Credit Lines as Monitored Liquidity Insurance: Theory and Evidence*

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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 (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 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 face covenants and revocations when using credit lines.

Key words: Liquidity management, cash holdings, liquidity risk, covenants, loan commitments, credit line revocation

JEL classification: G21, G31, G32, E22, E5.

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1 Introduction

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 (e.g., Holmstrom and Tirole (1997, 1998) and Shockley and Thakor (1997)). This pre-commitment creates value for credit lines as a corporate liquidity management tool, in that they help 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. 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 corporate CFOs do not always use credit lines as precautionary savings against negative profitability shocks, but also to help fund future growth opportunities.

We propose and test a theory of corporate liquidity management that bridges the gap between existing theory and empirical evidence on credit lines. This theory explains how credit line revocation following negative profitability shocks can be optimal, and it shows when the presence of future growth opportunities may induce firms to use credit lines in their liquidity management. The theory generates empirical predictions that we test using a novel dataset on credit lines, and a new identification strategy.

In the model, a fully committed credit line (that is, full and irrevocable liquidity insurance) creates the following problem. While it protects firms from value-destroying profitability shocks, once full 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 firm's incentive to engage in illiquidity transformation, because the bank retains the right (through credit line covenants, for example) to revoke access to the credit line if it obtains a signal that the firm may have engaged in illiquidity transformation. Crucially, bank monitoring and line revocation tend to happen in the same states in which the firm needs the credit line the most (liquidity-shock states). This coincidence arises because credit line drawdowns are negative NPV loans for the bank. Thus, the bank's incentive to monitor is strongest precisely when the firm attempts to draw on the credit line. And, in this way, credit line revocation provides incentives *both* for the firm to avoid illiquidity transformation, and for the bank to pay monitoring costs.

In this framework, the cost of credit line-provided liquidity insurance arises not only from direct monitoring costs, but also because credit line revocations cause the firm to pass on

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valuable investments. 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 to an important determinant of the choice between cash and credit lines - the firm's total liquidity risk. Firms with greater liquidity risk are monitored more often, causing direct and indirect monitoring costs (i.e., expected costs of credit line revocation) to increase, and as a result are particularly likely to forego monitored liquidity insurance and to switch to self-insurance (cash holdings).

We extend the model to allow firms to demand liquidity not only to absorb negative profitability 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 credit line revocation both limits the continuation of existing projects, and stops the firm from undertaking new investments. 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). 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 implies that firms with *low hedging needs* (high correlation between cash flows and investment opportunities) are less likely to use cash relative to credit lines, and are also less likely to require credit line covenants and revocation when using credit lines for liquidity insurance.

Overall, our model provides two sets of empirically testable 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 and revocations. We test these predictions using a novel dataset on credit lines from Capital IQ (CIQ). The data cover a large sample of firms in the United States for the period of 2002 to 2011. CIQ compiles detailed information on capital structure and debt structure by going through financial footnotes contained in firms' 10-K Securities and Exchange Commission (SEC) filings. In particular, CIQ contains detailed information on the drawn and undrawn portions of lines of credit.

We test the implication that an increase in liquidity risk decreases reliance on credit lines by exploiting a quasi-experiment: the downgrade of General Motors (GM) and Ford in 2005. The downgrade came as an exogenous and unexpected shock, especially for firms not in the auto sector. 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

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that operated as market makers for the securities issued by the two auto makers. The resulting effect on corporate bond prices went beyond the bonds of GM and Ford and of other producers in the auto sector, creating a widespread increase in liquidity risk that affected firms that relied on publicly-traded bonds for their financing.

Consistent with the 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. More specifically, we find that while "treated" firms had on average around 5% less cash holdings as a share of total liquidity relative to "control" firms before the GM-Ford downgrade, following the downgrade their cash holdings were on average around 2% higher as a share of total liquidity relative to "control" firms. A placebo test in a period outside of the downgrade episode reveals no such effect. Further, we find that there is both an increase in cash holdings and a decrease in credit line usage for the "treated" firms relative to the "control" firms.

Next, 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.

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, moving from the bottom quintile to the top quintile of hedging-needs is associated on average with a decrease of between 17% and 19% in the probability of having a line of credit, holding other variables constant. The credit lines of low hedging-needs firms are also less likely to contain covenants, and to be revoked by banks. These findings support the model's implications that credit lines are less costly for low-hedging needs firms, and that for such firms, the credit line provider (the bank) is less likely to retain revocation rights through covenants and to exercise them. In particular, these findings stem uniquely from the feature of our model that firms taking out lines of credit are monitored by banks that provide the lines by inclusion of contract terms such as covenants and by invoking them ex post; the high expected cost of monitoring and the ex-post revocation costs for high-hedging needs firms (which face a greater illiquidity transformation problem)

induce these firms in equilibrium to rely more on cash rather than on lines of credit.

While we see the new identification strategy for the liquidity risk tests and the hedging needs tests (which together provide support for lines of credit being a form of monitored finance) as the main empirical contributions of the paper, we show that our results are also consistent with existing empirical evidence. Our main goal is to show that the Capital IQ data delivers results that closely resemble those obtained with other datasets. For example, Capital IQ data confirm earlier findings 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. Credit line users tend to have higher bond ratings, and are more likely to have a rating when compared to firms that use cash for liquidity management. We also confirm Sufi's (2009) finding that credit lines tend to get revoked following decreases in profitability. In addition, we find evidence 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. For instance, 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. This result shows that the *ex-post* usage of credit lines and cash to meet liquidity needs is consistent with *ex-ante* differences in liquidity risk exposure across firms.

Our evidence is also related to Sufi (2009)'s result that firms with low profitability and high cash flow risk are less likely to use credit lines and more likely to use cash for liquidity management because they face a greater risk of covenant violation and credit line revocation.[1] Our theory and tests provide the new insight that credit line revocation following negative profitability shocks can be an optimal way to incentivize firms to not strategically increase liquidity risk of projects and banks to monitor firms to contain the illiquidity transformation problem.

Our findings on the role of hedging needs for liquidity management are related to those in Disatnik, Duchin and Schmidt (2010). They find that firms that use more derivatives-based hedging are also more likely to use credit lines to manage liquidity risk, because derivatives hedging reduces the risk of covenant violations. Our analysis differs in several dimensions. First, on the theoretical side we focus both on the management of liquidity risk and the funding of future investment opportunities. Second, we use an industry-level proxy for hedging needs rather than observed derivatives hedging, which is endogenously determined by the firm. Third, we provide evidence that hedging needs are related not only to observed liquidity

[1] The growing empirical literature on the role of credit lines in corporate finance also includes Yun (2009), Campello, Giambona, Graham, and Harvey (2010), and Acharya, Almeida and Campello (2012).

policies, but also to features of credit line contracts such as covenants and realized credit line revocations.

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

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

[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 $\rho = I_1$.

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 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 $\widehat{\lambda}$. Notice that the key difference between the liquidity need ρ, and the investment opportunity τ is that τ can arrive in both states of the world, whereas the liquidity need ρ arises only when firm cash flows are low (state $\lambda^{'}$). 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, liquid security (such as a Treasury bond) at date-0. The price of the bond is equal to q, which we take as exogenous. Holmstrom and Tirole endogenize the cost of cash and show that if the demand for liquid securities is high enough the firm may need to pay a liquidity premium to transfer cash across time (that is, $q > 1$ in equilibrium). In what follows we assume that $q = 1$, such that there is no liquidity premium. We note, however, that the model implications also hold when $q > 1$. In Section 3 we discuss the implications of the liquidity premium for the model predictions.

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

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

exchange for the right to draw on additional funds (up to a maximum equal to w) in state $\widehat{\lambda}$.[4] We assume that the bank can provide the credit line at zero deadweight cost, that is, the bank can offer contracts such that $(1-\widehat{\lambda})y = \widehat{\lambda}w$ ((e.g., actuarially fair insurance). As shown by Acharya, Almeida and Campello (2012), the bank should be able to offer fair insurance to firms that have idiosyncratic liquidity risk, but may need to increase the cost of credit line provision if liquidity risk is correlated across firms. In Section 3 we discuss the impact of such costs for the model implications.

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. 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

[4] In this model the firm does not need to repay the credit line drawdown w, that is, the drawdown of the credit line generates no liability. More generally, we can interpret w as the difference between the credit line drawdown, and the present value of the repayments from the firm to the bank. As discussed by Tirole (2006), the key insurance feature of the credit line is that it forces the bank to make loans that are (ex-post) negative-NPV for the bank. The bank breaks even through commitment fees y.

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:

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

and

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

Condition 7 ensures that the bank has incentives to pay the monitoring cost, if the firm is expected to draw on the credit line, since the credit line drawdown results in a loss of $\rho - \rho_0$ for the bank. Notice that this loss arises because the credit line allows the firm to access more funding than what its pledgeable income allows. In other words, the insurance role of the credit line and bank incentives to monitor are inherently linked. In particular, the bank does not have incentives to monitor if the firm does not report a liquidity shock. Thus, this framework helps explain why credit line revocation may happen precisely in states of the world when the firm needs the credit line the most.

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

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

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

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:

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

The term $\lambda\left[c + \mu(\rho_1 - \rho)\right]$ 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} 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 *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 $U^C = \rho_1^{'} - \lambda^{'}\rho - I$.*

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. In particular, cash is a better alternative for the firm in this case than a *non-monitored* credit line. 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:

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 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

revocation of credit line access. Thus, firms with high liquidity risk prefer to avoid monitored liquidity insurance and use cash for liquidity management.

2.2.3 Pledgeable income and liquidity risk

Proposition 3 characterizes the impact of liquidity risk on the firm's choice between cash and credit lines. In the model above the probability λ is an exogenous parameter that establishes the probability that the firm will suffer a liquidity shortfall. In terms of real world data, the probability λ should be a function of variables such as the firm's cash flow risk and the firm's ability to raise external finance. The cash flow risk interpretation directly matches the model presented above (see footnote 2). In the model the ability to raise external funds is captured by the parameter ρ_0. However, there is no link between ρ_0 and λ in the model.

As it turns out, the lack of link between liquidity risk and pledgeable income in the model is an artificial feature that is caused by the binomial structure of the model. It is straightforward to extend the model to a more general case in which the date-1 liquidity shock $\widehat{\rho}$ can assume values in a range $[0, \rho^{\max}]$ according to a distribution function $\widehat{F}(.)$.[6] This extension allows us to derive implications relating pledgeable income and the choice between cash and credit lines.

In this version of the model, illiquidity transformation can be modeled as a shift in the distribution function $\widehat{F}(.)$, which also affects the expected project payoff $\widehat{\rho_1}$. Specifically, we assume that the liquid project is represented by a function $F(.)$, and an expected payoff ρ_1, while the illiquid project is represented by a function $F^{'}(.) \leq F(.)$ for all ρ, and an expected payoff $\rho_1^{'} > \rho_1$. The former condition means that the probability that ρ is below any given value ρ_X is greater under the liquid project choice. That is, the illiquid project shifts mass towards high levels of the liquidity shock. As in the model above, we assume that illiquidity transformation does not affect date-1 pledgeable income ρ_0.

The main result, which we prove in the appendix, is that a decrease in pledgeable income ρ_0 makes it more likely that the firm will choose cash instead of the credit line. The intuition for this result is that a decrease in pledgeable income increases the firm's liquidity risk (the probability that it will require liquidity infusions from the credit line), and consequently the monitoring cost of the credit line. As pledgeable income decreases, the bank's incentive to monitor the firm increases, increasing direct and indirect monitoring costs. Thus, this model extension generates the implication that an increase in liquidity risk that is due to a reduction in pledgeable income makes it more likely that firms will choose cash rather than credit lines.

[6] We assume that $\rho^{\max} < \rho_1$, so that date-1 continuation is efficient for all values of the liquidity shock.

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 depicted in Figure 1, 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:

$$\begin{aligned} (1-\lambda)\upsilon^H + \lambda\upsilon^L &\equiv \overline{\upsilon} \\ (1-\lambda^{'})\upsilon^H + \lambda^{'}\upsilon^L &\equiv \overline{\upsilon}^{'} \end{aligned} \tag{11}$$

We maintain the basic assumptions of Section 2.2.1 (Equations 1, 2, 3, 4, 6, 7 and 8). In addition, we make the following assumptions:

$$\rho^{\tau} > \tau. \tag{12}$$

$$I + \lambda\rho + \overline{\upsilon}\tau \leq \rho_0. \tag{13}$$

$$(1-\lambda')(\rho_1^{'} + \upsilon^H(\rho^{\tau} - \tau)) < I \tag{14}$$

The first condition means that the new growth opportunity is positive NPV. 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 the 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:

$$U_b = \rho_1 - I - \lambda\rho - \overline{\upsilon}\tau + \overline{\upsilon}\rho^{\tau}. \tag{15}$$

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:

$$U_b^{'} = \rho_1^{'} - I - \lambda\rho - \overline{\upsilon}\tau + \overline{\upsilon}^{'}\rho^{\tau}. \tag{16}$$

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

$$\rho_1^{'} - \rho_1 \leq (\upsilon^H - \upsilon^L)(\lambda^{'} - \lambda)\rho^{\tau}. \tag{17}$$

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 if 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. In this case, bank monitoring is identical to the previous model. In particular, the bank has incentives to monitor the firm in the low cash flow state by condition 7.[7]

The next proposition characterizes the payoffs if condition 17 is not obeyed.

Proposition 4 *If condition 17 does not hold, and under assumptions 12, 13 and 14, 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* $\rho_0 - \lambda^{'}\rho - I - \overline{\upsilon}^{'}\tau > 0$, *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* $U_{\tau}^{C} = \rho_1^{'} - \lambda^{'}\rho - I + \overline{\upsilon}^{'}(\rho^{\tau} - \tau)$.

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:

$$\begin{aligned} U_{\tau}^{C} - U_{\tau}^{LC} \;\; = \;\; & \rho_1^{'} - \rho_1 - (\lambda^{'} - \lambda)\rho + \lambda\left[c + \mu\left[\rho_1 - \rho + \upsilon^L(\rho^{\tau} - \tau)\right]\right] + \\ & + (\overline{\upsilon}^{'} - \overline{\upsilon})(\rho^{\tau} - \tau) \end{aligned} \tag{18}$$

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 $\overline{\upsilon}^{'} - \overline{\upsilon} =$

[7] The only question is whether the bank may also monitor the firm in the high cash flow state, in the case in which $\tau > \rho_0$. In this case, the firm can use the credit line to help finance the new growth opportunity. Provided that $\mu(\tau - \rho_0) > c$, the bank would have incentives to monitor and deny access to the credit line. In this case, monitoring would happen both in the high and in the low cash flow states. However, this monitoring is wasteful because monitoring in the low cash flow state is sufficient to provide incentives to the firm (see the proof to Proposition 4). Excessive monitoring can be avoided through a covenant that restricts credit line revocation to the state of the world in which the firm has low cash flow.

$-(\upsilon^H - \upsilon^L)(\lambda^{'} - \lambda))$. 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 5 *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 18 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 18, 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 6 *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 5) can have a perfectly committed credit line when condition 17 holds.*

For the firm with high hedging needs, condition 17 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 17 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

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 17 becomes:

$$\rho_1^{'} - \rho_1 \leq \left[(\upsilon^H - \upsilon^L)(\lambda^{'} - \lambda) - (1-\lambda^{'})(\upsilon'^H - \upsilon^H)\right] \rho^{\tau} \tag{19}$$

The bottom line is that this additional effect makes it less likely that condition 17 holds, by increasing the incentive to engage illiquidity transformation. Thus, the result on Proposition 6 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 5 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

The first set of empirical predictions of the model 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. The key implication that we test is that:

1. *Firms with low liquidity risk are more likely to use credit lines rather than cash for liquidity management, when compared to firms with high liquidity risk.*

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.[8] A natural determinant of firm's liquidity risk is the variability in firm cash flows. Firms with greater cash flow variance face a higher risk of facing liquidity shortfalls. This line of reasoning suggests the following implication:

1.1 *Firms with low cash flow risk are more likely to use credit lines rather than cash for liquidity management, when compared to firms with high liquidity risk.*

In addition, the model also relates liquidity risk to pledgeable income. For a given level of cash flow risk, firms that have higher pledgeable income face a lower risk of facing future liquidity shortfalls. Thus, the model also delivers the following implication:

1.2 *Firms with high pledgeable income are more likely to use credit lines rather than cash for liquidity management, when compared to firms with low pledgeable income.*

Pledgeable income is a direct function of the firm's ability to raise external funds. Credit ratings should capture heterogeneity in pledgeable income, to the extent that they capture the ease of accessing public bond markets. The model would thus predict that rated firms should be more likely to use credit lines than non-rated firms, and firms with high credit ratings should be more likely to use credit lines than firms with low credit ratings. An alternative proxy for pledgeable income is the tangibility of firm's assets. Firms with more tangible assets

[8] As discussed in Section 2.2.1, this implication is derived under the assumptions that the firm can carry cash without incurring a liquidity premium and that the bank can provide actuarially fair liquidity insurance through credit lines. However, we note that this implication would continue to hold if we had introduced liquidity premia and costly credit line provision in the model. The key point to note is that these costs are independent of the liquidity risk mechanism. For example, having a positive liquidity premium would make it less likely that a firm would use cash (for a given amount of liquidity risk), but does not change the comparative statics on liquidity risk itself.

should be more likely to use credit lines for liquidity management. Finally, one may argue that firm size is correlated with pledgeable income. Larger firms are more transparent and have easier access to external finance.

These implications are broadly consistent with other results reported in the literature. The standard approach in the existing empirical literature is to examine the cross-sectional association between firm-level variables (such as cash flow risk, credit ratings and tangibility) and corporate liquidity policy.[9]

Nevertheless, these existing tests suffer from the usual limitations associated with cross-sectional regressions. Unobservable firm-level variation can make it difficult to interpret the coefficients on standard proxies for liquidity risk. For example, some firms may not have access to bank-provided insurance due to lack of reputation and track record. These firms are also likely to have lower credit ratings and to be riskier than other firms. In this case, a negative correlation between liquidity risk proxies and credit line usage cannot be interpreted as evidence that liquidity risk causes firms to switch to cash holdings. Reverse causality is also a possibility. To wit, firms may have high credit ratings *because* they 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, one would like to trace the effects of a shock that changes the liquidity risk (but not other fundamentals) of a group of firms, while leaving other firms unaffected. It is very difficult to think of a shock that changes cash flow risk without affecting other fundamentals such as the productivity of investment. Shocks that affect the ability of a group of firms to raise external funds, while arguably leaving fundamentals unaffected, provide a more suitable setting for a test of Implication 1.

We develop an empirical methodology that relies on a quasi-natural experiment to test the implication that liquidity risk causes changes in liquidity policy. 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

[9] Standard datasets that contain information on credit lines are typically short in the time dimension. For example, Sufi's (2009) data encompasses the period of 1996 to 2003. Thus, most of the variation driving existing results in the literature is cross-sectional.

were well-established, mature firms that have good access to bank financing. And for many of these firms (notably those outside of the auto sector), fundamentals were likely not affected by the bond market shock. In this sense, evidence that bond-reliant 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.[10]

The second set of empirical implications of the model relates to the relationship between credit lines, hedging needs, covenants and revocations. Our Proposition 5 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. An empirical proxy for the firm's hedging needs is the correlation between cash flows and investment opportunities (as in Acharya, Almeida and Campello (2007)). The following empirical prediction stems from the model:

2. *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, when compared to firms with high a low correlation (high hedging-needs firms).*

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:

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

Because low-hedging needs firms can access credit lines that contain less contractual restrictions, we should have that:

4. *Low hedging-needs firms are less likely to face revocation of bank credit lines than high hedging-needs firms.*

We also use our data to track down the following predictions about other characteristics of the monitoring mechanism which according to the theory is behind the empirical relationship between liquidity risk and liquidity management:

[10] Deadweight costs of credit line provision by banks (which are absent from the model) could have amplified this effect, because banks themselves faced greater costs of borrowing from the bond market in the aftermath of the GM-Ford crisis.

5. *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. In particular, the model explains why credit line revocation is concentrated in states in which the firm reports negative profitability shocks. Such shocks increase the demand for credit line insurance, and thus the bank's incentives to monitor in order to avoid credit line drawdowns by the firm.

Existing evidence on the frequency of credit line revocations is mixed. Some papers report significant revocation following covenant violations that are triggered by declines in profitability (e.g., Sufi, 2009), while other papers argue that revocations are infrequent (Barakova and Parthasarathy, 2012, Berrospide, Meisenzahl, and Sullivan, 2012). We use the Capital IQ data to provide additional large sample evidence on the frequency and magnitude of revocations.

The revocability of credit line access 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:

6. *Credit line drawdowns are more likely to happen following decreases in firm profitability.*

Thus, both drawdowns and revocations should be more likely in low profitability states. In addition, if credit line users have low liquidity risk when compared to firms that employ cash, the following implication should also hold:

7. *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 *ex-post* usage of credit lines and cash to meet liquidity needs should be consistent with *ex-ante* differences in liquidity risk exposure across firms. We use our data to verify whether these predicted patterns are consistent with data on real world credit lines.

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 2002-2011. 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 32,671 firm-years involving 4,741 unique firms.

CIQ compiles detailed information on capital structure and debt structure by going through financial footnotes contained in firms' 10-K 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 10-K. Following Sufi (2009) we also construct a measure of the amount of undrawn credit expressed as a percentage of net book assets. Following Lemmon, Roberts and Zender (2008), we compute a set of firm characteristics such as profitability, market-to-book (M/B) and tangibility. 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 (2012). Finally, following standard procedures, all variables are winsorized at the 0.5% level in both tails of the distribution. See the appendix for a complete set of definitions.

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 column 1 we report mean and median values for the entire sample, while column 2 and 3 contain values for the sub-samples of firms with and without a line of credit, respectively.

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. Focusing on firms with a line of credit, column 2 shows that average cash holdings are larger than average credit lines, both as a percentage of net book value assets (35% versus 15.6%). However, the magnitude of the ratio for cash and credit lines is similar if we divide by the market value of assets, respectively 9.3% and 9.6%.

TABLE 1 ABOUT HERE

Several of our model's predictions are consistent with this univariate evidence. Firms that use credit lines for liquidity management have more tangible assets, and higher credit ratings than those that use cash for liquidity management. This evidence is also in line with that reported in previous literature.[11]

Figure 4 illustrates the distribution of profitability and cash flows over assets for firms with and without a line of credit (*LC firms* and *cash firms*, respectively). The figure shows that firms that use cash have a higher probability of having low profitability and low cash flows than firms that use credit lines.

FIGURE 4 ABOUT HERE

4.3 Implication 1: Liquidity risk and liquidity management

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. To identify the causal link from liquidity risk to liquidity management, we examine the evolution of liquidity ratios during the downgrade to junk status of General Motors Corp. (GM) and Ford Motor Co. (Ford) that occurred in the spring of 2005.

In May 2005 Standard and Poor's downgraded the ratings of bonds issued by GM and GMAC, its financial arm, from BBB- to BB, two notches below investment grade. Similarly, Ford and FMCC, its financial subsidiary, had their rating reduced from BBB- to BB+, one notch below investment grade. According to Acharya, Schaefer and Zhang (2008), as a first order effect the downgrade led to a market-wide sell-off of the corporate bonds issued by these

[11] In Table A1 in the appendix, we provide multivariate evidence on the relationship between credit line usage and firm characteristics. The patterns that we uncover using Capital IQ data are very similar to those reported in existing literature.

two firms. It also had a significant impact on inventory risk faced by financial intermediaries that operated as market makers for the securities issued by the two auto makers. The effect of the downgrade went beyond the bond markets of GM and Ford and of other producers in the auto sector, and was perceived at the time to be potentially long-lasting. Because of their size and their importance in the debt markets, the credit deterioration of the two giant auto makers affected the functioning of corporate-bond markets as a whole. Acharya, Schaefer and Zhang 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.

In an article appeared on May 12th, 2005 *The Economist* observes that "*...the most obvious instances of this [rising interest rates on American companies' bonds] have been the bonds of two giant carmakers, General Motors and Ford, which Standard & Poor's (S&P), a rating agency, downgraded to junk status on May 5th. However, the malaise in the market for corporate debt goes far wider than these two big names....Several planned bond issues have been postponed because investors are becoming more demanding. Plenty of companies besides GM and Ford have been marked down.*" All of this happened in the context of a booming economy, and the same article comments that "*By many measures, America's economy continues in strikingly good health*". The last statement suggests that the effect of the GM-Ford downgrade was a shock primarily to the corporate bond market rather than to the economy at large.

The downgrade of GM-Ford offers an opportunity to identify the effects of liquidity risk on liquidity policy. 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, the *treatment* group) increased their cash holdings, as a share of total liquidity, more than the rest of the firms (*control* group).

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 ratings. 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] Thus, 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 might mean that the effect that we are trying to capture in this test, −i.e., increased cash holdings

[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.

in the face of higher future liquidity risk−, is harder to identify.

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 0 otherwise. To identify the treatment firms, we sort firms according to whether they were rated or not in fiscal year 2003, and this information is captured by $treatment_i$. We exclude from the analysis all firms with a rating below B- as they are too 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 May 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:

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

The coefficient of interest is α_3, which captures the estimate of the difference-in-difference. We expect α_3 to be positive. For robustness, we also construct a *placebo crisis* which is defined as the period that goes from 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 2 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.

TABLE 2 ABOUT HERE

[13] The crisis began with the downgrade 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 Moody's. 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 indices. See Acharya, Schaefer and Zhang (2008) for a detailed timetable of the events.

Column 1 shows that firms with a rating had on average around 4% less cash as a share of total liquidity relative to control firms before the crisis period, but this difference decreased in absolute terms during the crisis to approximately 2%. This evidence is even more striking for firms that relied more heavily on bonds (columns 2 and 3) who had on average around 5% less cash as a share of total liquidity relative to control firms before the crisis period, and saw this difference decrease in absolute terms around 7% during the crisis to end up with a higher ratio than the control group. These results are in line with our prediction that firms that relied on bonds shifted from lines of credit to cash, as a result of an increase in liquidity risk.

The results for the placebo crisis in columns 4-6 show that the difference in the liquidity ratio between treated and control firms did not vary significantly between the pre-crisis and the placebo crisis period, adding robustness to the mechanism proposed in our theory. In Table A2 of the appendix we perform further robustness checks. In columns 1-3 of Table A2 we replicate the analysis of columns 1-3 of Table 2 carrying out a sorting based on being rated in 2002 rather than in 2003. In columns 4-6 of Table A2 we extend the crisis period to include also June 2005. In both robustness checks, results are unaffected.

In Table 3 we replicate the analysis of Table 2 using as dependent variables, respectively, cash and undrawn credit lines, both computed as a percentage of net assets. This analysis allows us to identify which margins were at work during the GM-Ford crisis. We find that while cash holdings decreased around 2% on average in the control group during the crisis, they remained essentially unchanged for treatment firms (columns 1-3). This evidence is consistent with our interpretation of the GM-Ford event as a rise in future liquidity risk rather than as a current liquidity shock. Under the liquidity shock interpretation, treatment firms would have been expected to decrease their cash as a percentage of assets during the crisis period.

TABLE 3 ABOUT HERE

In columns 4-6 of Table 3 we find that undrawn credit lines did not vary for the control group, while they decreased by around 1% as a percentage of assets during the crisis for the treated group. This last evidence could suggest that treatment firms drew down on their outstanding credit lines, or opened less or smaller credit lines, both possibly as a result of increased liquidity risk and both consistent with our theoretical predictions. It could also mean, however, that treatment firms faced a restriction in access to credit lines during the GM-Ford event that did not affect control firms as much. While this mechanism is not inconsistent with our model, it suggests that the downgrade affected the liquidity of banks,

who reacted by revoking their outstanding credit lines. Likely, revocations occurred at a faster rate for treated firms because their liquidity position had deteriorated more. Alternatively, treatment firms may have violated some of the covenants associated with their credit lines, and these violations may have led to a revocation of the line. In Table A3 of the Appendix we show that treatment firms were not exposed to an increase in revocations of credit lines during the crisis months relative to control firms, and that treatment firms did not suffer an increase in covenant violations relative to control firms.[14] This evidence suggests that bank credit line revocations were not behind the decrease in undrawn credit experienced by treatment firms in the aftermath of the GM-Ford downgrade.[15]

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 (for definitions of variables see the Appendix):

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

We use industry-level variables to mitigate the possibility that cash flows are endogenously related with investment and therefore with Tobin's Q. To further address this issue, we calculate industry-level 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 2: Hedging needs and the use of lines of credit

We first test the empirical prediction that *low hedging needs* firms are more likely to use lines of credit instead of cash for liquidity management, when compared to *high hedging needs*

[14] We collect data on covenant violations from Nini, Smith and Sufi (2010).

[15] One possible concern is that our treatment group might have suffered a deterioration of their funding ability during the same period but for reasons that had nothing to do with the exogenous shock that was the GM-Ford downgrade. If this was the case, then it is likely that it was reflected in a large number of credit rating downgrades in our treatment group. To deal with this concern, we first explore whether there was an unusually large number of downgrades in the treatment group during this period, and this was not the case when compared to two placebo periods one year before and two years after the GM-Ford event. In unreported results, we also confirm that our main evidence of Table 2 is robust to removing from the treatment group those firms that suffered a credit rating downgrade during the GM-Ford downgrade period.

firms. Table 4 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 net assets, the share of undrawn credit in total liquidity, and total revolving credit over net 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 relate hedging needs with the residuals obtained from regressions in which we control for a set of firm characteristics. By looking at regression residuals, rather than at the raw variables, we can evaluate the relationship between hedging needs and our four liquidity variables after controlling for firm characteristics.

TABLE 4 ABOUT HERE

The evidence of Table 4 is consistent with the prediction of the model. Using the measure of hedging needs based on industry median investment activities, Panel A shows that the percentage of firms with a credit line is 84.8% among firms with low hedging needs, while it is only 57.3% for firms with high hedging needs. Low hedging needs firms have more undrawn credit both as a percentage of assets (12.7%) and as a percentage of total liquidity (53.6%), than high hedging needs firms (respectively 8.2% and 26.7%). Low hedging needs firm also have a higher percentage of revolving credit as a percentage of net assets (4.2%) than high hedging needs firms (2.2%). Panel B shows that, depending on the measure chosen, moving from the bottom quintile to the top quintile of hedging-needs is associated on average with a decrease of between 17.1% and 18.8% in the probability of having a line of credit, holding other variables constant.

4.4.2 Implication 3: Hedging needs and the use of covenants

Table 5 estimates the relationship between the covenants attached to credit lines and hedging needs. We obtain data on covenants from LPC Dealscan and examine all the covenants on 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 covenants across facilities.

We use four measures of covenant intensity. The first 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. Our second measure is borrowed from Demiroglu and James (2010), and it is 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. 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. 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 on managers' payout and reinvestment policy, giving preference to debt reimbursement over other possible uses of cash flows.

TABLE 5 ABOUT HERE

In Table 5 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 4, 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 5 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). Focusing on the covenant intensity measure most relevant to the type of bank monitoring described in our model, the cash flow covenant index, Column 5 shows that, for the hedging needs measure based on investment activities, an increase by two standard deviations in the hedging variable (0.239), i.e. an increase in correlation between cash flows and investment opportunities, is associated on average with having 16% ($= 1 - e^{-0.742 \times 0.239}$) less covenants, holding the other variables in the model constant.

4.4.3 Implication 4: Hedging needs and credit line revocations

To test the implication that low hedging-needs firms are less likely to face revocation of credit lines, we limit the sample to firms that have undrawn credit available under a credit line in period $t-1$, and study whether access to the line of credit is restricted during period t. We consider a full revocation to occur in period t when a firm has a positive amount of undrawn credit in period $t-1$ and none in period t, and the amount of drawn credit has not increased between the two periods. For robustness, we also consider partial revocations by examining

losses of at least 50% of undrawn credit over one year.[16] At the univariate level, the annual frequency of revocations is 4.1% and that of a reduction in credit lines greater than 50% is 7.9%. In the subsample of firms with negative profits, these percentages are respectively 15.3% and 23.5%.[17]

TABLE 6 ABOUT HERE

Table 6 provides evidence on the relationship between revocations of credit lines and hedging needs, controlling for a set of key firm characteristics. The evidence reported is consistent with our theory. Column 1 shows that an increase by two standard deviations (0.239) in the hedging variable based on investing activities, i.e. a decrease in hedging needs, is associated on average with a decrease of 0.6% ($= -0.023 \times 0.239$) in the probability of facing a revocation, holding other variables constant. This effect is stronger (a decrease of 1%) for the hedging needs measure based Tobin's Q (column 2). The evidence for partial revocations is less strong, suggesting that the effect of hedging needs on the probability of revocations is mainly associated with full revocations.

4.4.4 Implications 5-7: Profitability, revocations and drawdowns

With respect to the relationship between profitability and revocations, columns 1-4 of Table 6 shows that access to undrawn credit depends positively on profitability.[18] A two standard deviations increase in profitability (0.24) is associated with an decrease of 1.2% ($= -0.050 \times 0.24$) in the probability of facing a full revocation (column 1), and a 2.7% ($= -0.112 \times 0.24$) decrease in the probability of facing a revocation of at least 50% of undrawn credit (column 3).

Table 6 also provides evidence on the relationship between credit line drawdowns and profitability. The evidence above on the revocability of credit line access is not incompatible

[16] As firms typically hold lines of credit with more than one bank, our measure of partial revocations may capture full revocations of individual lines.

[17] Both our measures of revocations, full and partial, might overestimate true revocations because they treat voluntary non-renovations of credit lines as revocations. However, two reasons suggest that this overestimation might be small, particularly for full revocations. First, undrawn credit lines are not very expensive; annual fees on the undrawn portions of credit lines are around 25 basis points on average (Sufi (2009)). Second, firms may be unwilling to lose their credit lines as it may send a negative signal to investors.

[18] For each regression specification we provide several different definitions of profitability: the standard definition of profitability computed as operating income before depreciation, scaled by assets (reported in Table 6); a dummy for profitability being positive; a dummy for profitability being above 5%; the change in profitability, measured as the difference between profitability in year t minus profitability in year $t-1$; and one variable for the positive changes in profitability *(increases in profitability)* and one for the negative changes (*decreases in profitability*). Results (unreported) are qualitatively unaffected for these other measures of profitability.

with credit lines' role as liquidity insurance and if revocation does not occur, a firm facing a liquidity shock may draw down on the credit line to meet the shortage of liquidity. To see if this is the case, in columns 5 and 6 of Table 6, we regress the annual variation in revolving credit on profitability. The regression shows a negative and significant relationship between profitability and variations in total drawn lines of credit, as predicted by our 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.[19]

Implication 7 says that firms that use credit lines for liquidity management should be less likely to draw on credit lines to meet liquidity needs, when compared to firms that rely on cash holdings. 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 7, shows that on average credit line users are significantly less likely to face a negative or low profitability shock.

TABLE 7 ABOUT HERE

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 of Table 7. 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.

5 Conclusions

Recent empirical evidence on corporate liquidity management suggests that bank credit lines do not offer fully committed liquidity insurance, and that they are used not only for precautionary motives, but also to finance future growth opportunities. In this paper, we propose

[19] For robustness, we also run unreported tests in which we restrict variations in revolving credit to be positive. In this way, we can better isolate the variations in revolving credit that arise from a drawdown, from the variations that arise from repayments. We also run a specification in which the dependent variable takes value zero if the change in revolving credit is non-positive. The results obtained in these additional regressions confirm the above results.

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 only to hedge against negative profitability shocks, but to help finance future growth opportunities. We show that bank monitoring is more costly for firms that have greater arrival of growth opportunities in states in which cash flows are low (high hedging-needs firms). Such firms find it more beneficial to move to cash holdings, in order to avoid revocation costs associated with credit lines.

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 that exploit a quasi-natural experiment that occurred with the 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 high hedging needs are more likely to use cash rather than credit lines for liquidity management. These firms also face more covenants and credit line revocations when they do use credit lines, when compared to firms with low hedging needs.

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:

$$\begin{aligned} p_G\widehat{R}_M &\geq p_B\widehat{R}_M + \widehat{B}, \text{ or} \\ \widehat{R}_M &\geq \frac{\widehat{B}}{\Delta p}, \end{aligned} \tag{20}$$

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:

$$\widehat{\rho_0} \equiv p_G(\widehat{R} - \frac{\widehat{B}}{\Delta p}) < \widehat{\rho_1} \equiv p_G\widehat{R}. \tag{21}$$

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:

$$\rho_0^{'} \equiv p_G(R^{'} - \frac{B^{'}}{\Delta p}) = \rho_0 \equiv p_G(R - \frac{B}{\Delta p}). \tag{22}$$

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:

$$U_b = [1 - \lambda + \lambda(1-\mu)]\,(\rho_1 - \rho_0). \tag{23}$$

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:

$$U_b^{'} = (1 - \lambda^{'})(\rho_1^{'} - \rho_0) \tag{24}$$

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:

$$I + \lambda(1-\mu)\rho + \lambda c \leq (1 - \lambda\mu)\rho_0. \tag{25}$$

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, investors' date-0 break even constraint is:

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

and limited pledgeability requires that $p_G D^C \leq \rho_0$. These two constraints imply that this strategy is feasible when $\rho_0 - \lambda^{'}\rho - I > 0$, which holds by assumption 5. The resulting payoff is the NPV of the illiquid investment, $U^C = \rho_1^{'} - \lambda^{'}\rho - I$.

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:

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

Similarly, for firms of type H:

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

Thus, we have that:

$$(U^C - U^{LC})_H - (U^C - U^{LC})_L = (\lambda_H - \lambda_L)\left[c + \mu(\rho_1 - \rho)\right] > 0. \tag{26}$$

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 26 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 Model extension of Section 2.2.3

In this case the optimal liquidity policy is to establish a cutoff ρ^* below which the firm is allowed to continue the project in date-1 (see Tirole (2006), p. 201-204). The cutoff ρ^* is always greater or equal to the pledgeable income ρ_0, since for $\rho < \rho_0$ continuation benefits both outside investors and the firm. In order to be able to pay for liquidity shocks above ρ_0, the firm must have access to pre-committed liquidity sources such as cash or credit lines. Increasing the cutoff up to $\rho^* = \widehat{\rho_1}$ maximizes the NPV of the project, but may not be feasible. In what follows we assume that the firm can finance the NPV-maximizing cutoffs for both the liquid and the illiquid project:

$$I + \int_0^{\rho_1^{'}} \rho f^{'}(\rho)d\rho \leq F^{'}(\rho_1^{'})\rho_0. \tag{27}$$

This condition ensures that the firm can fund the NPV-maximizing cutoff if it chooses the liquid project as well (in this case the value-maximizing cutoff is $\rho^* = \rho_1$). The liquid project has greater *date-0* expected pledgeable income since $\rho_1^{'} > \rho_1$ and $F(.) \geq F^{'}(.)$ for all ρ, and because date-1 pledgeable income (ρ_0) is the same for both projects. In other words, both projects produce the same pledgeable income contingent on continuation (ρ_0), but the illiquid project requires liquidity infusions with greater probability at date-1.

The monitoring technology is identical to the model above. For this version of the model we have:

$$\begin{aligned}\text{Prob}(s &= s^{'}/\widehat{F} = F) = \mu < 1 \\ \text{Prob}(s &= s^{'}/\widehat{F} = F^{'}) = 1.\end{aligned} \tag{28}$$

As in the model above, the bank monitors after the firm reports a given liquidity shock ρ and attempts to draw on the credit line if $\rho > \rho_0$.

We also make the following assumptions:

$$F^{'}(\rho_1)(\rho_1^{'} - \rho_0) > F(\rho_1)(\rho_1 - \rho_0), \tag{29}$$

$$\mu(\rho_1 - \rho_0) \geq c, \text{ and} \tag{30}$$

$$\left[F(\rho_0 + \frac{c}{\mu}) + (1-\mu)(F(\rho_1) - F(\rho_0 + \frac{c}{\mu}))\right](\rho_1 - \rho_0) > F^{'}(\rho_0 + \frac{c}{\mu})(\rho_1^{'} - \rho_0). \tag{31}$$

The first assumption (condition 29) creates a role for monitoring. In order to see this, suppose that the firm wishes to implement the liquid project. Since $\rho^* = \rho_1$ is feasible, the firm would open a credit line of size $\rho_1 - \rho_0$, and use it to fund liquidity shocks above ρ_0 and up to ρ_1. Conditional on having started the project and secured a fully committed credit line, the firm's payoff is then $F(\rho_1)(\rho_1 - \rho_0)$, while the payoff from deviating to the illiquid project is $F^{'}(\rho_1)(\rho_1^{'} - \rho_0)$. Thus, as long as condition 29 holds, the firm cannot access fully committed liquidity insurance. Notice that the firm will be liquidated for $\rho > \rho_1$ even when it deviates to the illiquid project, since its credit line is of size $\rho_1 - \rho_0$.

The second assumption (condition 30) assures that the bank has incentives to monitor. In particular, the bank will monitor if and only if $\mu(\rho - \rho_0) > c$. Thus, there is a minimum level of the liquidity shock ρ that will induce bank monitoring. This is such that:

$$\mu(\rho_{\min} - \rho_0) = c. \tag{32}$$

Assumption 30 assures that $\rho_{\min} \leq \rho_1$. Firm and bank strategies are as follows (as a function of ρ): if $\rho < \rho_0$, the firm can continue the project without drawing on the credit line. If $\rho_0 \leq \rho \leq \rho_{\min}$, the firm draws on the credit line and the bank does not monitor. If $\rho_{\min} < \rho \leq \rho_1$, the bank will monitor in equilibrium and may revoke the credit line. Finally, if $\rho_1 < \rho$ the firm has no incentive to draw on the credit line because it is not sufficient to finance continuation.

The third assumption (condition 31) assures that bank monitoring is sufficient to induce the firm not to deviate to the illiquid project once the credit line is in place (see the proof to Proposition 7). The firm's ex-ante payoff under the monitored credit line is:

$$U^{LC} = F(\rho_1)\rho_1 - I - \int_0^{\rho_1} \rho f(\rho)d\rho - \int_{\rho_{\min}}^{\rho_1} \left[c + \mu(\rho_1 - \rho)\right] f(\rho)d\rho. \tag{33}$$

The expression $F(\rho_1)\rho_1 - I - \int_0^{\rho_1} \rho f(\rho)d\rho$ represents the firm's liquid project payoff under fully committed liquidity insurance. The term $\int_{\rho_{\min}}^{\rho_1} \left[c + \mu(\rho_1 - \rho)\right] f(\rho)d\rho$ represents the monitoring cost. If $\rho_{\min} < \rho < \rho_1$, the bank monitors (at cost c), and the credit line is revoked with probability μ, implying a value loss $\rho_1 - \rho$ for each ρ.

The firm's alternative is to use cash, and to invest in the illiquid project. In this case, the payoff is:

$$U^{C} = F^{'}(\rho_1^{'})\rho_1^{'} - I - \int_0^{\rho_1^{'}} \rho f^{'}(\rho)d\rho \tag{34}$$

Condition 27 ensures that both payoffs are achievable. As in the previous model, the firm chooses cash when $U^C \geq U^{LC}$, and the credit line otherwise. The main result of this extension is as follows:

Proposition 7 *Under assumptions 27, 29, 30, and 31, a decrease in pledgeable income ρ_0 makes it more likely that the firm will choose cash instead of the credit line. That is, $U^{LC} - U^C$ is increasing in ρ_0.*

Given the bank's monitoring strategy, the firm's payoff conditional on having started a project and secured a credit line of size $\rho_1 - \rho_0$ is:

$$\left[F(\rho_{\min}) + (1-\mu)(F(\rho_1) - F(\rho_{\min}))\right](\rho_1 - \rho_0) \tag{35}$$

If $\rho < \rho_{\min}$, the firm can continue the project with probability one because the bank does not monitor. If $\rho_{\min} < \rho < \rho_1$, then the bank monitors and revokes the credit line with probability μ.

If the firm deviates to the illiquid project, the payoff is:

$$F^{'}(\rho_{\min})(\rho_1^{'} - \rho_0). \tag{36}$$

In this case the bank revokes the credit line with probability one if $\rho > \rho_{\min}$.

As long as $\left[F(\rho_{\min}) + (1-\mu)(F(\rho_1) - F(\rho_{\min}))\right](\rho_1 - \rho_0) > F^{'}(\rho_{\min})(\rho_1^{'} - \rho_0)$, the firm can implement the liquid project using a monitored credit line.

The monitored credit line is feasible if:

$$I + \int_0^{\rho_1} \rho f(\rho) d\rho \leq F(\rho_1)\rho_0 + \int_{\rho_{\min}}^{\rho_1} \left[\mu(\rho - \rho_0) - c\right] f(\rho) d\rho \tag{37}$$

This condition is implied by equation 27 above, since the expression $\int_{\rho_{\min}}^{\rho_1} \left[\mu(\rho - \rho_0) - c\right] f(\rho) d\rho$ is positive, and because $\rho_1^{'} > \rho_1$ and $F(.) \geq F^{'}(.)$ for all ρ. Thus, the payoff under the credit line is given by equation 33.

The feasibility condition for the cash solution is $I + \int_0^{\rho_1^{'}} \rho f^{'}(\rho) d\rho \leq F^{'}(\rho_1^{'})\rho_0$, which is exactly condition 27. In this case the firm holds an amount of cash equal to $\rho_1^{'} - \rho_0$, and uses it to fund liquidity shocks up to $\rho_1^{'}$ at date 1. Thus, the payoff is given by equation 34.

To derive the comparative statics, notice that the expression U^C does not depend on ρ_0. In contrast, U^{LC} is increasing in $\rho_{\min}$, which is increasing in ρ_0 by equation 32. Thus, the difference $U^C - U^{LC}$ decreases in ρ_0.

6.6 Proof of proposition 4

Under monitoring we have:

$$U_b = (1-\lambda)(\rho_1 - \rho_0 + \upsilon^H \rho^\tau) + \lambda(1-\mu)(\rho_1 - \rho_0 + \upsilon^L \rho^\tau) \tag{38}$$

$$U_b^{'} = (1 - \lambda^{'})(\rho_1^{'} - \rho_0 + \upsilon^H \rho^\tau) \tag{39}$$

which is equivalent to:

$$[1 - \lambda + \lambda(1 - \mu)] (\rho_1 - \rho_0) + (\lambda^{'} - \lambda)\upsilon^H \rho^\tau + \lambda(1 - \mu)\upsilon^L \rho^\tau > (1 - \lambda^{'})(\rho_1^{'} - \rho_0). \tag{40}$$

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

$$I + \lambda [(1 - \mu)\rho + c] + \left[(1 - \lambda)\upsilon^H + \lambda(1 - \mu)\upsilon^L\right] \tau \leq (1 - \lambda\mu)\rho_0, \tag{41}$$

which is implied by equations 13 and 7 (bank monitoring increases pledgeable income and relaxes the feasibility constraint, as in the basic model). Finally, the ex-ante payoff is:

$$U_\tau^{LC} = \rho_1 - \lambda\rho - I + \overline{\upsilon}(\rho^\tau - \tau) - \lambda \left[c + \mu \left[\rho_1 - \rho + \upsilon^L(\rho^\tau - \tau)\right]\right]. \tag{42}$$

The alternative for the firm is to implement the illiquid project. As in the basic model, given equation 14 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:

$$\rho_0 - \lambda^{'}\rho - I - \overline{\upsilon}^{'}\tau > 0. \tag{43}$$

Assuming that this condition holds, the associated payoff is:

$$U_\tau^C = \rho_1^{'} - \lambda^{'}\rho - I + \overline{\upsilon}^{'}(\rho^\tau - \tau). \tag{44}$$

6.7 Proof of proposition 5

Using Equation 18, 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 $K = \rho_1^{'} - \rho_1 - (\lambda^{'} - \lambda)\rho + \lambda [c + \mu (\rho_1 - \rho)]$ 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

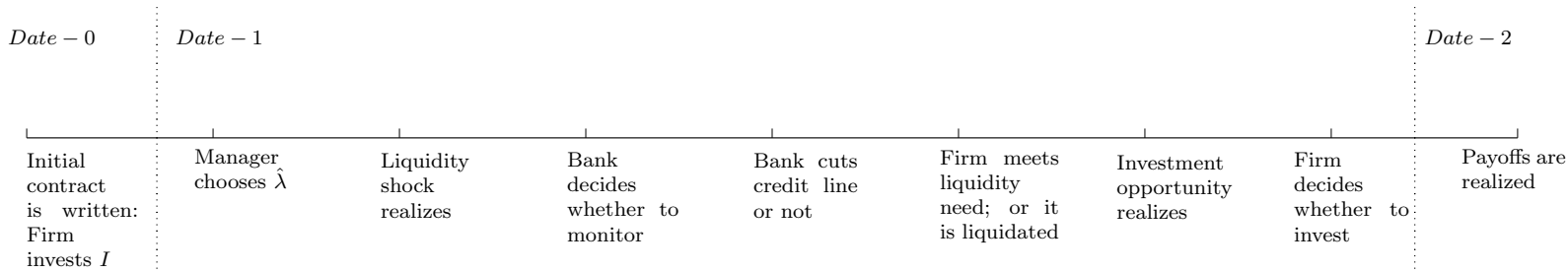


Figure 1b

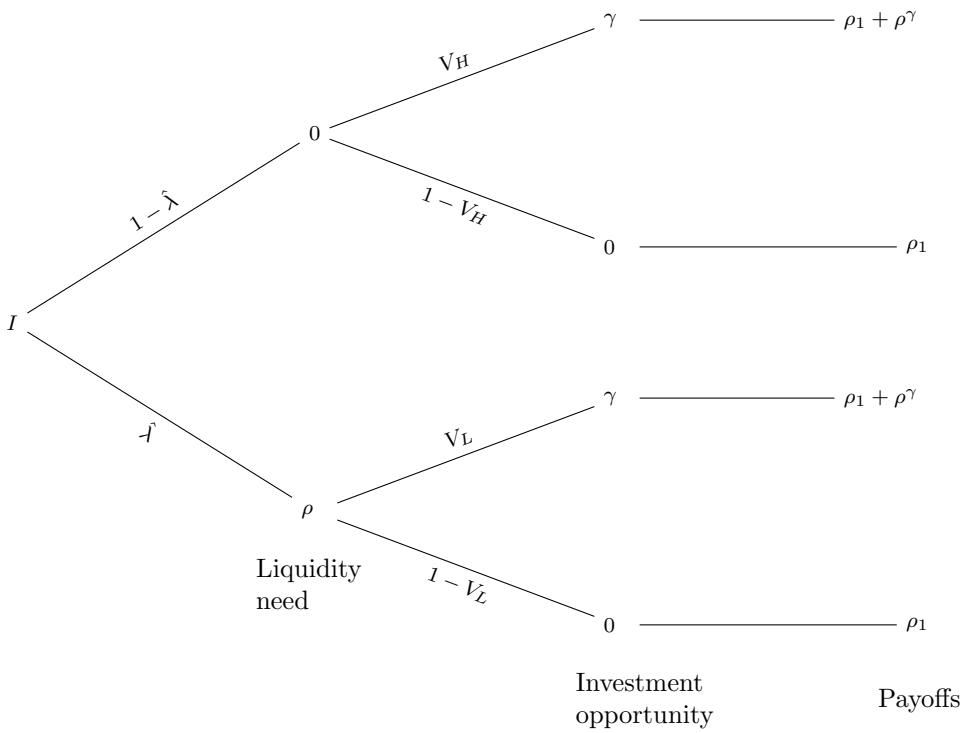


Figure 2 Bank's decision tree and payoffs

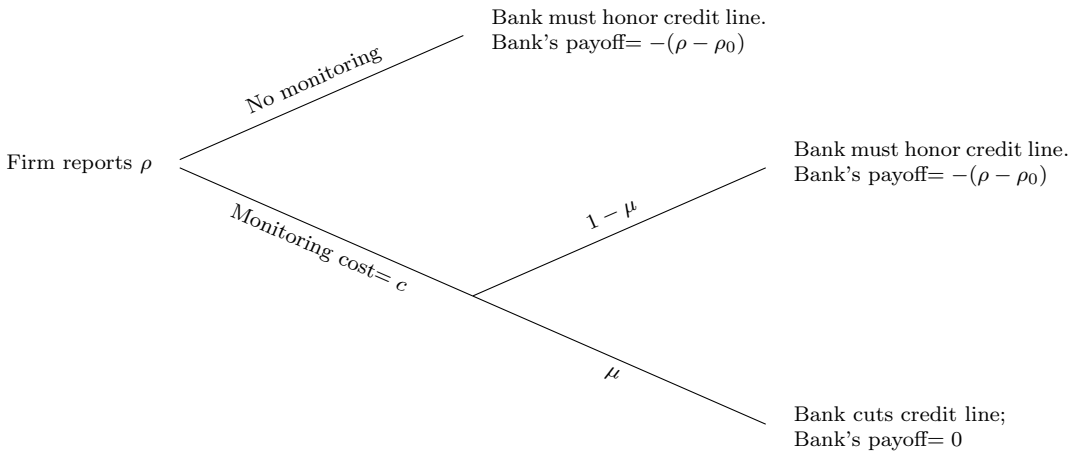


Figure 3 Firm's choice of λ and payoffs

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

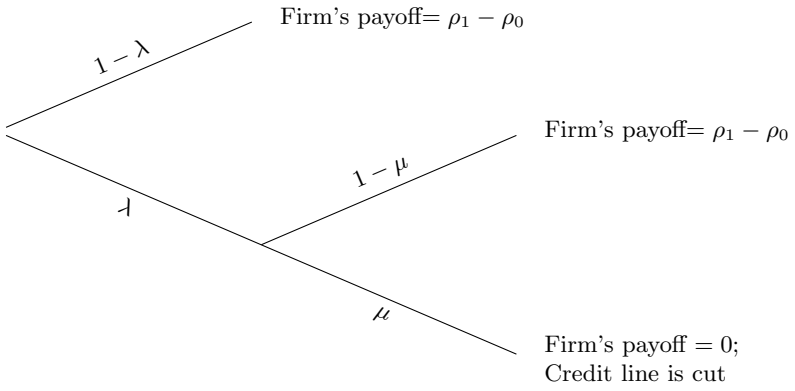


Figure 3b Illiquid Project: $\hat{\lambda} = \lambda'$

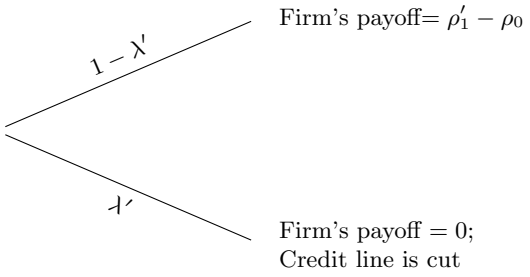
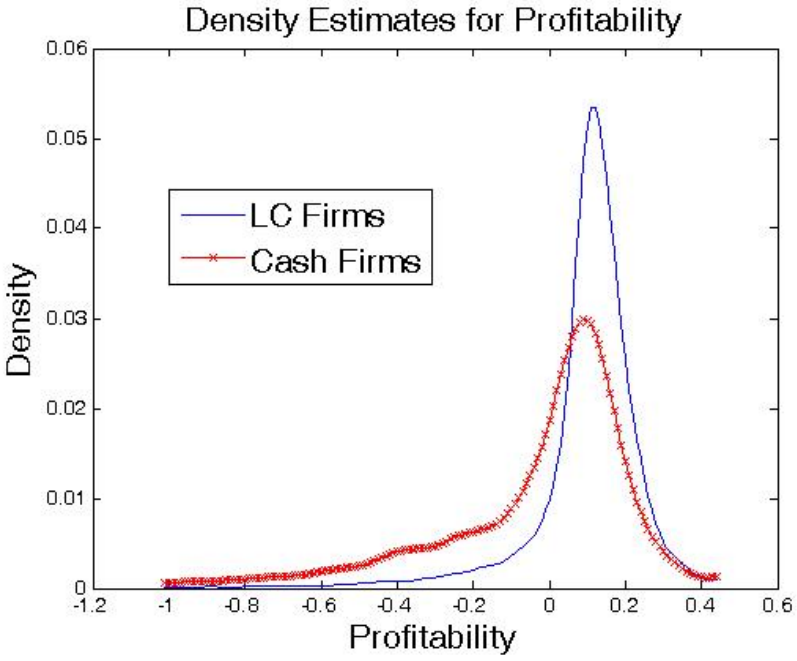


Figure 4. Distribution of Liquidity Shocks

This figure presents evidence on the differences in the distribution of profitability and cash flows over assets 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 winsorized at the 0.5% level on both tails.



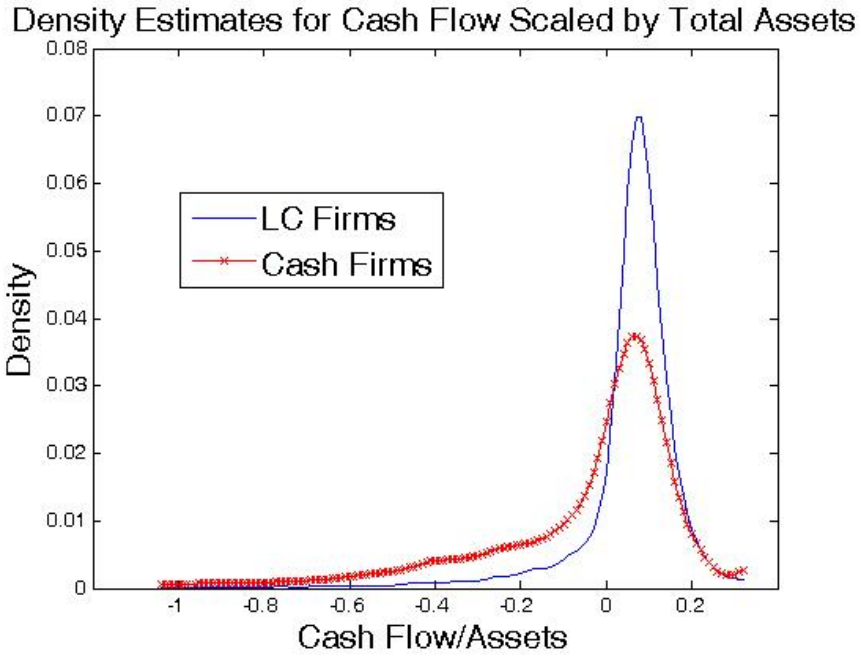


Table 1. Comparison of Firms with and without Credit Lines

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 2011. We have removed firm- years with 1) negative revenues, and 2) negative or missing assets. After the above filters, the sample consists of 32,671 firm-year observations involving 4,741 unique firms. In this table, "size" is measured as the book value of assets. 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)	(5)
	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
Cash/ Net At	0.657	0.350	1.517	45.658	80.044
	[0.147]	[0.094]	[0.576]	(0.000)	(0.000)
Credit Lines/Net At	0.106	0.156			
	[0.071]	[0.124]			
Cash/ Net At	0.115	0.093	0.185	33.527	50.649
(market value)	[0.054]	[0.043]	[0.100]	(0.000)	(0.000)
Credit Lines/Net At	0.067	0.096			
(market value)	[0.041]	[0.071]			
Profitability	0.059	0.097	-0.048	-46.411	-52.245
	[0.107]	[0.119]	[0.045]	(0.000)	(0.000)
Size	2181.0	2618.9	952.8	-30.560	-55.191
	[317.2]	[453.8]	[118.5]	(0.000)	(0.000)
Book Leverage	0.211	0.232	0.151	-30.678	-49.071
	[0.152]	[0.192]	[0.017]	(0.000)	(0.000)
M/B	1.728	1.576	2.195	28.841	32.753
	[1.232]	[1.152]	[1.582]	(0.000)	(0.000)
Tangibility	0.248	0.273	0.177	-39.567	-47.168
	[0.167]	[0.197]	[0.094]	(0.000)	(0.000)
NWC/At	0.050	0.076	-0.019	-43.110	-44.129
	[0.042]	[0.064]	[-0.015]	(0.000)	(0.000)
Capex/At	0.054	0.057	0.045	-16.503	-32.671
	[0.033]	[0.036]	[0.023]	(0.000)	(0.000)
R&D/Sales	0.370	0.136	1.034	29.731	63.398
	[0.005]	[0.000]	[0.106]	(0.000)	(0.000)
Dividend Payer	0.275	0.330	0.117	-49.989	-40.888
	[0.000]	[0.000]	[0.000]	(0.000)	(0.000)
Beta KMV	1.245	1.176	1.419	13.428	12.227
	[1.099]	[1.054]	[1.247]	(0.000)	(0.000)
Rating Dummy	0.265	0.327	0.092	-59.701	-46.715
	[0.000]	[0.000]	[0.000]	(0.000)	(0.000)
Observations	32671	22186	10485		

Table 2. The Effect of the GM-Ford Crisis on Liquidity Components

This table presents estimates of how the difference in average cash-to-total-liquidity ratios between "treated" and "control" firms changed in the GM-Ford downgrade event period (the "Crisis Period") relative to the preceding period, which ranges from June 2003 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), and in which the preceding period starts in June 2002. In the main test we include only firm-years for which reporting occurred during any month of the fiscal years 2003-2004. 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 and 2002 respectively. In columns 2 and 5, the treatment group includes firms with a rating (B- or better) in 2003 and 2002 respectively 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 2002 respectively and with senior and subordinated bonds representing more than 70% of debt.

	Variable: Cash / (Cash + 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 3. 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 / Net Assets GM-Ford Crisis December 2004-May 2005			Credit Lines/ Net 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 4. 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). 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 (low) hedging needs firms are those with a correlation in the bottom (top) quintile. Total liquidity is cash and short-term investments plus undrawn credit. In Panel A we examine the relationship between hedging needs and liquidity variables. In Panel B we examine the relationship between hedging needs and the residuals of regressions in which the dependent variables are the liquidity variables and in which we control for the following firm characteristics: profitability, size, book leverage, M/B, tangibility, NWC/assets, capex/assets, R&D/sales, dividend payer dummy, CF volatility, beta KMV, and rating. In both panels we include a test for differences between samples with high and low hedging needs using the unequal variances t-test.

Panel A	Variable: Mean (Median)			
	Presence of a Credit Line (Dummy)	Undrawn Credit / Net Assets	Undrawn Credit / Total Liquidity	Revolving Credit /Net Assets
Industry median Invest. Activities				
High hedging needs	0.573	0.082	0.267	0.022
N= 6288	(1.000)	(0.029)	(0.109)	(0.000)
Low hedging needs	0.848	0.127	0.536	0.042
N= 6568	(1.000)	(0.105)	(0.587)	(0.000)
t-test	35.919	21.081	46.402	16.362
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)
Industry median Tobin's Q				
High hedging needs	0.595	0.087	0.289	0.021
N= 6488	(1.000)	(0.037)	(0.151)	(0.000)
Low hedging needs	0.831	0.133	0.544	0.054
N=6657	(1.000)	(0.107)	(0.616)	(0.000)
t-test	30.821	20.761	42.933	24.063
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)
Panel B	Residuals: Mean (Median)			
	Presence of a Credit Line (Dummy)	Undrawn Credit / Net Assets	Undrawn Credit / Total Liquidity	Revolving Credit /Net Assets
Industry median Invest. Activities				
High hedging needs	0.056	0.006	0.250	0.022
N= 6288	(0.366)	(-0.024)	(0.088)	(0.000)
Low hedging needs	0.244	0.022	0.512	0.042
N= 6568	(0.389)	(0.000)	(0.554)	(0.000)
t-test	9.839	6.765	45.716	16.362
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)
Industry median Tobin's Q				
High hedging needs	0.055	0.009	0.271	0.021
N= 6488	(0.360)	(-0.020)	(0.117)	(0.000)
Low hedging needs	0.226	0.030	0.526	0.054
N=6657	(0.369)	(0.004)	(0.587)	(0.000)
t-test	9.058	8.479	43.387	24.063
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)

Table 5. 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		Covenant Index		Covenant Index		Covenant Index	
	Drucker and Puri (2010)		Demiroglu and James (2010)		Only CF Covenants		Only Sweeps	
Hedging Inv. Activities	-0.274***		-0.168*		-0.742***		-0.407***	
	(0.082)		(0.094)		(0.130)		(0.146)	
Hedging Tobin's Q		-0.232***		-0.069		-0.602***		-0.505***
		(0.076)		(0.087)		(0.124)		(0.139)
Profitability	0.224**	0.219*	-0.146	-0.158	0.264	0.244	-0.256	-0.247
	(0.112)	(0.112)	(0.122)	(0.122)	(0.177)	(0.177)	(0.196)	(0.197)
Size	-0.238***	-0.240***	-0.242***	-0.243***	-0.273***	-0.277***	-0.361***	-0.362***
	(0.008)	(0.008)	(0.010)	(0.010)	(0.013)	(0.013)	(0.015)	(0.015)
Book Leverage	0.716***	0.718***	0.737***	0.740***	0.774***	0.778***	1.418***	1.415***
	(0.046)	(0.046)	(0.053)	(0.053)	(0.071)	(0.071)	(0.075)	(0.075)
MB	-0.103***	-0.101***	-0.138***	-0.136***	-0.108***	-0.103***	-0.201***	-0.200***
	(0.012)	(0.012)	(0.014)	(0.014)	(0.019)	(0.019)	(0.024)	(0.024)
Rated	0.146***	0.147***	0.128***	0.127***	0.117***	0.120***	0.339***	0.346***
	(0.026)	(0.027)	(0.030)	(0.030)	(0.042)	(0.042)	(0.047)	(0.047)
CF Volatility	-1.906***	-1.873***	-1.419**	-1.416**	-1.661*	-1.587*	-1.741	-1.670
	(0.590)	(0.590)	(0.650)	(0.651)	(0.913)	(0.913)	(1.069)	(1.068)
General Purpose LC	-0.225***	-0.226***	-0.249***	-0.250***	-0.212***	-0.214***	-0.394***	-0.395***
	(0.020)	(0.020)	(0.023)	(0.023)	(0.032)	(0.032)	(0.035)	(0.035)
Ln(Maturity) of LC	0.407***	0.407***	0.476***	0.476***	0.469***	0.469***	0.751***	0.750***
	(0.022)	(0.022)	(0.026)	(0.026)	(0.036)	(0.036)	(0.045)	(0.045)
Facility Amount/At	-0.629***	-0.628***	-0.241***	-0.249***	-0.864***	-0.868***	-1.330***	-1.308***
	(0.073)	(0.073)	(0.080)	(0.080)	(0.116)	(0.117)	(0.136)	(0.136)
Observations	4,637	4,637	4,637	4,637	4,637	4,637	4,637	4,637
Pseudo R^2	0.098	0.098	0.101	0.101	0.084	0.083	0.139	0.139

Table 6. Revocations and Drawdowns

This table presents Probit (marginal effects dF/dx) and OLS regression results for the contemporaneous relationship between restriction of access to credit lines, profitability and hedging needs (columns 1-4), and for the relationship between drawdown of credit lines, profitability and hedging needs (columns 5-6). In columns 1-2 the dependent variable is a dummy for a full revocation of the credit line. In columns 3-4 the dependent variable is a dummy for a decrease in undrawn credit greater than 50% of the outstanding amount. In columns 5-6 the dependent variable is the annual change in drawn credit lines as a percentage of total assets. 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*). 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 Line (Dummy)		Full or Partial (>50%) Revocation of Credit Line (Dummy)		Drawdown of Credit Lines	
Hedging Inv Act	-0.023**		-0.034*		-0.001	
	(0.011)		(0.019)		(0.004)	
Hedging Tobin's Q		-0.040***		-0.027		0.009***
		(0.012)		(0.018)		(0.004)
Profitability	-0.050***	-0.048***	-0.112***	-0.110***	-0.024***	-0.024***
	(0.010)	(0.010)	(0.018)	(0.018)	(0.007)	(0.007)
Size	-0.001	-0.001	-0.002	-0.002	0.001	0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.000)	(0.000)
Book Leverage	-0.037***	-0.036***	-0.047***	-0.048***	0.046***	0.046***
	(0.008)	(0.008)	(0.013)	(0.013)	(0.005)	(0.005)
M/B	0.003***	0.003***	0.003*	0.003*	-0.001*	-0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Tangibility	-0.017**	-0.017**	-0.003	-0.006	-0.025***	-0.027***
	(0.009)	(0.009)	(0.014)	(0.013)	(0.004)	(0.004)
NWC/Assets	-0.070***	-0.067***	-0.141***	-0.143***	-0.004	-0.006
	(0.008)	(0.008)	(0.014)	(0.014)	(0.004)	(0.004)
Capex/Assets	-0.039	-0.033	-0.235***	-0.232***	0.176***	0.176***
	(0.032)	(0.031)	(0.054)	(0.054)	(0.020)	(0.020)
R&D/Sales	0.001	0.001	-0.002	-0.001	-0.002	-0.002
	(0.002)	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)
Div. Payer Dummy	-0.014***	-0.014***	-0.019***	-0.020***	0.005***	0.005***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.001)	(0.001)
CF Volatility	0.064	0.072	0.341***	0.347***	-0.239***	-0.243***
	(0.053)	(0.053)	(0.087)	(0.087)	(0.031)	(0.032)
Beta KMV	0.002*	0.002*	0.002	0.002	0.000	0.000
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Observations	15,116	15,116	15,129	15,129	15,176	15,176
R-squared	0.141	0.143	0.0930	0.0928	0.059	0.059

Table 7. 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 ($\Delta RC>0$) 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%	0.128	0.368	52.644	(0.000)	59.627	(0.000)
Probability of Profits < 5%	0.203	0.476	55.001	(0.000)	58.113	(0.000)

Panel B: Probability of a liquidity event

	Credit Line	Cash	t-stat	*p-value*	wilcoxon	*p-value*
Probability of a Liquidity Event	0.016	0.185	40.494	(0.000)	58.691	(0.000)
Probability of a Liquidity Event > 0.5% of Assets	0.014	0.179	39.726	(0.000)	57.833	(0.000)

Tables for the Appendix

Table A1. Access to Credit Lines

This table relates firm characteristics to various liquidity measures. In column (1) and (2) we run Probit regressions (marginal effects dF/dx) 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/ Net Assets
	All Firms	Rated	Rated	Rated with a LC	Rated with a LC
Profitability	0.362***	0.116*	-0.190**	0.041	-0.078
	(0.041)	(0.069)	(0.086)	(0.087)	(0.080)
Size	0.002	-0.013**	0.048***	0.041***	-0.003
	(0.005)	(0.006)	(0.007)	(0.007)	(0.004)
Book Leverage	0.271***	0.080***	-0.338***	-0.314***	-0.202***
	(0.034)	(0.028)	(0.037)	(0.035)	(0.032)
M/B	-0.035***	-0.029***	0.082***	0.055***	0.061***
	(0.005)	(0.006)	(0.009)	(0.009)	(0.011)
Tangibility	0.201***	0.043	-0.156***	-0.093***	-0.119***
	(0.039)	(0.032)	(0.038)	(0.034)	(0.018)
NWC/Assets	0.504***	0.134***	-0.430***	-0.410***	-0.286***
	(0.036)	(0.043)	(0.056)	(0.053)	(0.036)
Capex/Assets	0.210*	0.015	-0.553***	-0.637***	-0.126***
	(0.126)	(0.123)	(0.137)	(0.115)	(0.043)
R&D/Sales	-0.023**	-0.304***	0.037*	0.878***	0.555***
	(0.009)	(0.084)	(0.022)	(0.155)	(0.159)
Div. Payer Dum.	0.076***	0.015	-0.071***	-0.058***	-0.006
	(0.015)	(0.011)	(0.015)	(0.014)	(0.008)
CF Volatility	-2.172***	-0.977**	3.591***	2.948***	1.059***
	(0.555)	(0.382)	(0.537)	(0.596)	(0.323)
Beta KMV	-0.004	0.002	0.029***	0.031***	0.017***
	(0.003)	(0.004)	(0.005)	(0.005)	(0.003)
Rating	-0.009***	-0.012***	0.019***	0.017***	0.008***
	(0.001)	(0.003)	(0.004)	(0.003)	(0.002)
Observations	23,653	6,848	6,839	6,166	6,172
R-squared	0.272	0.259	0.287	0.286	0.239

Table A2. Robustness Tests on GM-Ford Crisis

This table presents two robustness checks for our tests on the GM-Ford crisis (Table 2). 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 A3. 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
Capex/Assets	Capital Expenditures (128)/ Total Assets (6)
Cash Flow/Assets	(Operating Income Before Depreciation (13) – Interest Expense (15) – Income Taxes (16) – Dividends (21)) / Total Assets (6)
Cash Ratio	Cash and Short-Term Investments (1) / (Cash and Short-Term Investments (1) +(Undrawn) Credit Lines (CapitalIQ))
Cash/Net Assets	Cash and Short-Term Investments (1) / Net Assets
Cash/Net Assets (market value)	Cash and Short-Term Investments (1) / (Total Assets (6)- BV Equity + Market Value of Equity - Cash and Short-Term Investments (1))
CF Volatility	Standard Deviation of Operating Income Before Depreciation (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.
Credit Lines/Net Assets	(Undrawn) Credit Lines (CapitalIQ)/ Net Assets
Credit Lines/Net Assets (market value)	(Undrawn) Credit Lines (CapitalIQ) / (Total Assets (6)- BV Equity + Market Value of Equity - Cash and Short-Term Investments (1))
Dividend Payer Dummy	A dummy variable that takes the value of one if common stock dividends (21) are positive, and zero otherwise
Full (Partial) Revocation of Credit Line (Dummy)	Takes value 1 in period t if a firm has available undrawn credit in t-1 and no available undrawn credit in t, and drawn credit has not increased between t-1 and t. Partial revocations are those in which undrawn credit availability decreases by 30% or more.
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+.
Industry Mean Cash Ratio	Mean cash ratio at the two digit SIC code
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)
Net Assets	Assets (item 6) minus Cash and Short-Term Investments (1))
NWC/ Assets	(Working Capital (179) - Cash and Short-Term Investments (1))/ Total Assets (6)
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)
R&D/Sales	Research and Development Expenses (46) / Sales (12)
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
Revolving Credit / Net Assets	Revolving Credit (CapitalIQ)/ Net Assets
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)