7]

Given these assumptions, the following proposition considers the implementation of the liquid project in this version of the model:

Proposition 4 *The firm can implement the liquid investment ($\widehat{\lambda} = \lambda$) by opening a monitored credit line of size ρI^{LC} and commitment fee equal to $y = \lambda\frac{(1-\mu)(\rho-\rho_0)+c}{(1-\lambda)}I^{LC}$ with the bank. The date-0 investment level is $I^{LC} = \frac{1}{1-\rho_0+\lambda\rho+\lambda[c-\mu(\rho-\rho_0)]}A$, and the payoff $U^{LC} = \left[\rho_1 - \lambda\rho - 1 - \lambda\left(c + \mu(\rho_1 - \rho)\right)\right] I^{LC}$. The firm raises external financing at date-0 to fund the initial investment I^{LC}. The bank can revoke access to the credit line at date-1 if it monitors the firm (at a cost c) and obtains a signal $s = s^{'}$.*

The proof (in the Appendix) is virtually identical to that for Proposition 1. Next, the following proposition considers implementation of the illiquid project:

Proposition 5 *The firm can implement the illiquid investment ($\widehat{\lambda} = \lambda^{'}$) by holding an amount of cash equal to $(\rho - \rho_0)I^C$. The date-0 investment level is $I^C = \frac{1}{1-\rho_0+\lambda^{'}\rho+(q-1)(\rho-\rho_0)}A$. The firm raises enough external financing at date-0 to fund the initial investment I and the cash balance, and continues the project at date 1 with probability equal to 1. The firm's payoff under cash management is $U^C = \left[\rho_1^{'} - \lambda^{'}\rho - 1 - (q-1)(\rho - \rho_0)\right] I^C$.*

[7] To see this, notice that:

$$1 - \rho_0 + \lambda\rho + \lambda\left[c - \mu(\rho - \rho_0)\right] < 1 - \rho_0 + \lambda\rho < 1 - \rho_0 + \lambda^{'}\rho < 1 - \rho_0 + \lambda^{'}\rho + (q-1)(\rho - \rho_0), \tag{14}$$

so that the pledgeable income per unit of illiquid investment $(1 - \rho_0 + \lambda^{'}\rho + (q-1)(\rho - \rho_0))$ is also lower than one. The first inequality holds because of assumption 7 (so that bank monitoring is time consistent).

The proof is identical to that for Proposition 2. Notice that assumption 13 together with the inequalities in 14 assure that I^C is finite. Given assumption 12, $U^C > 0$. Then, the next result follows from Propositions 4 and 5:

Corollary 2 *The firm chooses the monitored credit line when $U^{LC} > U^C$, and it chooses cash holdings when $U^C > U^{LC}$.*

While the structure of the variable investment model is very similar to that of the fixed investment version, it gives rise to additional implications. These implications follow from the fact that pledgeable income per unit of investment is larger for the liquid investment (the inequality in 14). This inequality, coupled with Corollary 2, gives rise to the following results:

1. The level of investment is larger when the firm chooses the monitored credit line, that is, $I^{LC} > I^C$

2. If the illiquid investment is chosen by the firm, its payoff per unit of investment must be larger than that of the liquid investment, that is, $\frac{U^C}{I^C} > \frac{U^{LC}}{I^{LC}}$.

Result 1 follows directly from inequality 14, and the expressions for investment I^C and I^{LC}. Result 2 follows from corollary 2 and result 1. Given that $I^C < I^{LC}$, the firm will only choose the illiquid investment if its payoff per unit is higher than that of the liquid investment, that is, $\frac{U^C}{I^C} > \frac{U^{LC}}{I^{LC}}$.

In other words, the choice between the liquid and the illiquid projects is equivalent to a choice between pledgeability and productivity. The liquid project has greater pledgeability, and allows the firm to increase investment levels. Thus, the illiquid project will only be chosen in equilibrium when its payoff per unit of investment (or the productivity of investment) is larger than that of the liquid project.

2.3 Liquidity management and hedging needs

We now reintroduce the date-1 investment opportunity into the model, to analyze the link between hedging needs and liquidity management.

2.3.1 Basic framework

As explained above, we assume that the probability of the arrival of the investment opportunity in the high cash flow state $(1 - \widehat{\lambda})$ is equal to $\upsilon = \upsilon^H$ in state $(1 - \widehat{\lambda})$, and $\upsilon = \upsilon^L$ in state $\widehat{\lambda}$ (see Figure 1). To economize on notation denote the following quantities:

$$\begin{aligned} (1-\lambda)\upsilon^H + \lambda \upsilon^L &\equiv \overline{\upsilon} \\ (1-\lambda^{'})\upsilon^H + \lambda^{'} \upsilon^L &\equiv \overline{\upsilon}^{'} \end{aligned} \tag{15}$$

We return to the simpler case of fixed investment size (Section 2.2.1) and maintain its basic assumptions (Equations 1, 2, 3, 4, 6, 7 and 8). In addition, we make the following assumptions:

$$\rho^{\tau} > \tau > \rho_0. \tag{16}$$

$$I + \lambda\rho + \overline{\upsilon}\tau \leq \rho_0. \tag{17}$$

$$(1-\lambda')(\rho_1^{'} + \upsilon^H (\rho^{\tau} - \tau)) < I \tag{18}$$

The first condition means that the new growth opportunity is positive NPV but that the firm cannot fund it solely by resorting to the pledgeable income of the original project. The second condition means that the firm has enough pledgeable income to fund both the initial investment (cost $I + \lambda\rho$) and the new opportunity, at expected cost $\overline{\upsilon}\tau$. The third condition states that the total NPV of the firm's investments is negative if the firm is liquidated in the low cash flow state, for illiquid investment choice.

Notice that in this version of the model the firms must finance both the liquidity shock ρ, and the new growth opportunity τ. The key aspect to analyze is how the presence of the growth opportunity changes the firm's incentive to engage in illiquidity transformation of the original project. In order to characterize this, assume that the firm has access to perfectly committed liquidity insurance. Assume for now that all feasibility conditions are obeyed. Under the liquid choice the firm's payoff (post initial contracting) is:

$$U_b = \rho_1 - \rho_0 + \overline{\upsilon}\rho^{\tau}. \tag{19}$$

Recall that the payoff of the new investment opportunity is not pledgeable by assumption. If the firm deviates the investment into the illiquid project, the payoff is:

$$U_b^{'} = \rho_1^{'} - \rho_0 + \overline{\upsilon}^{'}\rho^{\tau}. \tag{20}$$

Perfectly committed liquidity insurance is feasible if $U_b > U_b^{'}$, which is equivalent to:

$$\rho_1^{'} - \rho_1 \leq (\upsilon^H - \upsilon^L)(\lambda^{'} - \lambda)\rho^{\tau}. \tag{21}$$

Intuitively, illiquidity transformation is less desirable when $\upsilon^H > \upsilon^L$, because it reduces the likelihood that the firm can take advantage of the investment opportunity in the high cash flow state. If this condition holds, then monitoring is not required and the firm can manage its liquidity using a fully committed credit line (which dominates cash in this case because the liquidity premium is positive).

On the other hand, if this condition does not hold, then monitoring is required for the firm to be able to implement the liquid project choice. The next proposition characterizes the payoffs if condition 21 is not obeyed.

Proposition 6 *If condition 21 does not hold, and under assumptions 16, 17 and 18, the firm can always implement the liquid project with a monitored credit line of size $\rho + \tau - \rho_0$. The associated payoff is $U_\tau^{LC} = \rho_1 - \lambda\rho - I + \overline{\upsilon}(\rho^\tau - \tau) - \lambda\left[c + \mu\left[\rho_1 - \rho + \upsilon^L(\rho^\tau - \tau)\right]\right]$. If the cost of holding cash is not too high, such that $(q-1)(\rho+\tau-\rho_0) < \rho_0 - \lambda^{'}\rho - I - \overline{\upsilon}^{'}\tau$, then the firm can implement the illiquid project by holding an amount of cash equal to $C = \rho + \tau - \rho_0$. The associated payoff is $U_\tau^C = \rho_1^{'} - \lambda^{'}\rho - I + \overline{\upsilon}^{'}(\rho^\tau - \tau) - (q-1)(\rho + \tau - \rho_0)$.*

As for the other results, the detailed proof is in the appendix. As in the basic model, the firm chooses the credit line (cash) when U_τ^{LC} is greater (lower) than U_τ^C. The difference between U_τ^{LC} and U_τ^C is given by:

$$\begin{aligned} U_\tau^C - U_\tau^{LC} &= \rho_1^{'} - \rho_1 - (\lambda^{'} - \lambda)\rho + \lambda\left[c + \mu\left[\rho_1 - \rho + \upsilon^L(\rho^\tau - \tau)\right]\right] - \\ &\quad -(q-1)(\rho + \tau - \rho_0) + (\overline{\upsilon}^{'} - \overline{\upsilon})(\rho^\tau - \tau) \end{aligned} \tag{22}$$

2.3.2 Introducing heterogeneity in hedging needs

We now allow firms to vary with respect to their correlation between date-1 cash flows and the investment opportunity τ. Specifically, we compare two types of firms. A firm with low hedging needs (LHN) has $\upsilon^H > \upsilon^L$, and consequently $\overline{\upsilon}^{'} - \overline{\upsilon} < 0$ (notice that $\overline{\upsilon}^{'} - \overline{\upsilon} = -(\upsilon^H - \upsilon^L)(\lambda^{'} - \lambda)$). This firm has a greater probability of having the investment opportunity τ in the high cash flow state $(1 - \widehat{\lambda})$. A firm with high hedging needs (HHN) has $\upsilon^H = \upsilon^L \equiv \upsilon$, or the same probability of the investment opportunity in both states. We let $\upsilon = \overline{\upsilon} > \upsilon^L$, so that the expected arrival of the investment opportunity is identical for the two types of firms. This set up also implies that $\overline{\upsilon}^{'} = \overline{\upsilon}$ for the high hedging-needs firm. We now state our main results about hedging needs:

Proposition 7 *The firm with low hedging needs is more likely to use credit lines for liquidity management, when compared to the firm with high hedging needs. That is, $(U_\tau^C - U_\tau^{LC})_{HHN} >$*

$(U_\tau^C - U_\tau^{LC})_{LHN}$. *Thus, if* $(U_\tau^C - U_\tau^{LC})_{HHN}$ *is lower than zero, then* $(U_\tau^C - U_\tau^{LC})_{LHN}$ *must be lower than zero.*

The proof is in the appendix. There are two effects that differentiate low and high hedging-needs firms. First, the firm with high hedging needs faces a greater cost of using the monitored credit line because its investment opportunities tend to be concentrated in states with low cash flow (in which the credit line is likely to be revoked). This effect is captured by the term $\lambda\left[c + \mu\left[\rho_1 - \rho + \upsilon^L(\rho^\tau - \tau)\right]\right]$ in Equation 22 which picks up the cost of the monitored credit line. In state λ, the firm loses access to the investment opportunity with probability $\mu\upsilon^L$ which is increasing in υ^L. Since υ^L is greater for the firm with high hedging needs, it is more likely to switch to cash holdings when compared to the low hedging-needs firm. Second, the firm with low hedging needs has a greater incentive to avoid the low cash flow state because its investment opportunities are positively correlated with cash flows. In Equation 22, the term $(\overline{\upsilon}' - \overline{\upsilon})(\rho^\tau - \tau)$ is negative for a firm with low hedging needs. In contrast, this term is zero for a firm with high hedging needs (its investments are uncorrelated with cash flows). This effect increases the benefit of the liquid investment and the monitored credit line for the firm with low hedging needs.

The second result has to do with the contractual structure of credit lines:

Proposition 8 *Suppose that* $(U_\tau^C - U_\tau^{LC})_{HHN} < 0$*, so that the firm with high hedging needs finds it optimal to use credit lines. The credit line for the firm with high hedging needs cannot be perfectly committed. In contrast, the firm with low hedging needs (which also chooses credit lines according to Proposition 7) can have a perfectly committed credit line when condition 21 holds.*

For the firm with high hedging needs, condition 21 cannot hold because $\upsilon^H = \upsilon^L$. In contrast, the firm with low hedging needs may not require the threat of credit line revocation in order to invest in the liquid project if condition 21 holds. This result arises from the incentive effect mentioned above, the firm with low hedging needs has a greater incentive to avoid the low cash flow state because its investment opportunities are positively correlated with cash flows.

2.3.3 Discussion

As discussed above, the impact of hedging needs on liquidity policy arises from two distinct effects. First, the firm with high hedging needs faces a greater cost of using monitored liquidity insurance, because its investment opportunities tend to be concentrated in the same states in which the credit line is likely to be revoked. Second, the firm with low hedging needs has increased incentives to avoid illiquidity transformation (which increases the probability that the original project has low short-term cash flow), because its investment opportunities tend to arrive in states with high cash flows (an incentive effect).

However, there is a potential countervailing effect that may impact the incentive effect. In the model above, illiquidity transformation increases the (long-term) payoff of the original investment but has no effect on the expected payoff of the new investment opportunities. However, it is reasonable to expect that illiquidity transformation may also increase the expected payoff of the new investment opportunity. One way to capture this effect in the model above is to allow the probability of arrival of the new investment opportunity (υ^H) to increase in state $(1-\lambda')$, the state in which illiquidity transformation is successful (see Figure 1). Let this probability be equal to $\upsilon'^H > \upsilon^H$. In that case, condition 21 becomes:

$$\rho_1^{'} - \rho_1 \leq \left[(\upsilon^H - \upsilon^L)(\lambda^{'} - \lambda) - (1-\lambda^{'})(\upsilon'^H - \upsilon^H) \right] \rho^\tau \tag{23}$$

The bottomline is that this additional effect makes it less likely that condition 21 holds, by increasing the incentive to engage illiquidity transformation. Thus, the result on Proposition 8 is less likely to hold: firms with low hedging needs are more likely to require credit line covenants in this case.

Nevertheless, notice that the result on Proposition 7 is robust to this model change because it also relies on a distinct effect: the greater monitoring cost for the high hedging-needs firm that arises from the fact that its investment opportunities are concentrated in high cash flow states.

3 Empirical implications

Our model provides two sets of empirical predictions, one set dealing with the relationship between liquidity risk and lines of credit, and another set dealing with the relationship between hedging needs, lines of credit, and covenants.

The first set of empirical predictions focuses on the role of revocations of lines of credit as a monitoring mechanism to prevent illiquidity transformation by firms, and the implications of this monitoring mechanism for optimal liquidity management. These predictions derive from the model in section 2.2 which stresses the liquidity insurance role of credit lines. In particular, our model yields the following predictions about the characteristics of the monitoring mechanism:

1. *Credit line contracts contain covenants contingent on firm profitability, and access to credit lines is sometimes restricted when firm profitability decreases.*

In the model, this pattern is part of an optimal liquidity management policy that discourages credit line users from engaging in illiquidity transformation. Importantly, this feature of credit line contracts is not incompatible with credit lines' role as liquidity insurance. If revocation does not occur, a firm facing a liquidity shock may draw down on the credit line to meet the shortage of liquidity. As a result the model also makes the following prediction which simultaneously helps establish credit lines' role as liquidity insurance:

2. *Credit line drawdowns tend to happen following decreases in firm profitability.*

This leads us to one of the main predictions of our model, which is based on proposition 3:

3. *Firms with low liquidity risk are more likely to use credit lines rather than cash for liquidity management.*

The mechanism behind this prediction is the trade-off between the reliability of cash holdings, which are never revoked unlike lines of credit, and their opportunity cost. Firms that face a high risk of facing credit line revocation (those with high liquidity risk) find it more costly to employ monitored liquidity insurance and switch to cash holdings.

These implications (in particular 1 and 3) are consistent with other results reported in the literature, notably those in Sufi (2009). The standard approach in the existing empirical literature is to examine cross-sectional association between risk proxies (such as cash flow risk) and corporate liquidity policy. We follow this approach in our main regressions as well, by using the volatility of profits at the industry-level and credit ratings to proxy for liquidity risk. Firms with higher profit volatility are more likely to face a negative liquidity shock that requires a credit line drawdown. Credit ratings also capture heterogeneity in liquidity risk, to the extent that they capture the ease of accessing public bond markets. The main goal of these cross-sectional tests is to show that standard results also hold in the Capital IQ credit line data.[8]

Nevertheless, these standard tests suffer from the usual limitations associated with simple cross-sectional regressions. For example, unobservable firm-level variation can make it difficult for us to interpret the coefficients on standard proxies for risk. One specific story is that some firms may not have access to bank-provided insurance due to lack of reputation and track

[8] We note though that Implication 2 has not been directly examined in previous literature.

record. If these firms also tend to be riskier than other similar firms, then a negative correlation between risk and credit line usage cannot be interpreted as evidence that liquidity risk causes firms to switch to cash holdings (other similar stories can be easily constructed). Reverse causality is also a possibility. Firms may have low credit ratings (for example) because they do have access to credit line insurance.

In order to provide evidence that liquidity risk causes firms to switch from credit lines to cash-based liquidity insurance, we develop an alternative empirical methodology that relies on a quasi-natural experiment. In 2005, the rating of GM and Ford was reduced from above to below investment grade. Due to their importance as issuers in the public bond market, the downgrade had an impact on the liquidity of the bond market as a whole. Firms that depended on bond financing and needed financing became suddenly exposed to the effects of the downgrade, and found it more difficult to raise debt in the form of bonds. Firms that were rated and for which bonds represented a higher percentage of their outstanding debt were arguably more exposed to the liquidity shock that hit the market in the follow up of the downgrade. Notably, the firms that were most affected by this shock were well-established, mature firms that have good access to bank financing. In this sense, evidence that these firms switch from credit lines to cash in the aftermath of the GM-Ford crisis is consistent with the hypothesis that liquidity risk causes firms to change their liquidity policy.

In addition to developing this new empirical methodology, we examine an additional implication of the monitoring framework that has not been tested in previous literature:

4. *Credit line drawdowns are relatively infrequent, so that credit line drawdowns to meet liquidity needs are significantly less frequent that reductions in cash holdings to meet liquidity needs.*

The second set of empirical implications of the model relates to the relationship between credit lines, hedging needs and covenants. Our Proposition 7 states that firms with low hedging needs are more likely to use credit lines for liquidity management, when compared to firms with high hedging needs. According to Disatnik, Duchin and Schmidt (2010) firms that find it easier to hedge cash flows (due to the nature of their business) are more likely to use credit lines for liquidity management. Our explanation for this finding is that cash flow hedging handles liquidity management for bad times for hedgers, but not for non-hedgers. In other words, hedgers use credit lines to manage liquidity for good times, while non-hedgers use credit lines to manage liquidity for bad times.

A possible empirical proxy for the firm's hedging needs is the correlation between cash flows and investment opportunities (as in Acharya, Almeida and Campello (2007)). There are two challenges to testing implication relating to hedging needs: first, firms with high correlations between cash flows and investment opportunities have a natural hedge and are likely to be unconstrained. These firms would need little or no liquidity management, rather than demanding credit lines. Second, it is difficult to measure the pledgeability of new investment opportunities. If these new opportunities can be funded in the spot market, then again the firm needs no liquidity management. In contrast, it is more natural to argue that the firm will have difficulty raising external funds in bad times (when it is hit by a negative liquidity shock). Thus, one may not find any relationship between hedging needs and liquidity policy in the data. Insofar as the correlation between cash flows and investment opportunities can be used as a proxy for hedging needs, the following empirical prediction stems from the model:

5. *Firms with a high correlation between cash flows and investment opportunities (low hedging-needs firms) should be more likely to use credit lines rather than cash for liquidity management.*

Our model also has predictions for the relationship between hedging needs and covenants in credit line contracts. The presence of a future investment opportunity may provide incentives for firms to avoid illiquidity transformation independently of monitoring, and these incentives are stronger for firms whose investment opportunities tend to arrive in high cash flow states (low hedging-needs firms). Because of this differential incentive effect, we have:

6. *Credit lines for low hedging-needs firms are less likely to contain covenants than credit lines for high hedging-needs firms.*

A related implication is that:

7. *Low hedging-needs firms are less likely to violate covenants of bank credit lines than high hedging-needs firms.*

Implications 6 and 7 are closely related but not identical since banks have to determine whether a firm is in violation of a credit line covenant or not.

4 Empirical tests

In this section we present our empirical analysis.

4.1 Sample Construction and Description

We obtain firm-level data from the Capital IQ (CIQ) and Compustat databases for the period of 2002-2008. We restrict ourselves to U.S. firms covered on both databases and traded on AMEX, NASDAQ, or NYSE. We remove utilities (SIC codes 4900-4999) and financial firms (SIC codes 6000-6999). Following Bates, Kahle and Stulz (2009), we further remove firm-years with negative revenues, and negative or missing assets, obtaining in the end a sample of 23,013 firm-years involving 4,248 unique firms.

CIQ compiles detailed information on capital structure and debt structure by going through financial footnotes contained in firms' 10K Securities and Exchange Commission (SEC) filings. Most importantly for our purposes, firms provide detailed information on the drawn and undrawn portions of their lines of credit in the liquidity and capital resources section under the management discussion, or in the financial footnotes explaining debt obligations, and CIQ compiles this data. We use the information of CIQ to construct a dummy for the presence of a credit line, which is equal to one if the firm has a positive amount of undrawn credit reported in the 10K. Following Sufi (2009) we also construct a measure of the amount of undrawn credit expressed as a percentage of book assets (Compustat item 6).

We also compute the following variables that are known to be relevant for line of credit holdings behavior. Cash as a percentage of assets is computed as cash and short-term investments (item 1) over assets (item 6). As in Sufi (2009), size is measured as the logarithm of assets minus cash and short term investments. Book leverage is debt in current liabilities (item 34) plus long-term debt (item 9) over assets. Net working capital to assets is computed as the difference between working capital (item 179) and cash and investments (item 1) divided by assets. R&D expenses are computed as the ratio of research and development expenses (item 46) over sales (item 12). Industry cash-flow risk (named industry sigma) is the mean cash-flow volatility computed by two-digit SIC code. Cash-flow volatility is the standard deviation of operating income before depreciation (item 13) calculated over the previous twelve quarters and scaled by assets. Dividend payout dummy is a dummy that takes value of one if common stock has paid dividends (item 21).

Following Lemmon, Roberts and Zender (2008), we compute profitability as operating income before depreciation (item 13) over assets. Market-to-book (M/B) is the sum of the market value of equity, total debt, and preferred stock at liquidating value (item 10), minus deferred taxes and investment tax credit (item 35), all divided by assets. Market value of equity is computed as stock price (item 199) times number of common shares used to calculate the earnings per share (item 54). Total debt is current liabilities (item 34) plus long-term debt (item 9). Tangibility is net property, plant and equipment (item 8) over assets.

We also compute firm–year rating as the average monthly rating by S&P (item 280), after converting the S&P rating into numbers. Credit spread is the spread on U.S. corporate bond yields between Moody's AAA and BAA provided by Datastream, based on averages of seasoned issues. We compute the firm's asset (unlevered) beta, calculated from equity (levered) betas and a Merton-KMV formula as in Acharya, Almeida and Campello (2010). Finally, following standard procedures, all variables are winsorized at the 0.5% in both tails of the distribution.

4.2 Descriptive Statistics

Table 1 provides univariate evidence on the differences in firm characteristics across the samples of firms with and without a line of credit. In columns (1)-(2) we report mean and median values for the entire sample, while columns (3)-(4) and (5)-(6) contain values for the subsamples of firms with and without a line of credit, respectively. Firms with a line of credit have a median size that is approximately 4.7 times larger than firms without a line of credit. Median tangibility for firms with a line of credit is 20.2% while for firms without a line of credit is 9.1%. Proxying for Q with the M/B, firms with a line of credit have M/B of 1.2 while this ratio is 1.6 for firms without a line of credit. The t- and Mann-Withney tests show that the differences in values across the two samples are statistically significant. These findings are consistent with the predictions of our variable investment model according to which firms that use credit lines for liquidity management tend to be larger, more tangible, and to have lower Qs than those that use cash for liquidity management:

More generally, Table 1 allows for a broad comparison of firms with and without a line of credit. The main picture that emerges from the table is that the sample of firms with a line of credit is significantly different from the rest along all the dimensions reported in the table. Firms with a line of credit are more profitable, more leveraged, are more likely to pay dividends, have lower beta, and are more likely to be rated. These firms also invest more in working capital and capex, but have lower R&D expenses. Overall, these characteristics suggest that firms with a line of credit are more established, mature firms with fewer growth opportunities and more stable cash flows. Table 1 is also informative on the relative sizes of lines of credit and cash across the two samples. First, column (3) shows that the mean value of lines of credit as a percentage of assets is of a comparable magnitude to cash. Second, measuring liquidity as the sum of cash plus undrawn credit divided by assets, the mean liquidity of firms with a line of credit is significantly lower than that of firms without a line of credit (respectively, 27.5% of assets, and 40.5%).[9]

TABLE 1 ABOUT HERE

Several of our model's predictions are consistent with this univariate evidence. The variable investment model in section 2.2.3 predicts that firms that use credit lines for liquidity management are larger, more tangible, and have lower Qs than those that use cash for liquidity management, all of which is consistent with the evidence discussed above. Furthermore, both the fixed and variable investment models predict that firms that use credit lines for liquidity management have higher credit ratings than those that use cash for liquidity management, which again is consistent with the evidence in Table 1. This evidence is even clearer in Figure 4, which shows that firms that have a line of credit tend to have higher credit rating compared to firms that do not have a line of credit and use cash for liquidity management instead. Less than 10% of firms without a line of credit have a rating, while more than 30% of firms with a line of credit have one.

FIGURE 4 ABOUT HERE

4.3 Liquidity risk and liquidity management

4.3.1 Implications 1-2: Profitability, revocations and drawdowns

In Table 2 we focus on the relationship between profitability and both restriction of access to credit lines and usage of credit lines. Focusing first on revocations, we limit the sample to firms that have a credit line in period $t-1$, and study whether access to the line of credit is restricted during period t. We first run probit regressions where the dependent variable takes value 1 if a firm had a line of credit in $t-1$ but not in t. For robustness, we also consider the possibility that a restriction of access is partial and does not lead to a complete revocation. For this purpose, we run OLS regressions of the change in undrawn credit (with the opposite sign, i.e. if undrawn credit decreases the variable takes a positive sign), and probit regressions where the dependent variable takes value 1 if undrawn credit has dropped by more than 30% and drawn credit.[10]

[9] This basic finding is not affected by how we measure assets. If we measure CLs and cash as percentages of non-cash assets, using medians (means are affected by a high proportion of outliers (Sufi(2009)) we obtain that CLs represent 8.5% of non-cash assets, while cash represents 12.5% of non-cash assets, in the sub-sample of firms with a CL. Cash consists of 62.7% of non-cash assets for the sub-sample of firms without a CL.

[10] For each regression specification we provide three different definitions of profitability: the standard definition of profitability computed as operating income before depreciation, scaled by assets (reported in Table 2); a dummy for profitability being positive; and a dummy for profitability being above 5% (both of which are reported in the Appendix in Table A1).

The results show that credit lines tend to get revoked following decreases in profitability (column (1)-(3)). At the mean, a decrease in profitability equivalent to 10% of assets is associated with an increase in the likelihood of having a line of credit revocation of 6.5%. In general, access to undrawn credit depends negatively on profitability, as shown in column (2). By excluding reductions in undrawn credit that are smaller than 30%, column (3) shows that the negative relationship between undrawn credit and profitability is not driven by small, insignificant variations in undrawn credit, but it is actually associated with large reductions.

In unreported tests, we exclude those cases in which the loss (total or partial) of the line of credit is due to a drawdown rather than to a revocation imposed by the bank. For this purpose, we define revocations as reductions in undrawn credit lines not associated with an increase in drawn credit lines. All the above results carry through in this alternative specification.

TABLE 2 ABOUT HERE

We now examine the relationship between credit line drawdowns and profitability. As explained above, if credit lines are monitored liquidity insurance, drawdowns should be negatively related to profitability. Although a decrease in profitability tends to reduce access to credit lines and may lead to a revocation (as shown in the previous section), we still expect credit lines to be used by firms as a source of liquidity following a shortfall in cash flows.

The results of this analysis are presented in column (4) of Table 2. We regress the annual variation in revolving credit on profitability and on a set of controls.[11] The regression shows a negative and significant relationship between profitability and variations in total drawn lines of credit, as predicted by the monitoring model. This evidence shows that an increase in revolving credit is associated with a drop in profitability, and it suggests that credit lines are employed by firms to withstand liquidity shocks resulting from a shortfall in cash flows.

In unreported tests, we restrict variations in revolving credit to be positive. In this way, we can more clearly separate drawdowns from repayments. The results obtained in these additional regressions confirm the above findings.

[11] In addition to the measures of profitability employed in Table 2, we control for the change in profitability, measured as the difference between profitability in year t minus profitability in year $t-1$. We also construct one variable for the positive changes in profitability (*increases in profitability*) and one for the negative changes (*decreases in profitability*).These additional definitions of profitability can be found in Table A2 in the Appendix.

4.3.2 Implication 3: Liquidity risk and liquidity management (I)

One of the main predictions of the model is that firms that use credit lines for liquidity management should have low liquidity risk relative to those that rely mostly on cash holdings. As a first piece of evidence in support of this prediction, Figure 5 illustrates the distribution of profitability for firms with and without a line of credit (*LC firms* and *cash firms*, respectively). It shows that firms that use cash have a higher probability of experiencing liquidity events (episodes of low profitability).

FIGURE 5 ABOUT HERE

In Table 3 we provide multivariate evidence on the determinants of credit line usage to test the negative relationship between liquidity risk and credit line usage. Our proxies for liquidity risk will be the volatility of profits at the industry-level and credit ratings. The volatility of profits (*CF Volatility*) is calculated at the industry level (two-digit SIC code), by calculating the standard deviation of operating income before depreciation calculated over the previous twelve quarters and scaled by assets. The choice of firm characteristics builds on the factors that have been identified to be relevant for cash holdings (Opler, Pinkowitz, Stulz and Williamson (1999)), for lines of credit (Sufi (2009) and Acharya, Almeida and Campello (2009)) and for capital structure (Lemmon, Roberts, and Zender (2008)). The sets of controls suggested by these literatures largely overlap.

TABLE 3 ABOUT HERE

Liquidity policies are captured by several different measures. In column (1) and (2) we run probit regressions for the presence of a credit line while in columns (3) and (4) we run OLS regressions for cash and short-term investments as a percentage of total liquidity, where total liquidity is computed as cash and short-term investments plus undrawn credit. Finally, in column (5) we run an OLS regression for cash and short-term investments as a percentage of total assets.

Columns (3)-(5) show that the volatility of profits is positively associated with the usage of cash versus lines of credit as a liquidity management tool. However, the margin of adjustment seems to happen more intensely for cash holdings, and this observation is clear in column (1), in which volatility of profits and line of credit access are not strongly related. This evidence would be consistent with a tendency of firms with higher liquidity risk to rely on cash holdings for liquidity management, but to still hold on to any lines of credit they may be able to access given that they carry a very low opportunity cost. Lines of credit are relatively cheap to open, and it may be a good approximate description to say that any firm that is able to be granted one will apply for one, even if it plans to rely mostly on cash. What may matter most instead is the amount of cash holdings the firm then goes on to accumulate relative to undrawn credit. For this reason, studying the extensive margin (presence of a line of credit) might be misleading, so in columns (3) and (4) we run two regressions where the dependent variable is the share of cash in total liquidity (cash + undrawn lines of credit). To better study the intensive margin in column (4) we restrict the sample to rated firms with a line of credit. Finally, we also add a regression with Cash/Assets for robustness.

All columns, on the other hand, show that ratings are positively associated with the usage of lines of credit. Within rated firms, an increase in one notch in rating is associated with an increase of around 6% in the probability of having access to a line of credit, and a decrease of 1% in the cash ratio.

Also consistent with the empirical predictions of the variable investment model, this regression shows that firms are more likely to carry a line of credit if they are larger, have lower Q, and higher tangibility (all three significant at the 1% level).

Finally, it is useful to consider the possibility that we are capturing an alternative mechanism based on agency costs or asymmetry of information through which both profit volatility and ratings are related to the presence of a line of credit. For example, it could be that a large, well-rated, low MB, safe firm is more likely to be granted a line of credit by a bank because it is easier to monitor. To deal with this concern, in columns (2) and (3) we restrict the sample to rated firms, and this way we better isolate our mechanism by only studying firms who are very likely to be able to get a line of credit but who may prefer to rely mostly on cash for liquidity management.

Implication 4: Frequency of credit line drawdowns The model predicts (Implication 4) that firms that use credit lines for liquidity management should have low liquidity risk. We first test this prediction by comparing the frequency of low profit realizations for firms with and without a credit line. In particular, we compare the frequency of profitability being below 0% and 5%. The evidence, reported in Panel A of Table 4, shows that on average credit line users are significantly less likely to face a negative or low profitability shock.

Next, we examine the probability that firms with and without credit lines use their liquidity to meet a shortfall in cash flows. For this purpose, we construct a new variable which is a dummy that takes the value of one when a drawdown occurs during a period in which profitability is negative. We then calculate the frequency of this event (*liquidity event*) in the sample of firms with a line of credit. To compare this with firms that do not use credit lines, we calculate a similar variable for cash drawdowns, and compare both frequencies. The evidence is reported in Panel B. In line with the empirical prediction of the model, liquidity events associated with drawdowns of credit lines are significantly less frequent than liquidity events associated with reductions in cash holdings. This result suggests that liquidity risk is lower for credit line users, than for firms that use cash for liquidity management.

TABLE 4 ABOUT HERE

4.3.3 Implication 3: Liquidity risk and liquidity management (II) - the GM-Ford downgrade

Next, we improve our identification strategy by examining the evolution of liquidity ratios during the downgrade of General Motors Corp (GM) and Ford Motor Co (Ford) to junk status that occurred in the Spring of 2005. In May 2005, Standard and Poor's downgraded the bonds issued by GM and Ford, the world's first and third largest automakers respectively, to junk status. More precisely, Standard and Poor's downgraded the ratings of bonds issued by GM and GMAC, its financial arm, from BBB- to BB. At the same time, Ford and FMCC, its financial subsidiary, had their rating reduced from BBB- to BB+. In the case of GM/GMAC the new rating was two notches below investment grade, while in the case of Ford/FMCC the rating was one notch below investment grade.

Acharya, Schaefer and Zhang (2008) examine the GM-Ford downgrade in detail, and show that it led to a market-wide sell-off of the corporate bonds issued by these two firms. The downgrade had a significant impact on inventory risk faced by financial intermediaries that operated as market makers for the securities issued by the two automakers. The effect of the downgrade went beyond the bond markets of GM and Ford and of other producers in the auto sector. Because of their size and their importance in the debt markets, the credit deterioration of the two giant automakers affected the functioning of corporate-bond markets as a whole. The authors document that simultaneously with the downgrade, there was excess comovement in the fixed-income securities of all industries, not just in those of auto firms.

The downgrade of GM-Ford offers an opportunity to strengthen identification because it generated an increase in liquidity risk which particularly affected firms for which publicly-traded bonds constitute an important source of financing. Insofar as the downgrade of GM-Ford came as an exogenous and unexpected shock, its effects can be used to test the relationship between liquidity risk and liquidity policy. In particular, our empirical strategy is to examine whether firms that faced a larger increase in liquidity risk (firms who are heavily financed by publicly-traded bonds) reacted by increasing their cash holdings relative to those that faced a lower or no increase in liquidity risk.

In setting up the empirical tests it is worth making several remarks. First, the GM-Ford event mainly had effects on publicly-traded bonds and to a significantly smaller extent on privately traded bonds, which suggests that the treatment group should be chosen on the basis of being rated. Second, although GM and Ford were originally investment grade, the effect of their downgrade could have been felt both by investment grade and speculative grade firms.[12] As a result the treatment firms should include both groups. Finally, during the liquidity crisis associated with the GM-Ford downgrade some firms who could not raise funds in bond markets might have used their existing cash holdings to meet their liquidity needs. This adds power to our test as the effect that we are trying to capture −i.e., increased cash holdings in the face of higher future liquidity risk− may be hard to identify.

Table 5 About Here

We conduct a difference-in-difference analysis in a regression framework. In our main specification, the crisis period lasts from December 2004 to May 2005.[13] For all observations that occur during the crisis period the variable $crisis_{i,t}$ takes the value of 1, and is 0 otherwise. To identify treatment firms, we sort firms according to whether they were rated or not in fiscal year 2003. We exclude from the analysis all firms with a rating below B- as they are excessively close to default. To focus only on a "pure" liquidity risk event, and to exclude possible supply effects, we drop all firm-years for which reporting occurred after June 2005. In other words, we include only firm-years for which reporting occurred during any month of the fiscal years 2002-2004 (according to Compustat May 2005 belongs to fiscal year 2004). Finally, we require all firms to have data for every period in fiscal years 2003-2005. Our base specification is as follows:

$$\left(\frac{cash}{cash + undrawn}\right)_{i,t} = \alpha_0 + \alpha_1 crisis_{i,t} + \alpha_2 treatment_i + \alpha_3(crisis_{i,t} * treatment_i) + firm\ controls_{i,t} + industry\ mean_{i,t} + \varepsilon_{i,t}$$

For robustness, we also construct a *placebo crisis* which is defined as the period that goes from

[12] Mutual funds and other financial intermediaries specialized in investment grade bonds reallocated their portfolios away from GM and Ford bonds into other issuers. At the same time, financial intermediaries specialized in speculative bonds reallocated their portfolios into GM and Ford bonds, reducing the weight of other issuers.

[13] The crisis began with the downgrad of GM and GMAC by S&P and Moody's in October 2004. In March 2005 GM issued a profit warning, and was subsequently downgraded by Fitch and Moodys. In April 2005 Ford issued a profit warning which subsequently led to its downgrade by all three rating agencies. In May 2005 both automakers were excluded from Merrill's and Lehman's investment-grade indeces. See Acharya, Schaefer and Zhang (2008) for a detailed timetable of the events.

December 2003 to May 2004. For this exercise, we classify firms as being in the treatment group depending on whether they were rated in fiscal year 2002.

Table 5 illustrates the results of our analysis. Our base specification is performed in columns 1 and 4, respectively for the (true) crisis period and for the placebo crisis. In columns 2 and 5, we provide a refined specification, in which firms enter the treatment group if they satisfy the requirements of the base specification (having a rating (B- or better) in 2003 for the true crisis, and in 2002 for the placebo crisis), and for which senior and subordinated bonds represent more than 50% of outstanding debt (Compustat items dlc+dltt). In columns 3 and 6, we raise the threshold of bonds to represent more than 70% of debt outstanding. We expect firms with a higher percentage of bond financing to be more exposed to the liquidity effects of the GM-Ford downgrade.

We find that across columns 1-3 the coefficient for the crisis dummy is negative and significant (with the exception of column 1 where it is negative but not significant). The coefficient of the treatment dummy is also negative and significant, while that of the interaction term is positive and significant. The coefficient of the interaction term increases in size as we move from column 1 to 3, going from 0.022 to 0.071. Therefore, during the crisis firms in general had less cash as a percentage of total liquidity, here represented by the sum of cash and undrawn credit lines. In general, treatment firms held less cash as a percentage of liquidity during the sample years. However, during the crisis treatment firms held more cash, and this effect was more pronounced for firms with more bond financing. These findings are precisely in line with our predictions that rated firms rely more on credit lines, but also with the prediction that firms shift to cash as their liquidity risk increases. And, they do more so if their exposure to liquidity risk is higher (higher bond percentage of debt).

The results for the placebo crisis in columns 4-6 show that, while lower levels of cash were observed also in 2002, the coefficients for the treatment dummy and the interaction dummy are not significant. In Table A3 of the appendix we perform further robustness checks. In columns 1-3 of Table A3 we replicate the analysis of columns 1-3 of Table 5, carrying out a sorting based on being rated in 2002 rather than in 2003. In columns 4-6 of Table A3 we extend the crisis period to include also June 2005. In both robustness checks, results are unaffected.

In Table 6 we replicate the analysis of Table 5 using as dependent variables, respectively, cash and undrawn credit lines both computed as a percentage of assets. This analysis allows us to identify which margins were at work during the GM-Ford crisis. We find that cash increased as a percentage of assets during the crisis (columns 1-3), while undrawn credit lines decreased as a percentage of assets during the crisis (columns 4-6). This suggests two possible mechanisms: 1) access to credit lines was restricted by banks in anticipation of a liquidity shock, and firms accumulated cash from other sources, not drawing down on their credit lines; 2) firms drew down their outstanding credit lines into cash. Both mechanisms are consistent with our theoretical predictions.

Table 6 About Here

Table 6 also helps in the identification of the GM-Ford event as a rise in future liquidity risk rather than as a liquidity shock. If the GM-Ford event had been a liquidity shock, then treatment firms would have decreased their cash as a percentage of assets during the crisis period. On the contrary columns 1-3 of Table 6 show that cash increased during the crisis, thus suggesting that treatment firms hoarded rather than spent cash in this period. Table A4 of the appendix provides further tests on the "exogeneity" assumption that during the crisis months the GM-Ford event was essentially a liquidity risk event rather than a liquidity shock. Treatment firms were not exposed to an increase in revocations of credit lines during the crisis months. Similarly, these firms did not violate covenants on credit lines more than control firms. These two findings suggest that treatment firms did not face a liquidity shortage due to restriction in access to credit lines during the GM-Ford event.

4.4 Liquidity management and hedging needs

In this section we test the predictions of the model regarding the relationship between hedging needs and a firm's liquidity policy.

Hedging needs are defined as the correlation between investment opportunities and firm-level cash flows, and are calculated at the 3-digit SIC code industry level. To estimate investment opportunities, we build on Acharya, Almeida and Campello (2007) and Duchin (2010) and construct the following measures:

1. Median industry annual investing activities;
2. Median industry market-to-book ratio (Tobin's Q).

We envisage that for financially constrained firms cash flows may be endogenously related with investments and therefore with Tobin's Q. To address this problem, we calculate investment opportunities using only data for financially unconstrained firms. Firms are defined to be financially unconstrained if they pay dividends, have assets above $500m and rating above B+.

4.4.1 Implication 5: Hedging needs and the use of lines of credit

We first test the empirical prediction that firms that need liquidity for good times (*low hedging needs*) are more likely to use lines of credit instead of cash for liquidity management. Table 7 compares several measures of liquidity policy by sorting firms into high and low hedging needs categories. The table displays the differences in the presence of a line of credit, the amount of undrawn credit as a share of assets, the share of cash in total liquidity, and total revolving credit over assets. In Panel A we calculate the raw statistics for the four liquidity variables across the sample of high and low hedging needs firms. In Panel B we carry out a similar exercise, however this time we relate hedging needs with the residuals obtained from the regressions in Table 3. By looking at regression residuals, rather than the raw variables, we can evaluate the relationship between hedging needs and the four liquidity variables after controlling for the firm characteristics of Table 3.

The evidence of Table 7 is consistent with the prediction of the model, according to which firms with low hedging needs are significantly more likely to use credit lines rather than cash for liquidity management. Low hedging needs firms have more undrawn credit as a percentage of assets, and as a percentage of total liquidity. Low hedging needs firm also have a higher percentage of revolving credit as a percentage of assets.

TABLE 7 ABOUT HERE

4.4.2 Implication 6: Hedging needs and the use of covenants

Table 8 estimates the relationship between bank monitoring and hedging needs. As a proxy of bank monitoring, we employ covenants on credit lines. We obtain data on covenants from LPC Dealscan. We list all the covenants attached to credit lines for the firms in our sample during the period 2002-2008. In most cases, firms are granted several new credit line facilities in the same year. For these cases we report the median number of covenant across facilities.

We use four measures of covenant intensity. We borrow the first measure from Demiroglu and James (2010), itself based on the covenant intensity index originally introduced by Bradley and Roberts (2004). This index consists of covenants that limit the actions of the borrower, or give lenders rights that are contingent on adverse future events. The index is composed of six types of covenants: asset sales sweeps, collateral releases, debt issuance sweeps, dividend restrictions, a dummy for financial covenants, and equity issuance sweeps.[14] Our second

[14] The dummy for financial covenants takes value one if at least two of the following covenants are included: Debt/Tangible Assets, Max Capex, Max Debt/Assets, Max Debt/Ebitda, Max Debt/Equity, Max Leverage, Max Senior Debt/Ebitda, Max Senior Leverage, Min Change Interest Coverage, Min Current Ratio, Min Debt

measure of covenant intensity is based on the covenant index of Drucker and Puri (2009) which is computed as the sum of all the covenants included in a loan agreement.[15] This index differs from that of Demiroglu and James (2010) primarily in that it gives equal weight to all covenants. Our third measure of covenant intensity focuses on the covenants that relate directly to cash flows. These covenants primarily require minimum profitability levels, minimum interest coverage ratios, and restrictions on cash flow usage.[16] Our fourth measure of covenant intensity is based on the presence of *sweeps*, such as asset sale sweeps, debt issuance sweeps, and excess cash-flow sweeps. These covenants impose restrictions to managers' payout and reinvestment policy, giving preference to debt reimbursement over other possible uses of cash flows.[17]

Table 8 About Here

In Table 8 we run a set of Poisson regressions using our four covenant intensity measures as dependent variables. Among the explanatory variables, the variables of main interest are the two hedging measures already employed in Table 7, the first one based on investment activities and the second one on Tobin's Q. We also control for a set of variables identified by Demiroglu and James (2010) as relevant for the use of covenants.

According to our model, we should expect a positive relationship between the intensity of covenants and hedging needs, meaning that credit lines for low hedging needs firms tend to carry fewer covenants. The evidence provided in Table 9 suggests that this is the case, as covenants are less prevalent for firms that have high correlation between cash flows and investment opportunities (low hedging needs firms).

Coverage, Min Ebitda, Min Equity/Asset, Min Fixed Charge, Min Interest Coverage, Min Net Worth/Assets, Min Quick Ratio, Net Worth, Other Ratio, Other, Tangible Net Worth.

[15] The index is computed as the sum of the following covenants (dummy equal to one if covenant is present): % of Excess CF, % of Net Income, Asset Sales Sweep, Collateral Release, Debt Issuance Sweep, Dividend Restrictions, Equity Issuance Sweep, Excess CF Sweep, Insurance Proceeds Sweep, Max Capex , Max Debt/Assets, Max Debt/Ebitda, Max Debt/Equity, Max Debt/Tangible Assets, Max Leverage, Max Senior Debt/Ebitda, Max Senior Leverage, Min Change Interest Coverage, Min Current Ratio, Min Debt Coverage, Min Ebitda, Min Equity/Asset, Min Fixed Charge, Min Interest Coverage, Min Net Worth/Assets, Min Quick Ratio, Net Worth, Other, Other Ratio, Tangible Net Worth.

[16] More precisely our cash flow covenant index is computed as the sum of the following covenants (dummy equal to one if covenant is present): % of Excess CF, % of Net Income, Excess CF Sweep, Max Capex, Max Debt/Ebitda, Max Senior Debt/Ebitda, Min Change Interest Coverage, Min Ebitda.

[17] More precisely, this covenant index is obtained as the sum of the following covenants (dummy equal to one if covenant is present): Asset Sales Sweep, Debt Issuance Sweep, Equity Issuance Sweep, Excess CF Sweep, Insurance Proceeds Sweep.

4.4.3 Implication 7: Hedging needs and covenant violations

Finally, we turn our attention to covenant violations. We obtain data on covenant violations from the website of Amir Sufi. The database contains quarterly financial covenant violation data and is employed in Nini, Smith and Sufi (2010) for the analysis of creditor control rights. Importantly, the data contain violations on covenants on any type of debt and not only on credit lines. With this caveat in mind, we regard the violations of covenants in general as a proxy for the violation of covenants on credit lines. We annualize the violation data and consider a violation to have occurred if at least in one quarter a violation has been observed.

Table 9 provides our results on the analysis of the relationship between covenant violation and hedging needs of firms, using a Probit estimation. The dependent variable is a dummy for the presence of at least one covenant violation during that year. For the explanatory variables we borrow from Demiroglu and James (2010) and Nini, Smith and Sufi (2010). As from Table 8, firms with high hedging needs carry a larger number of covenants, we include the covenant index of Drucker and Puri (2009) as an extra control variable.

As predicted by the model, the evidence of Table 9 suggests that covenant violations are less common for firms that have high correlation between cash flows and investment opportunities (low hedging needs firms), also after controlling for the presence of covenants (which is lower for these firms as shown in Table 8).

TABLE 9 ABOUT HERE

5 Conclusions

Recent empirical and survey evidence on corporate liquidity management suggests that bank credit lines do not offer fully committed liquidity insurance, and that they are frequently used to finance future growth opportunities rather than for precautionary motives. In this paper, we propose and test a theory of corporate liquidity management that is consistent with these findings. We argue that a corporate credit line can be understood as a form of monitored liquidity insurance, which controls illiquidity-seeking behavior by firms through bank monitoring and credit line revocation. In addition, we allow firms to demand liquidity not to hedge against negative liquidity shocks, but to help finance future growth opportunities. We show that bank monitoring and credit line revocation play less of a role for such firms, because the nature of their liquidity demand reduces their incentives to engage in illiquidity-seeking behavior. Thus, firms that have low hedging-needs (e.g., high correlation between cash flows and investment opportunities) can access fully committed credit lines that dominate cash holdings as an optimal liquidity management tool.

We use a novel dataset on corporate credit lines to provide empirical evidence that is consistent with the predictions of the model. The evidence suggests that credit line users have lower liquidity risk than firms that use cash for liquidity management. The causality from liquidity risk to liquidity management is supported by our tests around a quasi-natural experiment in the form of downgrade of General Motors and Ford in 2005, which adversely affected bond-market financing conditions, and induced firms relying on bond financing to move away from credit lines into cash holdings. In addition, we also find evidence that firms with low hedging needs are more likely to use credit lines for liquidity management, but have fewer covenants and covenant violations.

There are several interesting avenues for shedding further light on the relationship between illiquidity transformation and bank monitoring. One is the empirical relationship between the ex-post reported purpose of line of credit draw-downs and the presence of covenants. Credit lines designated and primarily used for activities with low illiquidity-seeking risk, such as working capital management, may reflect fewer features of monitored insurance than credit lines used for activities with high illiquidity-seeking risk, such as mergers and acquisitions. Another avenue is to study carefully the aftermath of a covenant violation for a firm's line of credit, and in particular, the factors that determine whether covenants are waived by banks providing the credit line or whether they instead generate credit revocations. Finally, material adverse clauses (MACs) are another way through which banks may employ their monitoring information. While invoked infrequently, the off-equilibrium threat of MACs could have significant impact on firm incentives to engage in illiquidity-seeking activities.

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6 Appendix

In this theoretical appendix we provide proofs and develop some of the arguments in the main body of the paper in greater detail.

6.1 Moral hazard and pledgeability

In order to see how moral hazard generates limited pledgeability, consider the following set up. If the firm continues until date-2, the investment produces a date-2 cash flow $\widehat{R}$ which obtains with probability p. With probability $1-p$, the investment produces nothing. The probability of success depends on the input of specific human capital by the firms' managers. If the managers exert high effort, the probability of success is equal to p_G. Otherwise, the probability is p_B, but the managers consume a private benefit equal to $\widehat{B}$. While the cash flow $\widehat{R}$ is verifiable, the managerial effort and the private benefit are neither verifiable nor contractible. Because of the moral hazard due to this private benefit, managers must keep a high enough stake in the project to be induced to exert effort. We assume that the investment is negative NPV if the managers do not exert effort, implying the following incentive constraint:

$$\begin{aligned} p_G\widehat{R}_M &\geq p_B\widehat{R}_M+\widehat{B}, \text{ or} \\ \widehat{R}_M &\geq \frac{\widehat{B}}{\Delta p}, \end{aligned} \tag{24}$$

where $\widehat{R}_M$ is the managers' compensation and $\Delta p = p_G - p_B$. This moral hazard problem implies that the firms' cash flows cannot be pledged in their entirety to outside investors. In particular, we have that:

$$\widehat{\rho_0} \equiv p_G(\widehat{R}-\frac{\widehat{B}}{\Delta p}) < \widehat{\rho_1} \equiv p_G\widehat{R}. \tag{25}$$

The manager's choice of $\widehat{\lambda}$ impacts the project's cash flows and private benefits in the following way. If the manager chooses the illiquid project ($\widehat{\lambda}=\lambda^{'}$), we have that $\widehat{R}=R^{'}$ and $\widehat{B}=B^{'}$. If the manager chooses the liquid project ($\widehat{\lambda}=\lambda$), we have that $\widehat{R}=R$ and $\widehat{B}=B$. Finally, we have that $R^{'}>R$ and $B^{'}>B$. Thus, the illiquid project produces a higher cash flow when it is successful, and a higher associated private benefit. We make the following assumption:

$$\rho_0^{'} \equiv p_G(R^{'}-\frac{B^{'}}{\Delta p}) = \rho_0 \equiv p_G(R-\frac{B}{\Delta p}). \tag{26}$$

Thus, $\widehat{R}$ and $\widehat{B}$ change in a way that leaves ρ_0 constant.

6.2 Proof of proposition 1

First, we show that the bank has incentives to monitor and deny access to the credit line if $s=s^{'}$, given that the firm follows the equilibrium strategy ($\widehat{\lambda}=\lambda$). Then, we show that the firm indeed has incentives to pick $\widehat{\lambda}=\lambda$, and that the ex-ante feasibility constraint is obeyed.

Conditional on the liquidity shock, if the bank does not monitor it must honor the credit line and its payoff is $-(\rho-\rho_0)$ (see Figure 2 for the timeline that refers to bank's actions). This is because the maximum expected payment that the bank can extract in state L is capped by pledgeable income ρ_0. In other words, if the date-2 liability generated by the credit line is D^{LC}, then it must be the case that $p_G D^{LC} \leq \rho_0$. If the bank does monitor, it obtains a signal $s = s^{'}$ with probability μ and it can deny access to the credit line. Its payoff is then $-(1-\mu)(\rho - \rho_0) - c$. So as long as $\mu(\rho - \rho_0) > c$ (equation 7), it is incentive compatible for the bank to monitor even when the bank anticipates that the firm has made the correct choice and picked $\widehat{\lambda} = \lambda$. Incentive compatibility is preserved because of the "negative NPV" feature of the date-1 loan. In terms of a credit line, the bank loses money when the firm draws on the credit line. Thus, the optimal contract can rely on the bank's incentives to deny access to liquidity insurance (the credit line) in order to induce good behavior by the firm.

Given that the bank is expected to monitor, if the firm chooses the right project its payoff (after the initial contract is written) is:

$$U_b = [1 - \lambda + \lambda(1-\mu)] (\rho_1 - \rho_0). \tag{27}$$

The firm earns the rent $\rho_1 - \rho_0$ upon continuation, but continuation only occurs with probability $(1-\mu)$ in state λ (see Figure 1 for an illustration). If the borrower deviates from the equilibrium strategy and chooses $\lambda^{'}$instead, the firm is liquidated with probability one in state $\lambda^{'}$ and the payoff is:

$$U_b^{'} = (1 - \lambda^{'})(\rho_1^{'} - \rho_0) \tag{28}$$

So if equation 8 holds, the borrower has the incentive to choose the correct project.

Finally, we show that the firm generates enough pledgeable income to fund the initial investment and the credit line, taking into account the monitoring technology. Since $y = \lambda \frac{(1-\mu)(\rho-\rho_0)+c}{(1-\lambda)}$, the bank breaks even on the credit line (including the monitoring cost c). Let D represent the additional payment that is promised to investors at date-2 (conditional on success). Limited pledgeability requires $y + p_G D \leq \rho_0$. To fund the initial investment, it must be that $(1-\lambda) p_G D \geq I$. Putting these conditions together we obtain:

$$I + \lambda(1-\mu)\rho + \lambda c \leq (1 - \lambda\mu)\rho_0. \tag{29}$$

The bank must now fund the monitoring cost c with probability λ. The firm is liquidated with probability $\lambda\mu$, and the credit line is used with probability $\lambda(1-\mu)$. Since $\mu(\rho - \rho_0) > c$, it can be shown that this condition is implied by that above $(\rho_0 - \lambda^{'}\rho > I)$. Intuitively, monitoring is increasing equilibrium pledgeable income for the bank.

6.3 Proof of proposition 2

Since the firm holds cash equal to $(\rho - \rho_0)$, it can continue the project in state $\lambda^{'}$ in date 1. It returns the cash to investors in state $(1 - \lambda^{'})$. Thus, the investors' date-0 break even constraint is:

$$I + q(\rho - \rho_0) \leq (1 - \lambda^{'})(p_G D^C + \rho - \rho_0),$$

and limited pledgeability requires that $p_G D^C \leq \rho_0$. These two constraints imply that this strategy is feasible when $\rho_0 - \lambda^{'}\rho - I > (q-1)(\rho - \rho_0)$, which holds if q is low. The resulting payoff is the NPV of the illiquid investment, net of the cost of carrying cash, $U^C = \rho_1^{'} - \lambda^{'}\rho - I - (q-1)(\rho - \rho_0)$.

6.4 Proof of proposition 3

As explained in Corollary 1, the choice between cash and credit lines is driven by the difference between U^C and U^{LC}. For firms of type L:

$$\begin{aligned}(U^C - U^{LC})_L &= \rho_1^{'} - \lambda_L^{'}\rho - (q-1)(\rho - \rho_0) - \rho_1 + \lambda_L\rho + \lambda_L\left[c + \mu(\rho_1 - \rho)\right] = \\ &= \rho_1^{'} - \rho_1 + \lambda_L\left[c + \mu(\rho_1 - \rho)\right] - t\rho - (q-1)(\rho - \rho_0)\end{aligned}$$

Similarly, for firms of type H:

$$(U^C - U^{LC})_H = \rho_1^{'} - \rho_1 + \lambda_H\left[c + \mu(\rho_1 - \rho)\right] - t\rho - (q-1)(\rho - \rho_0).$$

Thus, we have that:

$$(U^C - U^{LC})_H - (U^C - U^{LC})_L = (\lambda_H - \lambda_L)\left[c + \mu(\rho_1 - \rho)\right] > 0. \tag{30}$$

Thus, the difference in payoffs is larger for firms of type H which are then more likely to choose cash.

Finally, notice that if we eliminate assumption 10, there would be an additional term in equation 30 equal to $[(\lambda_L^{'} - \lambda_L) - (\lambda_H^{'} - \lambda_H)]\rho$. Thus, as long as the difference $(\lambda_H^{'} - \lambda_H)$ is not significantly larger than $(\lambda_L^{'} - \lambda_L)$ the result will continue to hold.

6.5 Proof of proposition 4

Assumption 7 means that the bank has incentives to monitor at date-1 (monitoring increases pledgeable income). Assumption 8 assures that the firm has incentives to pick the liquid investment given that it expects monitoring. The bank breaks even on the credit line given a commitment fee equal to y. The date-0 budget constraint is:

$$\begin{aligned}I^{LC} - A &= \left(\rho_0 - \lambda\rho - \lambda\left[c - \mu(\rho - \rho_0)\right]\right) I^{LC} \text{ or} \\ I^{LC} &= \frac{1}{1 - \rho_0 + \lambda\rho + \lambda\left[c - \mu(\rho - \rho_0)\right]} A.\end{aligned} \tag{31}$$

Given assumption 13, I^{LC} is finite. The firm's payoff is then given by:

$$U^{LC} = \left[\rho_1 - \lambda\rho - 1 - \lambda\left(c + \mu(\rho_1 - \rho)\right)\right] I^{LC},$$

which is positive given assumption 11.

6.6 Proof of proposition 6

Under monitoring we have:

$$U_b = (1-\lambda)(\rho_1 - \rho_0 + \upsilon^H\rho^\tau) + \lambda(1-\mu)(\rho_1 - \rho_0 + \upsilon^L\rho^\tau) \tag{32}$$

$$U_b^{'} = (1-\lambda^{'})(\rho_1^{'} - \rho_0 + \upsilon^H\rho^\tau) \tag{33}$$

which is equivalent to:

$$\left[1 - \lambda + \lambda(1-\mu)\right](\rho_1 - \rho_0) + (\lambda^{'} - \lambda)\upsilon^H\rho^\tau + \lambda(1-\mu)\upsilon^L\rho^\tau > (1-\lambda^{'})(\rho_1^{'} - \rho_0). \tag{34}$$

Notice that this condition must hold under assumption 8. The feasibility condition is:

$$I + \lambda\left[(1-\mu)\rho + c\right] + \left[(1-\lambda)\upsilon^H + \lambda(1-\mu)\upsilon^L\right]\tau \leq (1-\lambda\mu)\rho_0, \tag{35}$$

which is implied by equations 17 and 7 (bank monitoring increases pledgeable income and relaxes the feasibility constraint, as in the basic model). Finally, the ex-ante payoff is:

$$U_\tau^{LC} = \rho_1 - \lambda\rho - I + \overline{\upsilon}(\rho^\tau - \tau) - \lambda\left[c + \mu\left[\rho_1 - \rho + \upsilon^L(\rho^\tau - \tau)\right]\right]. \tag{36}$$

The alternative for the firm is to implement the illiquid project. As in the basic model, given equation 18 the firm must make sure that it is able to continue the project in the low cash flow state $\lambda^{'}$, even taking into account the additional investment opportunity. Since the credit line would expose the firm to liquidation risk in that state, the optimal way to do so is to use cash holdings. To be able to fund both the liquidity shock and the investment opportunity, the firm must hold an amount of cash equal to $C = \rho + \tau - \rho_0$. This level of cash holdings is feasible if:

$$\rho_0 - \lambda^{'}\rho - I - \overline{\upsilon}^{'}\tau > (q-1)(\rho + \tau - \rho_0). \tag{37}$$

Assuming that this condition holds, the associated payoff is:

$$U_\tau^C = \rho_1^{'} - \lambda^{'}\rho - I + \overline{\upsilon}^{'}(\rho^\tau - \tau) - (q-1)(\rho + \tau - \rho_0). \tag{38}$$

6.7 Proof of proposition 7

Using Equation 22, the difference in payoffs for the firm with high hedging needs can be written as:

$$(U_\tau^C - U_\tau^{LC})_{HHN} = K + \lambda\upsilon(\rho^\tau - \tau),$$

where $K = \rho_1^{'} - \rho_1 - (\lambda^{'} - \lambda)\rho + \lambda\left[c + \mu\left(\rho_1 - \rho\right) - (q-1)(\rho + \tau - \rho_0)\right]$ is a term that does not depend on υ. Similarly, the difference in payoffs for the firm with low hedging needs can be written as:

$$(U_\tau^C - U_\tau^{LC})_{LHN} = K + \lambda\upsilon^L(\rho^\tau - \tau) + (\overline{\upsilon}^{'} - \overline{\upsilon})(\rho^\tau - \tau).$$

Since $\upsilon^L < \upsilon$ and $\overline{\upsilon}^{'} - \overline{\upsilon} > 0$, it follows that $(U_\tau^C - U_\tau^{LC})_{LHN} < (U_\tau^C - U_\tau^{LC})_{HHN}$.

Figure 1 Timeline of Model

Figure 1a

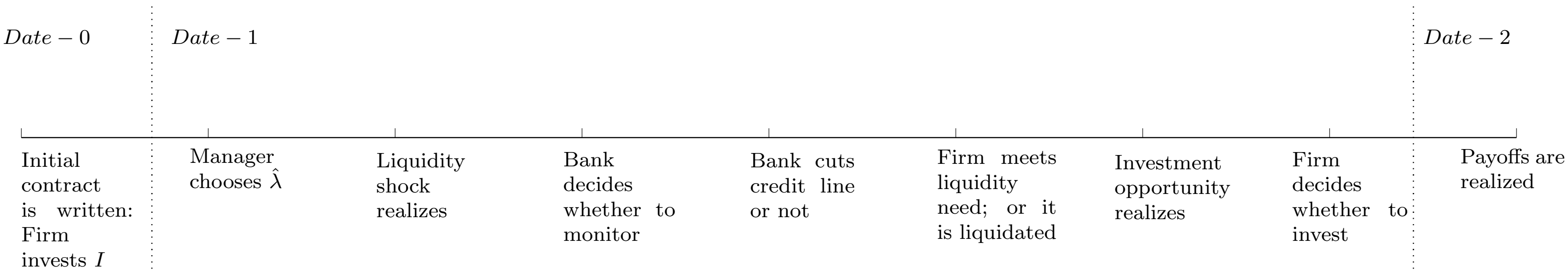

Figure 1b

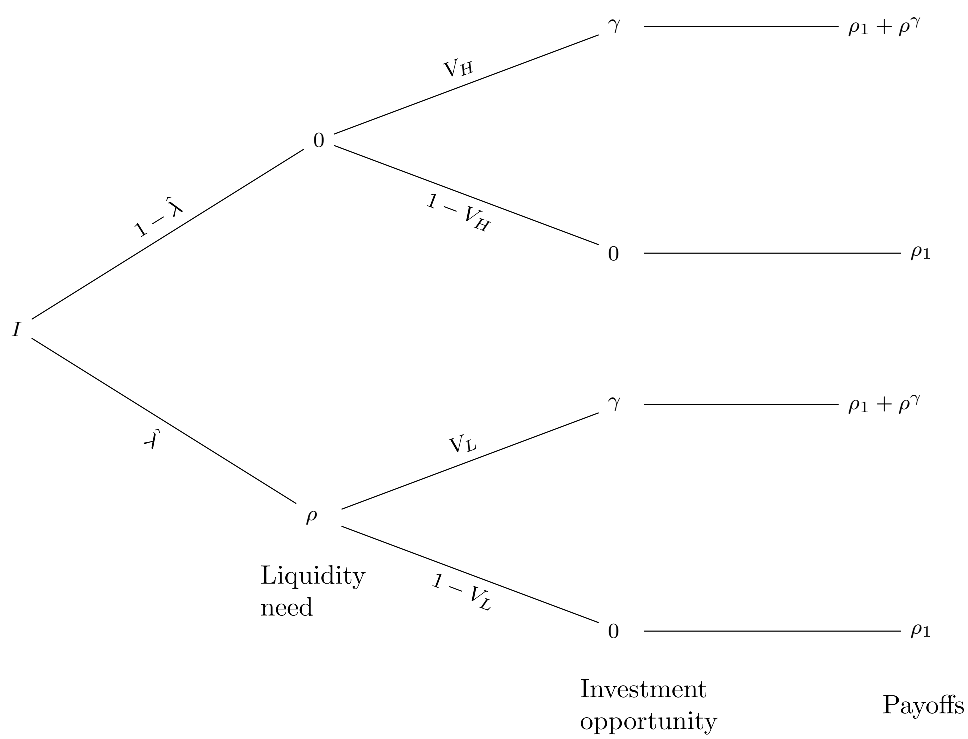

Figure 2 Bank's decision tree and payoffs

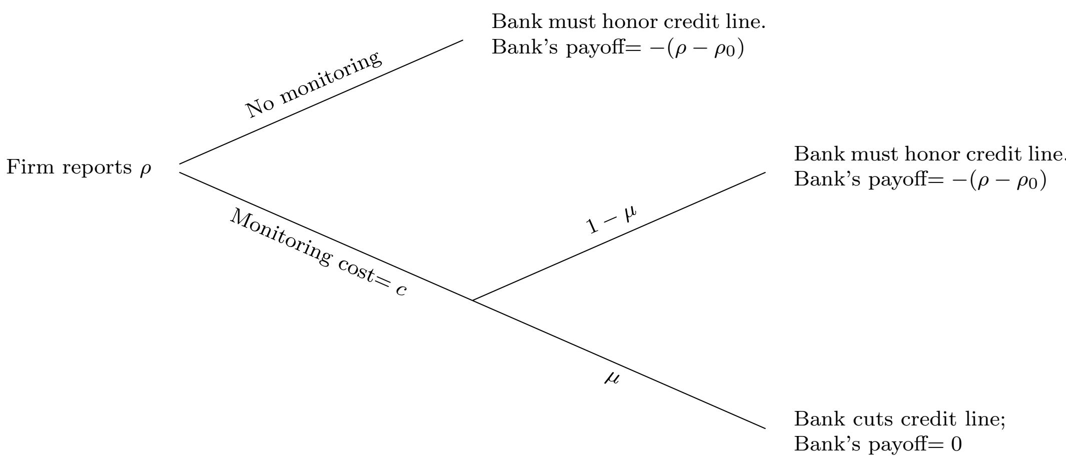

Figure 3 Firm's choice of λ and payoffs

Figure 3a Liquid Project: $\hat{\lambda} = \lambda$

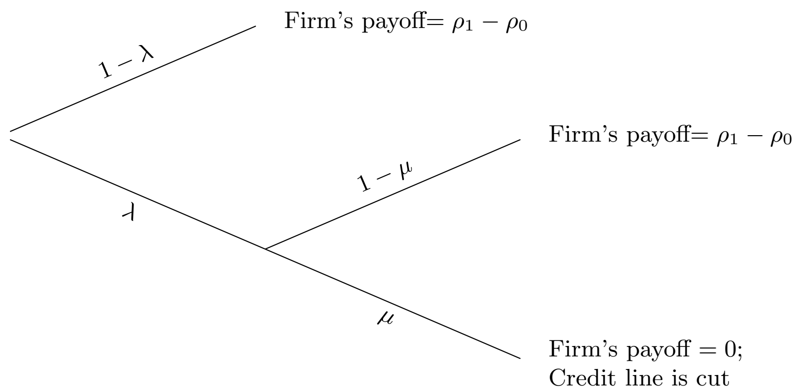

Figure 3b Illiquid Project: $\hat{\lambda} = \lambda'$

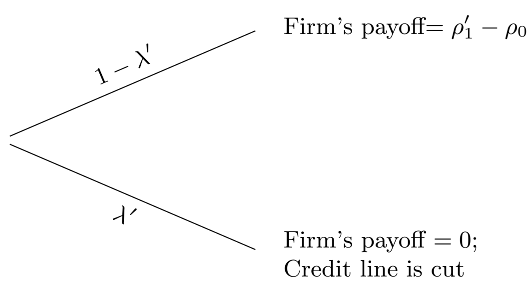

Figure 4

Presence of a Credit Line and Rating

This figure presents evidence on the differences in credit ratings between firms with a credit line ("LC Firms") and firms without one ("Cash Firms"). Credit ratings are aggregated into 8 groups: AAA, AA, A, BBB, BB, B, D to CCC+, and unrated. Each bar represents the percentage of firms in each group with a particular rating.

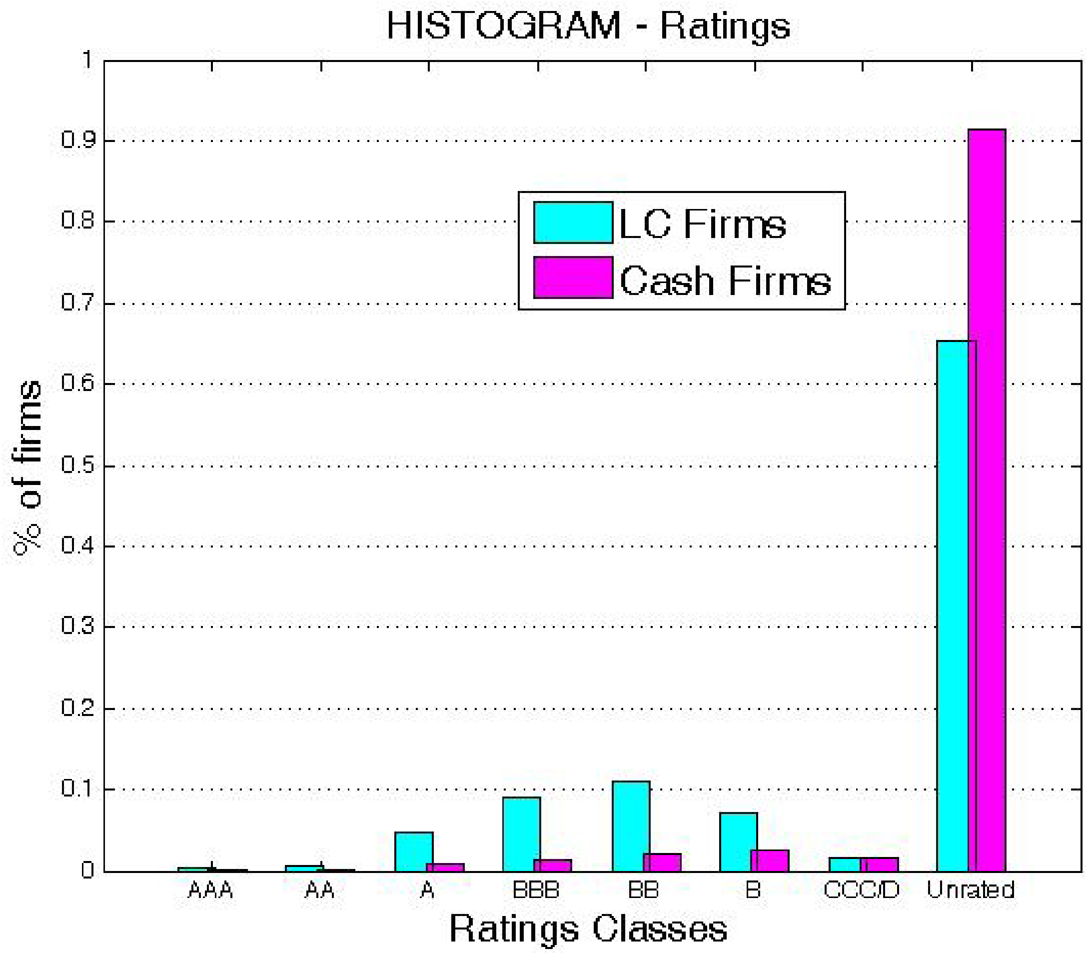

Figure 5

Distribution of Liquidity Shocks

This figure presents evidence on the differences in the distribution of profitability between firms with a credit line ("LC Firms") and firms without one ("Cash Firms"). The probability density displayed is an estimate using the data in the sample based on a normal kernel function and evaluated at 100 equally spaced points that cover the range of the data.

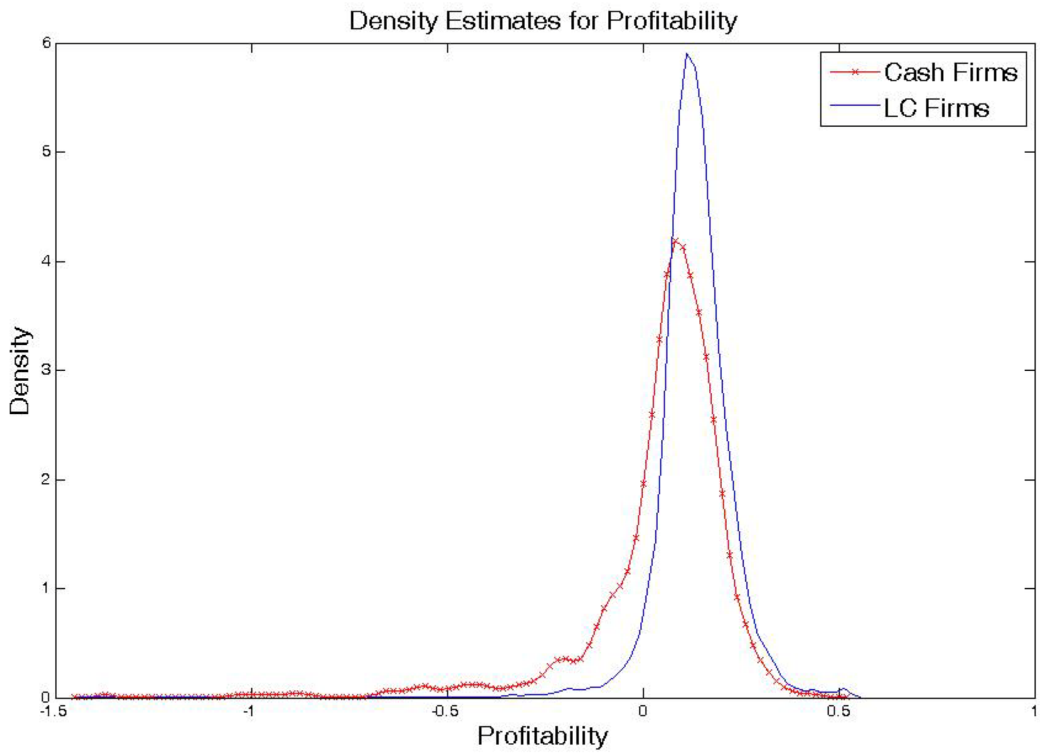

Table 1

Comparison of Firms with and without Credit Lines

This table provides summary statistics for the entire sample and for the restricted samples of firms with and without a credit line. The entire sample consists of non-utilities (excluding SIC codes 4900-4949) and non-financials (excluding SIC codes 6000-6999) U.S. firms covered by both Capital IQ and Compustat from 2002 to 2008. We have removed firm- years with 1) negative revenues, and 2) negative or missing assets. After the above filters, the sample consists of 23,013 firm-year observations involving 4,248 unique firms. In this table, "size" is measured as the book value of assets expressed in millions of 2001 dollars deflated by the consumer price index. All variables are winsorized at the 0.5% in both tails of the distribution. The last two columns test for differences between samples with and without undrawn credit using the unequal variances t-test and the two-sample Wilcoxon rank-sum (Mann-Whitney) test.

	(1)	(2)	(3)	(4)	(7)	(8)	(9)	(10)
	Entire Sample		Sample of Firms with a Credit Line		Sample of Firms without a Credit Line		Test of Difference with vs. without a Credit Line	
	Mean	Median	Mean	Median	Mean	Median	t-test p-value	MW p-value
Undrawn Credit Lines/At	0.091	0.061	0.134	0.107	-	-	-	-
Cash/ At	0.226	0.131	0.141	0.078	0.405	0.386	76.397	70.993
							(0.000)	(0.000)
Profitability	0.055	0.107	0.115	0.124	-0.072	0.036	-44.059	-53.049
							(0.000)	(0.000)
Size	2086.7	281.9	2673.9	470.0	852.0	100.5	-23.278	-51.556
							(0.000)	(0.000)
Book Leverage	0.208	0.147	0.236	0.197	0.151	0.015	-24.890	-42.623
							(0.000)	(0.000)
M/B	1.799	1.303	1.575	1.205	2.308	1.621	25.145	26.630
							(0.000)	(0.000)
Tangibility	0.243	0.163	0.275	0.202	0.176	0.091	-32.666	-40.200
							(0.000)	(0.000)
NWC/At	0.047	0.039	0.082	0.071	-0.026	-0.017	-37.129	-39.597
							(0.000)	(0.000)
Capex/At	0.053	0.032	0.057	0.035	0.045	0.023	-13.482	-27.773
							(0.000)	(0.000)
R&D/Sales	0.734	0.005	0.106	0.000	2.065	0.118	20.432	58.710
							(0.000)	(0.000)
Dividend Payer	0.280	0.000	0.360	0.000	0.107	0.000	-47.635	-39.423
							(0.000)	(0.000)
Beta KMV	1.279	1.119	1.177	1.038	1.530	1.381	15.360	15.544
							(0.000)	(0.000)
Rating Dummy	0.263	0.000	0.347	0.000	0.085	0.000	-52.301	-42.178
							(0.000)	(0.000)
Observations	23013		15596		7417			

Table 2: Revocations and Drawdowns

This table presents Probit and OLS regression results to study the relationship between profitability and restriction of access to credit lines (columns 1-3), and the relationship between profitability and drawdowns of credit lines (column 4). In column 1 the dependent variable is a dummy for the incidence of full credit line revocation. Column 2 displays OLS regression results in which the dependent variable is the decrease in undrawn credit available as a % of firm assets. In column 3 the dependent variable is a dummy for a decrease in undrawn credit greater than 30% of the outstanding amount. In column 4 the dependent variable is the annual change in drawn credit lines. Year, Rating and Exchange fixed effects included. Rating fixed effects are based on 22 rating dummies and the unrated dummy. Robust standard errors clustered at the firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels. All regressions include a constant term (unreported).

	(1) Full Revocation of Credit Line (Dummy)	(2) Partial Revocation of Credit Line	(3) Partial Revocation of Credit Line (Dummy)	(4) Changes in Drawn Credit Lines
Profitability	-0.649***	-0.035***	-0.836***	-0.022***
	(0.212)	(0.011)	(0.222)	(0.008)
Size	-0.024	-0.001	0.001	-0.000
	(0.027)	(0.001)	(0.013)	(0.000)
Book Leverage	-0.721***	0.020***	0.550***	0.029***
	(0.184)	(0.005)	(0.098)	(0.004)
M/B	0.071***	-0.001	-0.008	-0.000
	(0.019)	(0.001)	(0.020)	(0.001)
Tangibility	-0.053	-0.022***	-0.327***	-0.020***
	(0.202)	(0.005)	(0.091)	(0.004)
NWC/Assets	-1.332***	-0.018***	-0.589***	-0.006
	(0.182)	(0.005)	(0.101)	(0.003)
Capex/Assets	-1.611**	0.082***	1.552***	0.108***
	(0.757)	(0.020)	(0.298)	(0.017)
R&D/Sales	-0.001	0.000	-0.003	-0.000***
	(0.007)	(0.000)	(0.007)	(0.000)
Div. Payer Dummy	-0.253***	0.003*	-0.092***	0.005***
	(0.076)	(0.002)	(0.033)	(0.001)
Industry Sigma	2.714	-0.060	1.026	-0.020
	(1.890)	(0.049)	(0.927)	(0.026)
Beta KMV	0.049**	0.002**	0.031**	0.000
	(0.022)	(0.001)	(0.012)	(0.000)
Observations	9,930	10,244	10,238	10,219
R-squared		0.013		0.047

Table 3
Access to Credit Lines

This table relates firm characteristics to various liquidity measures. In column (1) and (2) we run probit regressions for the presence of a credit line, where the dependent variable is a dummy that takes value one, if the firm has an undrawn credit line. Column (1) is for all the firms in the sample, while column (2) is for the sub-sample of rated firms (>CCC). In columns (3) and (4) we run OLS regressions for cash and short-term investments as a percentage of total liquidity. Total liquidity is computed as cash and short-term investments plus undrawn credit. Column (3) is for sub-sample of rated firms (>CCC), while column (4) is for the sub-sample of rated firms that have a credit line. In column (5) we run an OLS regression for cash and short-term investments as a percentage of total assets, on the sub-sample of rated firms (>CCC) with a credit line. Year and Exchange fixed effects included. Robust standard errors clustered at the firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
	Presence of a Credit Line (Dummy)		Cash/ Total Liquidity		Cash/At
	All Firms	Rated	Rated	Rated with a LC	Rated with a LC
Profitability	0.484***	1.733**	-0.523***	-0.279***	-0.058
	(0.151)	(0.691)	(0.088)	(0.089)	(0.036)
Size	0.150***	0.002	0.020***	0.026***	0.000
	(0.019)	(0.048)	(0.007)	(0.007)	(0.002)
Book Leverage	0.877***	0.818***	-0.280***	-0.234***	-0.113***
	(0.112)	(0.260)	(0.039)	(0.037)	(0.013)
M/B	-0.057***	-0.299***	0.093***	0.069***	0.035***
	(0.016)	(0.059)	(0.010)	(0.010)	(0.005)
Tangibility	0.988***	-0.132	-0.121**	-0.116**	-0.073***
	(0.167)	(0.318)	(0.054)	(0.051)	(0.014)
NWC/Assets	1.860***	1.114***	-0.543***	-0.468***	-0.184***
	(0.139)	(0.351)	(0.061)	(0.056)	(0.022)
Capex/Assets	0.654	1.338	-0.376***	-0.359***	-0.033
	(0.403)	(1.165)	(0.134)	(0.114)	(0.028)
R&D/Sales	-0.001	-2.713***	0.007***	0.849***	0.270***
	(0.008)	(0.875)	(0.002)	(0.178)	(0.093)
Dividend Payer	0.215***	0.093	-0.062***	-0.052***	-0.002
	(0.054)	(0.101)	(0.015)	(0.014)	(0.005)
CF Volatility	1.075	-4.068	1.665***	1.010**	0.896***
	(0.698)	(3.396)	(0.525)	(0.484)	(0.202)
Beta KMV	-0.043***	-0.024	0.027***	0.027***	0.008***
	(0.011)	(0.033)	(0.005)	(0.004)	(0.002)
Rating	0.012**	0.061**	-0.010***	-0.012***	-0.004***
	(0.006)	(0.025)	(0.004)	(0.003)	(0.001)
Observations	16,873	4,410	4,770	4,338	4,338
(Pseudo) R2	0.304	0.288	0.346	0.348	0.410

Table 4
Probability of a Liquidity Event

This table examines the probability of a drawdown in credit lines or a reduction in cash associated with a drop in profitability. In Panel A, we compute the probability of profitability falling below 0% and 5%, respectively for firms with and without a credit line. In Panel B, we define *liquidity events* as follows: for credit line drawdowns, a liquidity event occurs if there is an increase in drawn revolving credit (ΔRC>0) while profitability is negative; for cash, a liquidity event occurs if there is a reduction in cash (ΔCash and ST Investments<0) while profitability is negative. The probability of a liquidity event for credit lines is computed as the ratio of credit line liquidity events divided by the number of firm-years with a credit line. The probability of a liquidity event for cash is computed as the ratio of cash liquidity events divided by the number of firm years without a credit line.

Panel A: Probability of a negative cash flow shock

	With Credit Line	W/out Credit Line	t-stat	*p-value*	wilcoxon	*p-value*
Probability of Profits < 0%	0.094	0.423	53.078	(0.000)	58.269	(0.000)
Probability of Profits < 5%	0.163	0.531	56.598	(0.000)	58.037	(0.000)

Panel B: Probability of a liquidity event

	Credit Line	Cash	t-stat	*p-value*	wilcoxon	*p-value*
Probability of a Liquidity Event	2.156%	19.197%	32.331	(0.000)	40.969	(0.000)
Probability of a Liquidity Event > 0.5% of Assets	2.062%	18.523%	31.679	(0.000)	40.265	(0.000)

Table 5

The Effect of the GM-Ford Crisis on Liquidity Components

This table presents estimates of the difference in average cash ratios between the GM-Ford downgrade event period (the “Crisis Period”) and the preceding period, which ranges from June 2002 until the start of the crisis. The crisis period is defined as the period that goes from December 2004 to May 2005 (columns 1-3). In columns 4-6 we provide a robustness check using a placebo crisis (December 2003 to May 2004). We include only firm-years for which reporting occurred during any month of the fiscal years 2002-2004, or in June 2005. We require all firms to have data for the fiscal years 2003-2005. In columns 1 and 4, the treatment group includes firms with a rating (B- or better) in 2003. In columns 2 and 5, the treatment group includes firms with a rating (B- or better) in 2003 and with senior and subordinated bonds representing more than 50% of debt. In columns 3 and 6, the treatment group includes firms with a rating (B- or better) in 2003 and with senior and subordinated bonds representing more than 70% of debt.

	Variable: Cash / (Cash + Undrawn Credit Lines)					
	GM-Ford Crisis December 2004-May 2005			Placebo Crisis December 2003-May 2004		
	(1) Rated 2003	(2) Rated 2003 with bonds >50% of debt	(3) Rated 2003 with bonds >70% of debt	(4) Rated 2002	(5) Rated 2002 with bonds >50% of debt	(6) Rated 2002 with bonds >70% of debt
Crisis Dummy	-0.012	-0.021***	-0.019***	-0.047***	-0.053***	-0.056***
	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)
Treatment Dummy	-0.039**	-0.051***	-0.049***	-0.013	-0.021	-0.026
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Treatment*Crisis	0.022*	0.065***	0.071***	-0.018	0.001	0.022
	(0.013)	(0.015)	(0.015)	(0.013)	(0.015)	(0.016)
Profitability	-0.061*	-0.059*	-0.060*	-0.061**	-0.061*	-0.060*
	(0.034)	(0.034)	(0.034)	(0.031)	(0.031)	(0.031)
Size	-0.014***	-0.014***	-0.014***	-0.017***	-0.016***	-0.017***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Book Leverage	-0.365***	-0.363***	-0.362***	-0.339***	-0.339***	-0.337***
	(0.033)	(0.033)	(0.033)	(0.031)	(0.031)	(0.031)
M/B	0.023***	0.023***	0.023***	0.019***	0.019***	0.020***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Tangibility	-0.208***	-0.211***	-0.210***	-0.210***	-0.210***	-0.211***
	(0.038)	(0.038)	(0.038)	(0.037)	(0.037)	(0.037)
NWC/Assets	-0.659***	-0.659***	-0.659***	-0.514***	-0.514***	-0.514***
	(0.034)	(0.034)	(0.034)	(0.033)	(0.033)	(0.033)
Capex/Assets	-0.192	-0.190	-0.195	-0.072	-0.073	-0.071
	(0.128)	(0.128)	(0.128)	(0.133)	(0.133)	(0.133)
R&D/Sales	-0.001	-0.001	-0.001	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Dividend Payer	-0.055***	-0.056***	-0.057***	-0.048***	-0.048***	-0.049***
	(0.013)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
CF Volatility	-0.035	-0.044	-0.043	-0.095	-0.093	-0.094
	(0.184)	(0.184)	(0.184)	(0.163)	(0.163)	(0.163)
Beta KMV	0.023***	0.024***	0.023***	0.020***	0.020***	0.019***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Ind. Mean Cash Ratio	0.393***	0.391***	0.391***	0.361***	0.362***	0.361***
	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)
Observations	4,705	4,705	4,705	4,775	4,775	4,775
R-squared	0.444	0.445	0.446	0.357	0.357	0.357

Table 6

Cash vs. Credit Line Margins over the GM-Ford Crisis

This table examines the cash and credit line margins during the GM-Ford downgrade crisis. The crisis period is defined as the period that goes from December 2004 to May 2005. We include only firm-years for which reporting occurred during any month of the fiscal years 2002-2004, or in June 2005. We require all firms to have data for the fiscal years 2003-2005. In columns 1 and 4, the treatment group includes firms with a rating (B- or better) in 2003. In columns 2 and 5, the treatment group includes firms with a rating (B- or better) in 2003 and with senior and subordinated bonds representing more than 50% of debt. In columns 3 and 6, the treatment group includes firms with a rating (B- or better) in 2003 and with senior and subordinated bonds representing more than 70% of debt.

	Cash / Assets GM-Ford Crisis December 2004-May 2005			Undrawn Credit Lines/ Assets GM-Ford Crisis December 2004-May 2005		
	(1) Rated 2003	(2) Rated 2003 with bonds >50% of debt	(3) Rated 2003 with bonds >70% of debt	(4) Rated 2003	(5) Rated 2003 with bonds >50% of debt	(6) Rated 2003 with bonds >70% of debt
Crisis Dummy	-0.021***	-0.023***	-0.022***	-0.001	-0.001	-0.002
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Treatment Dummy	-0.001	-0.004	-0.002	0.009	0.009	0.008
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Treatment*Crisis	0.015***	0.025***	0.026***	-0.010*	-0.010**	-0.007
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Profitability	0.007	0.008	0.007	0.080***	0.080***	0.080***
	(0.023)	(0.023)	(0.023)	(0.014)	(0.014)	(0.014)
Size	-0.015***	-0.015***	-0.015***	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Book Leverage	-0.144***	-0.144***	-0.143***	0.037***	0.037***	0.037***
	(0.014)	(0.014)	(0.014)	(0.011)	(0.011)	(0.011)
M/B	0.021***	0.021***	0.021***	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Tangibility	-0.156***	-0.157***	-0.157***	-0.013	-0.013	-0.013
	(0.013)	(0.013)	(0.013)	(0.012)	(0.012)	(0.012)
NWC/Assets	-0.222***	-0.222***	-0.222***	0.173***	0.173***	0.173***
	(0.015)	(0.015)	(0.015)	(0.014)	(0.014)	(0.014)
Capex/Assets	-0.064	-0.064	-0.066	0.082*	0.083*	0.083*
	(0.049)	(0.049)	(0.049)	(0.046)	(0.046)	(0.046)
R&D/Sales	0.000	0.000	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Dividend Payer	-0.007*	-0.008*	-0.008*	0.027***	0.027***	0.027***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
CF Volatility	0.571***	0.568***	0.569***	0.236***	0.237***	0.236***
	(0.114)	(0.114)	(0.114)	(0.082)	(0.083)	(0.083)
Beta KMV	0.004***	0.004***	0.004***	-0.004***	-0.004***	-0.004***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Ind. Mean Cash Ratio	0.041***	0.040***	0.040***	-0.080***	-0.079***	-0.079***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Observations	4,689	4,689	4,689	4,707	4,707	4,707
R-squared	0.429	0.430	0.430	0.194	0.194	0.193

Table 7

Credit Line Usage across Top and Bottom Quintiles of Hedging Needs

This table provides summary statistics across groups of high versus low correlation of investment opportunities and cash-flow (*low* and *high hedging needs*, respectively). In Panel A, we examine the relationship between hedging needs and liquidity variables. Hedging needs are calculated at the 3-digit SIC code industry level as the correlation between firm-level cash flow and the mean industry annual investment activities (*Hedging Investment Activities*, item 311 + 46), and the median industry Tobin's Q (*Hedging Tobin's Q*). High hedging needs firms are those with a correlation in the bottom quintile, and low hedging needs are those with a correlation in the top quintile. In Panel B, we examine the relationship between hedging needs and the residuals computed from the regressions in Table 2. In both panels we include a test for differences between samples with high and low hedging needs using the unequal variances t-test. Total liquidity is cash and short-term investments plus undrawn credit.

Panel A: Univariate relationship between hedging needs and liquidity variables

	Variable: Mean (Median)			
	Presence of a Credit Line (Dummy)	Undrawn Credit / Assets	Undrawn Credit / Total Liquidity	Revolving Credit /Assets
Industry median Invest. Activities				
High hedging needs	0.570	0.070	0.290	0.025
N=4350	(1.000)	(0.026)	(0.118)	(0.000)
Low hedging needs	0.830	0.122	0.583	0.061
N=4370	(1.000)	(0.099)	(0.685)	(0.005)
t-test	27.60	22.35	39.39	19.21
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)
Industry median Tobin's Q				
High hedging needs	0.731	0.096	0.431	0.032
N=4061	(1.000)	(0.070)	(0.431)	(0.000)
Low hedging needs	0.816	0.121	0.557	0.063
N=4346	(1.000)	(0.097)	(0.656)	(0.003)
t-test	9.30	10.08	16.11	14.99
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)

Panel B: Relationship between hedging needs and the regression residuals from Table 2

	Variable: Mean (Median)			
	Presence of a Credit Line (Dummy)	Undrawn Credit / Assets	Undrawn Credit / Total Liquidity	Revolving Credit /Assets
Industry median Invest, Activities				
High hedging needs	0.069	0.000	0.024	0.004
N=4350	(0.356)	(-0.023)	(-0.016)	(-0.004)
Low hedging needs	0.164	0.007	0.028	0.007
N=4370	(0.345)	(-0.017)	(0.087)	(-0.016)
t-test	4.225	2.940	0.616	1.748
(p-value)	0.000	0.003	0.538	0.080
Industry median Tobin's Q				
High hedging needs	0.146	-0.001	-0.002	-0.005
N=4061	(0.416)	(-0.024)	(-0.008)	(-0.016)
Low hedging needs	0.178	0.006	0.026	0.012
N=4346	(0.356)	(-0.016)	(0.084)	(-0.014)
t-test	1.524	2.782	3.909	8.864
(p-value)	0.128	0.005	0.000	0.000

Table 8
Hedging Needs and Covenants on Credit Lines

This table estimates the relationship between hedging needs and the use of covenants on credit lines using a Poisson specification. Hedging needs are calculated at the 3-digit SIC code industry level as the correlation between firm-level cash flow and the mean industry annual investment activities (*Hedging Investment Activities*, item 311 + 46), and the median industry Tobin's Q (*Hedging Tobin's Q*). We obtain data on covenants from LPC Dealscan. We list all the covenants attached to credit lines for the firms in our sample during the period 2002-2008. In most cases, firms are granted several new credit line facilities in the same year. For these cases we report the median number of covenant across facilities. *General Purpose LC* is a dummy that takes value 1 if the stated purpose of the line of credit is "General Corporate Purposes", as reported in LPC Dealscan. When firms are granted several new credit line facilities in the same year we report the median value. All regressions include year fixed effects. Robust standard errors clustered at the firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Covenant Index Drucker and Puri (2010)		Covenant Index Demiroglu and James (2010)		Covenant Index Only CF Covenants		Covenant Index Only Sweeps	
Hedging Inv. Activities	-0.186***		-0.126*		-0.812***		-0.526***	
	(0.055)		(0.071)		(0.113)		(0.115)	
Hedging Tobin's Q		-0.022		0.107		-0.789***		-0.302**
		(0.063)		(0.082)		(0.131)		(0.133)
Profitability	0.459***	0.438***	0.297**	0.272**	0.755***	0.723***	0.482**	0.447**
	(0.090)	(0.090)	(0.117)	(0.117)	(0.187)	(0.185)	(0.206)	(0.204)
Size	-0.189***	-0.191***	-0.176***	-0.178***	-0.216***	-0.224***	-0.268***	-0.274***
	(0.006)	(0.006)	(0.008)	(0.008)	(0.012)	(0.012)	(0.012)	(0.012)
Book Leverage	0.611***	0.608***	0.651***	0.656***	0.834***	0.780***	1.422***	1.402***
	(0.038)	(0.038)	(0.049)	(0.049)	(0.072)	(0.072)	(0.068)	(0.068)
MB	-0.118***	-0.114***	-0.128***	-0.123***	-0.146***	-0.143***	-0.223***	-0.216***
	(0.010)	(0.010)	(0.013)	(0.013)	(0.020)	(0.020)	(0.023)	(0.023)
Rated	0.029	0.029	0.015	0.014	-0.017	-0.004	0.208***	0.217***
	(0.021)	(0.021)	(0.027)	(0.027)	(0.041)	(0.041)	(0.042)	(0.042)
CF Volatility	-0.431	-0.422	0.366	0.361	-0.405	-0.293	-0.606	-0.655
	(0.490)	(0.491)	(0.632)	(0.633)	(0.977)	(0.983)	(1.064)	(1.069)
Current Ratio	0.008	0.007	0.028	0.029	-0.021	-0.033	0.013	0.011
	(0.019)	(0.019)	(0.025)	(0.025)	(0.040)	(0.040)	(0.040)	(0.039)
General Purpose LC	-0.160***	-0.161***	-0.181***	-0.182***	-0.170***	-0.172***	-0.380***	-0.381***
	(0.016)	(0.016)	(0.021)	(0.021)	(0.033)	(0.033)	(0.034)	(0.033)
Ln(Maturity) of LC	0.408***	0.410***	0.499***	0.502***	0.475***	0.480***	0.785***	0.792***

	(0.017)	(0.017)	(0.023)	(0.023)	(0.034)	(0.034)	(0.040)	(0.040)
Facility Amount/At	-0.419***	-0.435***	-0.236***	-0.257***	-0.718***	-0.723***	-0.970***	-0.998***
	(0.050)	(0.050)	(0.063)	(0.063)	(0.104)	(0.104)	(0.111)	(0.111)
Observations	4,499	4,515	4,499	4,515	4,499	4,515	4,499	4,515
Pseudo R^2	0.108	0.108	0.0952	0.0951	0.0878	0.0866	0.151	0.150

Table 9

Hedging Needs and Covenant Violation

We estimate the relationship between the violation of a covenant and the hedging needs of firms, using a Probit estimation. The dependent variable is a dummy for the presence of at least one covenant violation during that year. Hedging needs are calculated at the 3-digit SIC code industry level as the correlation between firm-level cash flow and the mean industry annual investment activities (*Hedging Investment Activities*, item 311 + 46), and the median industry Tobin's Q (*Hedging Tobin's Q*). The sample consists of non-utilities (excluding SIC codes 4900-4949) and non-financials (excluding SIC codes 6000-6999) U.S. firms covered by Capital IQ, Compustat and LPC DealScan that have information on covenant violations (online data obtained from Sufi's website (Nini, Smith, Sufi (2010)) over the period 2002 to 2008. The variable *Covenant Index* is calculated as in Drucker and Puri (2010). Robust standard errors clustered at the firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
	Covenant Violation (Dummy)			
Hedging Inv. Activities	-0.464***	-0.477***		
	(0.173)	(0.182)		
Hedging Tobin's Q			-0.381*	-0.380*
			(0.201)	(0.213)
Covenant Index	0.047***	0.018**	0.047***	0.019**
	(0.008)	(0.009)	(0.008)	(0.009)
Profitability	-3.409***	-2.562***	-3.457***	-2.609***
	(0.262)	(0.279)	(0.262)	(0.278)
Size		-0.182***		-0.183***
		(0.024)		(0.024)
Book Leverage		0.669***		0.635***
		(0.135)		(0.135)
MB		-0.182***		-0.179***
		(0.033)		(0.033)
CF Volatility		0.001*		0.001*
		(0.000)		(0.000)
Rated		-0.173**		-0.171**
		(0.077)		(0.077)
Constant	-0.929***	0.404***	-0.903***	0.441***
	(0.049)	(0.156)	(0.052)	(0.157)
Observations	4,367	4,273	4,384	4,289

Table A1: Robustness Checks on Columns 1-3 of Table 2

This table presents Probit and OLS regression results to study the relationship between profitability and restriction of access to credit lines. In columns (1)-(2) the dependent variable is a dummy for the incidence of full credit line revocation. Columns (3)-(4) display OLS regression results in which the dependent variable is the decrease in undrawn credit as a % of firm assets. In columns (5)-(6) the dependent variable is a dummy for a decrease in undrawn credit greater than 30% of the outstanding amount. Year, Rating and Exchange fixed effects included. Rating fixed effects are based on 22 rating dummies and the unrated dummy. Robust standard errors clustered at the firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels. All regressions include a constant term (unreported).

	(1)	(2)	(3)	(4)	(5)	(6)
	Full Revocation of Credit Lines (Dummy)		Partial Revocation of Credit Lines		Partial Revocation of Credit Lines (Dummy)	
Profits > 0%	-0.453***		-0.010**		-0.338***	
	(0.080)		(0.004)		(0.052)	
Profits > 5%		-0.406***		-0.014***		-0.350***
		(0.067)		(0.003)		(0.041)
Size	-0.010	-0.015	-0.001	-0.000	0.002	0.003
	(0.027)	(0.026)	(0.001)	(0.001)	(0.013)	(0.013)
Book Leverage	-0.655***	-0.615***	0.021***	0.022***	0.603***	0.622***
	(0.170)	(0.171)	(0.005)	(0.005)	(0.092)	(0.094)
M/B	0.072***	0.080***	-0.001*	-0.001	-0.020	-0.012
	(0.018)	(0.018)	(0.001)	(0.001)	(0.013)	(0.014)
Tangibility	-0.026	-0.046	-0.024***	-0.023***	-0.353***	-0.344***
	(0.198)	(0.195)	(0.005)	(0.005)	(0.091)	(0.091)
NWC/Assets	-1.257***	-1.255***	-0.020***	-0.017***	-0.603***	-0.562***
	(0.181)	(0.180)	(0.005)	(0.005)	(0.096)	(0.096)
Capex/Assets	-1.677**	-1.490**	0.077***	0.080***	1.438***	1.537***
	(0.742)	(0.721)	(0.019)	(0.019)	(0.289)	(0.289)
R&D/Sales	0.002	0.003	0.000	0.000	0.003	0.004
	(0.006)	(0.006)	(0.000)	(0.000)	(0.007)	(0.007)
Div. Payer Dummy	-0.244***	-0.229***	0.002	0.003*	-0.103***	-0.091***
	(0.077)	(0.077)	(0.002)	(0.002)	(0.032)	(0.033)
Industry Sigma	3.163*	2.583	-0.061	-0.068	1.041	0.793
	(1.889)	(1.818)	(0.050)	(0.049)	(0.936)	(0.930)
Beta KMV	0.048**	0.046**	0.002***	0.002**	0.031**	0.030**
	(0.022)	(0.022)	(0.001)	(0.001)	(0.012)	(0.012)
Observations	9,930	9,930	10,244	10,244	10,238	10,238
R-squared			0.011	0.013		

Table A2: Robustness Checks on Column 4 of Table 2

This table presents regression results to study the relationship between profitability and drawdowns of credit lines. The dependent variable is the annual variation in drawn credit lines. *Profits > 0%* and *Profits > 5%* are dummies for profitability being respectively above 0% and 5%. Year, Rating and Exchange fixed effects included. Rating fixed effects are based on 22 rating dummies and the unrated dummy. Robust standard errors clustered at the firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
	Changes in Drawn Credit Lines			
Profits > 0%	-0.008***			
	(0.002)			
Profits > 5%		-0.009***		
		(0.002)		
Change in Profitability			-0.056***	
			(0.013)	
Increases in Profitability				-0.055***
				(0.017)
Decreases in Profitability				-0.057**
				(0.025)
Size	-0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Book Leverage	0.030***	0.030***	0.029***	0.029***
	(0.004)	(0.004)	(0.004)	(0.004)
M/B	-0.001**	-0.001	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Tangibility	-0.021***	-0.021***	-0.020***	-0.020***
	(0.004)	(0.004)	(0.004)	(0.004)
NWC/Assets	-0.006*	-0.005	-0.009***	-0.009***
	(0.003)	(0.003)	(0.003)	(0.003)
Capex/Assets	0.105***	0.107***	0.093***	0.093***
	(0.017)	(0.017)	(0.017)	(0.016)
R&D/Sales	-0.000**	-0.000**	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Div. Payer Dummy	0.005***	0.005***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Industry Sigma	-0.020	-0.025	-0.021	-0.021
	(0.027)	(0.027)	(0.026)	(0.026)
Beta KMV	0.001	0.000	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.009*	-0.009**	-0.013***	-0.013***
	(0.005)	(0.005)	(0.005)	(0.005)
Observations	10,219	10,219	10,219	10,219
R-squared	0.046	0.047	0.053	0.053

Table A3

Robustness Tests on GM-Ford Crisis

This table presents two robustness checks for our tests on the GM-Ford crisis (Table 5). In column 1-3 we sort firms conditional on having a rating in 2002 (rather than 2003 as in the main table). In columns 4-6 we include June 2005 in the crisis period.

	Variable: Cash / (Cash + Undrawn)					
	Sorting in 2002 December 2004-May 2005			Alternative Definition of Crisis December 2004-June 2005		
	(1) Rated 2002	(2) Rated 2002 with bonds >50% of debt	(3) Rated 2002 with bonds >70% of debt	(4) Rated 2003	(5) Rated 2003 with bonds >50% of debt	(6) Rated 2003 with bonds >70% of debt
Crisis Dummy	-0.012	-0.020***	-0.018**	-0.015**	-0.024***	-0.022***
	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)
Treatment Dummy	-0.041**	-0.052***	-0.050***	-0.041**	-0.053***	-0.051***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Treatment*Crisis	0.024*	0.065***	0.069***	0.024**	0.065***	0.072***
	(0.013)	(0.015)	(0.016)	(0.011)	(0.014)	(0.015)
Profitability	-0.061*	-0.059*	-0.060*	-0.061*	-0.060*	-0.060*
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
Size	-0.014***	-0.014***	-0.014***	-0.014***	-0.014***	-0.014***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Book Leverage	-0.365***	-0.364***	-0.363***	-0.365***	-0.363***	-0.361***
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
M/B	0.023***	0.023***	0.023***	0.023***	0.023***	0.023***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Tangibility	-0.206***	-0.209***	-0.208***	-0.209***	-0.212***	-0.211***
	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)
NWC/Assets	-0.660***	-0.660***	-0.660***	-0.659***	-0.659***	-0.659***
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
Capex/Assets	-0.198	-0.194	-0.201	-0.188	-0.185	-0.190
	(0.128)	(0.128)	(0.128)	(0.128)	(0.128)	(0.128)
R&D/Sales	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Dividend Payer	-0.055***	-0.056***	-0.056***	-0.055***	-0.056***	-0.056***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
CF Volatility	-0.031	-0.040	-0.039	-0.042	-0.052	-0.052
	(0.184)	(0.184)	(0.184)	(0.184)	(0.184)	(0.184)
Beta KMV	0.023***	0.024***	0.023***	0.023***	0.024***	0.024***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Ind. Mean Cash Ratio	0.394***	0.393***	0.393***	0.393***	0.392***	0.392***
	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)
Observations	4,705	4,705	4,705	4,705	4,705	4,705
R-squared	0.444	0.445	0.445	0.444	0.445	0.446

Table A4

Exogeneity Checks on the GM-Ford Event

This table examines possible liquidity shocks associated with the GM-Ford downgrade. Columns 1-3 examine the restriction of access to credit lines in association with the GM-Ford event. Columns 4-6 examine covenant violations associated with the GM-Ford event. The crisis period is defined as the period that goes from December 2004 to May 2005. We include only firm-years for which reporting occurred during any month of the fiscal years 2002-2004, or in June 2005. We require all firms to have data for the fiscal years 2003-2005 and to have an outstanding credit line. Depending on the column, the treatment group includes firms with a rating (B- or better) in 2003 and with senior and subordinated bonds representing more than 50% or 70% of debt. Robust standard errors clustered at the firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels. All regressions include a constant term (unreported).

	(1)	(2)	(3)	(4)	(5)	(6)
	Revocation of Credit Line (Dummy)			Covenant Violation (Dummy)		
	Rated 2003	Rated 2003 with bonds >50% of debt	Rated 2003 with bonds >70% of debt	Rated 2003	Rated 2003 with bonds >50% of debt	Rated 2003 with bonds >70% of debt
Crisis Dummy	0.063	0.062	0.074	0.068	0.034	0.008
	(0.158)	(0.152)	(0.150)	(0.118)	(0.107)	(0.105)
Treatment Dummy	-0.364	-0.374	-0.282	-0.134	-0.252	-0.345**
	(0.418)	(0.321)	(0.270)	(0.214)	(0.165)	(0.152)
Treatment*Crisis	0.182	0.246	0.125	-0.321	-0.218	-0.076
	(0.436)	(0.337)	(0.308)	(0.230)	(0.189)	(0.181)
Profitability	0.254	0.263	0.257	-1.904***	-1.909***	-1.905***
	(0.373)	(0.371)	(0.373)	(0.467)	(0.468)	(0.470)
Size	-0.064	-0.065	-0.064	-0.068*	-0.065*	-0.066*
	(0.058)	(0.058)	(0.058)	(0.036)	(0.036)	(0.036)
Book Leverage	-0.168	-0.168	-0.161	1.361***	1.351***	1.352***
	(0.478)	(0.480)	(0.479)	(0.242)	(0.241)	(0.241)
M/B	0.029	0.029	0.029	-0.367***	-0.367***	-0.367***
	(0.036)	(0.036)	(0.036)	(0.066)	(0.066)	(0.067)
Tangibility	-0.486	-0.500	-0.482	-0.086	-0.068	-0.083
	(0.637)	(0.637)	(0.636)	(0.305)	(0.305)	(0.303)
NWC/Assets	-1.877***	-1.883***	-1.881***	-0.351	-0.347	-0.353
	(0.435)	(0.436)	(0.435)	(0.304)	(0.305)	(0.305)
Capex/Assets	0.464	0.453	0.437	0.113	0.087	0.086
	(2.002)	(2.006)	(1.999)	(1.046)	(1.041)	(1.042)
R&D/Sales	-0.025	-0.024	-0.025	-1.141	-1.092	-1.106
	(0.017)	(0.017)	(0.018)	(0.800)	(0.785)	(0.790)
Dividend Payer	-0.321*	-0.325*	-0.322*	-0.227**	-0.228**	-0.229**
	(0.188)	(0.187)	(0.187)	(0.106)	(0.106)	(0.106)
CF Volatility	1.193	1.210	1.190	7.514***	7.580***	7.558***
	(2.818)	(2.814)	(2.816)	(2.338)	(2.339)	(2.344)
Beta KMV	0.141***	0.141***	0.140***	-0.022	-0.021	-0.020
	(0.046)	(0.047)	(0.046)	(0.035)	(0.035)	(0.035)
Ind. Mean Cash Ratio	1.633***	1.621***	1.633***	0.471	0.452	0.449
	(0.518)	(0.516)	(0.520)	(0.326)	(0.325)	(0.324)
Observations	1,803	1,803	1,803	1,803	1,803	1,803
(Pseudo) R-2	0.211	0.211	0.211	0.172	0.171	0.171

Description of Variables

Variable	*Construction*
Beta KMV	Firm's asset (unlevered) beta, calculated from equity (levered) betas and a Merton-KMV formula as in Acharya, Almeida and Campello (2010)
Book Leverage	Total Debt / Total Assets (6)
BV Equity	Total Assets (6) – Total Liabilities (181) – Deferred Taxes and Investment Tax Credit (35) – Preferred Stock
Cash/Assets	Cash and Short-Term Investments (1) divided by Assets (item 6).
CF Volatility	Standard Deviation of Operating Income (13) over Previous 12 Quarters Scaled by Total Assets (6)
Covenant Index (Demiroglu and James (2010))	Sum of the following covenants: Collateral Release, Dividend Restrictions, Dummy Financial Covenants, Asset Sales Sweep, Equity Issuance Sweep, Debt Issuance Sweep. Where Dummy Financial Covenants equals one is at least two of the following covenants are included: Debt/Tangible Assets, Max Capex, Max Debt/Assets, Max Debt/Ebitda, Max Debt/Equity, Max Leverage, Max Senior Debt/Ebitda, Max Senior Leverage, Min Change Interest Coverage, Min Current Ratio, Min Debt Coverage, Min Ebitda, Min Equity/Asset, Min Fixed Charge, Min Interest Coverage, Min Net Worth/Assets, Min Quick Ratio, Net Worth, Other Ratio, Other, Tangible Net Worth.
Covenant Index (Drucker and Puri (2010)	Sum of following covenants: % Of Excess CF, % Of Net Income, Asset Sales Sweep, Collateral Release, Debt Issuance Sweep, Dividend Restrictions, Equity Issuance Sweep, Excess CF Sweep, Insurance Proceeds Sweep, Max Capex , Max Debt/Assets, Max Debt/Ebitda, Max Debt/Equity, Max Debt/Tangible Assets, Max Leverage, Max Senior Debt/Ebitda, Max Senior Leverage, Min Change Interest Coverage, Min Current Ratio, Min Debt Coverage, Min Ebitda, Min Equity/Asset, Min Fixed Charge, Min Interest Coverage, Min Net Worth/Assets, Min Quick Ratio, Net Worth, Other, Other Ratio, Tangible Net Worth.
Covenant Index (Only CF Covenants)	Sum of following covenants: % Of Excess CF, % Of Net Income, Excess CF Sweep, Max Capex, Max Debt/Ebitda, Max Senior Debt/Ebitda, Min Change Interest Coverage, Min Ebitda.
Covenant Index (Only Sweeps)	Sum of following covenants: Asset Sales Sweep, Debt Issuance Sweep, Equity Issuance Sweep, Excess CF Sweep, Insurance Proceeds Sweep.
Dividend Payer	A dummy variable that takes the value of one if common stock dividends (21) are positive, and zero otherwise
Hedging based on investment Activities	Correlation between three-digit median industry investment activities adjusted for R&D expenses (item 311 + 46) and the firm-year cash flows measured as in Acharya, Almeida and Campello (2007). The three-digit median industry investment activities is computed on the sample of unconstrained firms, defined as firms that pay dividends, have assets above $500m and rating above B+.
Hedging based on Tobin's Q	Correlation between three-digit median industry market-to-book and the firm-year cash flows measured as in Acharya, Almeida and Campello (2007). The three-digit median industry market-to-book is computed on the sample of unconstrained firms, defined as firms that pay dividends, have assets above $500m and rating above B+.
Investing Activities Net Cash Flow	- Increase in Investments (113) + Sale of Investments (109) + Change in Short Term Investments (309) - Capital Expenditures (128) + Sale of Property, Plant, and Equipment (107) - Acquisitions (129) + Investment Activities Other (310)

M/B	(Market Value of Equity + Total Debt + Preferred Stock Liquidating Value (10) – Deferred Taxes and Investment Tax Credit (35)) / Total Assets (6)
Market Value of Equity	Stock Price (199) × Common Shares Used to Calculate EPS (54)
Preferred Stock	Max[Preferred Stock Liquidating Value (10), Preferred Stock Redemption Value (56), Preferred Stock Carrying Value (130)]
Profitability	Operating Income Before Depreciation (13) / Total Assets (6)
Rated	A dummy variable that takes the value of one if the firm is rated by the S&P, and zero otherwise
Rating	Monthly S&P ratings (280). Takes 23 values: 1 = "AAA", 2="AA+", 3="AA", 4="AA-", 5="A+", 6="A", 7="A-", 8="BBB+", 9="BBB", 10="BBB-", 11="BB+", 12="BB", 13="BB-", 14="B+", 15="B", 16="B-", 17="CCC+", 18="CCC", 19="CCC-", 20="CC", 21="SD", 22="D", 23= Unrated
Size	Logarithm of Revenues (12)
Tangibility	Net Property, Plant, and Equipment (8) / Total Assets (6)
Total Debt	Debt in Current Liabilities (34) + Long-Term Debt (9)