Liquidity Mergers*

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Abstract

We model the interplay between corporate liquidity and asset reallocation opportunities. Our model implies that financially distressed firms may be acquired by liquid firms in their industries even when there are no operational synergies associated with the merger. We call these transactions "liquidity mergers," since their main purpose is to reallocate liquidity to firms that might be otherwise inefficiently terminated. We show that liquidity mergers are more likely to occur when industry-level asset specificity is high (i.e., industry-specific rents are high) and firm-level asset specificity is low (industry counterparts can efficiently operate the distressed firms' assets). We also provide a detailed analysis of firms' optimal liquidity policies as a function of real asset reallocation. We show that firms are more likely to use credit lines relative to cash if they anticipate liquidity-merger activity in their industry. The model makes a number of predictions that have not been examined in the literature. Using a large sample of mergers, we verify the model's prediction that liquidity-driven acquisitions are more likely to occur in industries with specific, but transferable assets. Using alternative data sources for credit lines, we also confirm the model's prediction that firms are more likely to use credit lines (relative to cash) when they operate in industries in which liquidity mergers are more frequent.

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1 Introduction

The existing research argues that the funding of investment needs is a key determinant of corporate liquidity policies (see, e.g., Opler et al. (1999), Graham and Harvey (2001), Almeida et al. (2004), and Denis and Sibilikov (2007)). Given that acquisitions are one of the most important forms of investment, one would expect that the benefits and costs of asset reallocation would be an important driver of liquidity. Surprisingly, this notion has been overlooked by the literature on corporate liquidity.

In this paper, we propose and develop a theoretical link between corporate liquidity policies and asset reallocation opportunities. Our model explains why a distressed firm might be acquired by a liquid firm in its industry, even when there are no true operational synergies between the firms.[1] We call this type of acquisition a *liquidity merger*. The model adds to our understanding of liquidity management by showing how credit lines might dominate alternatives such as cash and ex-post financing in the funding of acquisitions. In particular, credit lines can be a particularly attractive source of liquidity for high net worth, profitable firms. Although this result is observationally equivalent to findings in the recent literature on lines of credit, the rationale is different. As we discuss below, our analysis helps reconcile Sufi's (2009) finding that lines of credit do not work as liquidity insurance.

The model's basic argument is as follows. Consider a firm that finds it difficult to raise credit because it cannot pledge its cash flows to investors. Limited pledgeability can arise from many sources, including moral hazard, asymmetric information, or private control benefits. In our model, firm insiders derive a non-pledgeable rent from their ability to manage assets that are industry-specific. If the firm is hit by a liquidity shock that is larger than its pledgeable value, it will not be able to withstand the shock by raising capital even if continuation would be efficient. One option is to liquidate the distressed firm at the value that can be captured by industry outsiders ("sell for scrap"). But if other industry players are able to operate the industry-specific assets ("putting those assets to uses they were designed for") an acquisition by a healthy industry rival could dominate liquidation.[2] The problem with that alternative is that the industry acquirer itself may end up facing a similar pledgeability problem. In particular, outside investors (including those of the acquirer) might be unwilling to finance the merger since they can only capture the pledgeable portion of the gains associated with the deal.

How can the industry acquirer overcome this financing problem? To do this, the acquirer needs a source of funding that can be used at its discretion. The situation resembles the *ex-ante liquidity insurance* problem of Holmstrom and Tirole (1997, 1998). In the Holmstrom-Tirole framework, the firm cannot wait to borrow after a large liquidity shock is realized because at that point external

[1] We do not imply that mergers do not generate operational synergies, but simply that they might occur even in the absence of such synergies. See Maksimovic and Phillips (2001) for evidence on productivity gains arising from mergers.

[2] Consistent with this notion, Ortiz-Molina and Phillips (2009) find that inside liquidity (provided by buyers inside the industry) reduces a firm's cost of capital by more than outside liquidity (provided by firms outside the industry).

investors would be unwilling to provide funds. Instead, the firm needs to contract its financing ex-ante. The optimal liquidity policy can be implemented either in terms of cash (the firm borrows more than its ex-ante needs) or with an irrevocable line of credit. The same logic follows through in the financing of a liquidity merger. The industry acquirer can overcome investors' unwillingness to finance the merger by accessing a discretionary form of financing that does not require investors' ex-post approval. Liquidity mergers thus emerge as a link between firm financial policies and asset reallocation opportunities in a industry.

Putting our theory in perspective, we model the link between mergers and liquidity policy by embedding the Holmstrom-Tirole liquidity demand model in an industry equilibrium framework that draws on Shleifer and Vishny (1992). Previous research suggests that a key practical problem with lines of credit is that they could become unavailable precisely when the firm most needs them. However, the industry acquirer is most likely to demand liquidity for an acquisition in states in which it does not suffer a negative liquidity shock of its own. Hence covenants that link line of credit availability to the firm's cash flow performance need not restrict the availability of financing to acquirers. We use this insight to show that lines of credit might dominate cash in financing liquidity-driven mergers. In order to use cash to finance future acquisitions, the acquirer would need to carry large balances from the current period to all future states of the world. In the presence of a liquidity premium, this policy is costly. Given that cash flow-based covenants do not restrict the availability of merger financing under the credit line, cash becomes less desirable as the demand for merger financing increases. The model thus shows how merger activity may influence whether firms use cash or credit lines in their liquidity management. The analysis is novel, among other reasons, because it helps reconcile the observed positive correlation between a firm's profitability and its use of credit lines in lieu of cash for liquidity management (see Sufi (2009)).

The model has several implications that have not yet been examined. First, it predicts that liquidity mergers should be more frequent in industries with high asset specificity, but among firms whose assets are not too firm-specific. We identify these industries empirically based on two observations. First, we conjecture that *industry-specificity* is likely to be greater for assets such as machinery and equipment than for land and buildings. Accordingly, we use the ratio of machinery and equipment to total firm assets as a proxy for industry asset specificity ("machinery intensity"). Second, we conjecture that *firm-specificity* should be inversely related to the degree of activity in asset resale market in a firm's industry — the higher the use of second-hand capital amongst firms in an industry, the less firm-specific the capital. To construct a measure of "capital salability" within an industry, we hand collect data for used and new capital acquisitions from the Bureau of Census' *Economic Census*. These data allow us to gauge asset salability through the ratio of used to total (i.e., used plus new) fixed capital expenditures by firms in an industry. Combining those two observations, we construct our desired measure as the product of "machinery intensity" and "capital salability." We call this composite proxy *Transferable Assets.*

We then investigate if the ratio of liquidity mergers to the total number of mergers in an industry is related to asset specificity (*Transferable Assets*). Using a sample of 1,097 mergers drawn from the SDC database between 1980 and 2006, we identify 473 deals as potential liquidity mergers (mergers among firms in the same industry, in which the target is plausibly close to financial distress). Our tests include cross-industry regressions that control for characteristics such as industry-wide measures of financial distress, concentration, and capacity utilization. Consistent with the model, we find evidence that the likelihood of liquidity mergers is higher when assets are both highly industry-specific and easily redeployable amongst industry rivals.

The second model implication that we examine is that firms are more likely to use credit lines for liquidity management if industry asset-specificity is high, but firm asset-specificity is low (i.e., when *Transferable Assets* is high). We use two alternative data sources to test this implication. Our first sample consists of a large data set of loan initiations drawn from the LPC-DealScan over the 1987–2008 period. The LPC-DealScan data have two potential drawbacks, nonetheless. First, they are largely based on syndicated loans, thus biased towards large deals (consequently large firms). Second, they do not reveal the extent to which existing lines have been used (drawdowns). To overcome these issues, we also use an alternative sample that contains detailed information on the credit lines initiated and used by a random sample of 300 firms between 1996 and 2003. These data are drawn from Sufi (2009).

We follow Sufi (2009) and measure the usage of credit lines in corporate liquidity management by computing a ratio of available credit lines to available credit lines plus cash holdings. As discussed by Sufi, while some firms may have higher demand for *total* liquidity due to better investment opportunities, these ratios should help isolate the *relative* usage of lines of credit versus cash. We run firm-level panel regressions of the ratio of credit lines to total liquidity on *Transferable Assets* and other determinants of credit line usage. Our tests show that firms are more likely to use credit lines in their liquidity management (relative to cash holdings) if they operate in industries with specific but transferable assets. This result is statistically and economically significant. For example, when using Sufi's sample we find that a one-standard deviation increase in *Transferable Assets* increases the ratio of credit lines to total liquidity by 0.10, approximately 20% of the mean value of this ratio. This result is consistent with the model's implication that lines of credit are an attractive way to finance growth opportunities such as a liquidity-driven acquisition.

Existing survey evidence suggests that lines of credit are not only used for liquidity management, but also to fund real operations (see Campello et al. (2009)). CFOs also indicate that credit lines are used to finance growth opportunities (such as acquisitions), while cash is used to withstand negative liquidity shocks (Lins et al. (2007)). At the same time, theoretical models of liquidity are largely silent on the trade-off between cash and credit lines. To our knowledge, this is the first paper that theoretically reconciles real-world managers' view that cash and lines of credit are used for different purposes. A recent paper by Gabudean (2007) also analyzes the interaction among firm cash policies in a Shleifer-Vishny industry equilibrium, but he does not examine liquidity mergers nor the trade-off between cash and credit lines. Asvanunt et al. (2007) also show that cash holdings may be dominated by an adequately designed line of credit policy. Our paper, however, is the first to model the role of alternative liquidity instruments in the financing of acquisitions.[3]

Recent empirical papers examine the effect of excess cash on acquisitions (e.g., Harford (1999), Dittmar and Mahrt-Smith (2007), and Harford et al. (2008)). While their evidence motivates our analysis, we focus on the opposite direction of causality. Namely, we model how the anticipation of acquisition opportunities affects corporate liquidity policy. In this sense, our paper is closer to Harford et al. (2009), who look at how deviations from target leverage affect whether acquisitions are financed with debt or equity. The key difference is that we focus on liquidity policy variables rather than leverage ratios. Our paper is also related to previous studies that analyze conglomerate mergers as a way of dealing with the target's inability to raise external funds (e.g., Hubbard and Palia (1999), Fluck and Lynch (1999), Inderst and Mueller (2003)).[4] One salient feature of our merger model is that it pertains to within-industry acquisitions, as opposed to diversifying mergers. On a more theoretical level, in this earlier literature mergers help mitigate the friction that generates the target's financial distress and increase the target's external financing capacity.[5] However, it is not the case that the acquirer directly supplies liquidity to the target as in our model, nor there is a clear role for the acquirer's liquidity policy.

In the next section we develop the benchmark model of liquidity demand and liquidity mergers. We do so under a security design framework in which firms choose their optimal liquidity demand (at first) without any implementation constraints. The implementation of optimal liquidity using cash and credit lines is discussed in Section 3. Section 4 introduces a number of extensions of the basic model. Section 5 discusses the model's main empirical implications. The model's predictions are tested in Section 6. Section 7 concludes the paper. All proofs are in the Appendix.

[3] Maksimovic (1990) shows that credit lines can boost a firm's competitive position in an imperfectly competitive industry, but does not analyze the trade-off between cash and credit lines. Eisfeldt and Rampini (2006) study the cyclical properties of capital reallocation across firms, but they do not consider implications for firm financial policies.

[4] Maksimovic and Phillips (2002) consider an alternative neoclassical model of conglomerate mergers that rely on productivity gains rather than financing frictions. See also Maksimovic and Phillips (2001) and Schoar (2002).

[5] See also Stein (2003), who calls this argument the "more money effect." The effect of mergers in this case is that of relaxing a *financial constraint*. Our model, in contrast, focuses on *financial distress*. A financially constrained firm need not sell its assets. Instead, it may do better by waiting for a positive liquidity shock, underinvesting in the meantime.

2 A Model of Liquidity Mergers and Liquidity Demand

We start from Holmstrom and Tirole's (1997, 1998) model of corporate liquidity demand, and embed the firm's liquidity optimization problem in an industry equilibrium that follows Shleifer and Vishny (1992). While these two theoretical pieces are well known, their insights have not been brought up together as a way to rationalize firm liquidity policy as a function of merger activity.

2.1 Basic framework

Consider an industry with two firms, which we call H and L. There are three dates, and no discounting. Both firms have an investment opportunity of fixed size I at date 0.[6] The firms differ according to their date-0 wealth, A. Firm H is a high wealth firm, so that $A_H > A_L$. The investment opportunity also requires an additional investment at date 1, of uncertain size. This additional investment represents the firms' liquidity need at date 1. We assume that the date 1 investment can be either equal to ρ, with probability λ, or 0, with probability $(1-\lambda)$.[7] The investment need is i.i.d. across firms, that is, the probability that firm H draws ρ is independent of whether firm L draws ρ or 0.[8] We refer to states using probabilities. So, for example, state λ^2 is the state in which both firms have date 1 investment needs. For convention, we let $\lambda(1-\lambda)$ be the state in which only firm H has a liquidity need for investment, and $(1-\lambda)\lambda$ be the state in which only firm L has a date 1 liquidity need.

A firm will only continue its date 0 investment until date 2 if it can meet the date 1 liquidity need. If the firm continues, the investment produces a date-2 cash flow 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 B. Because of the private benefit, managers must keep a high enough stake in the project to induce effort. We assume that the investment is negative NPV if the managers do not exert effort, implying the following incentive constraint:

$$\begin{aligned} p_G R_M &\geq p_B R_M + B, \text{ or} \\ R_M &\geq \frac{B}{\Delta p}, \end{aligned} \tag{1}$$

where 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. Following Holmstrom

[6] The main implications of the model are robust to variable investment. That is, if firms can also choose their investment size, the main change in the model is that they can also increase liquidity hoarding by decreasing the size of the investment. However, by virtue of its deeper pockets, firm H can achieve a more favorable solution relative to firm L.

[7] In Section 4 we consider the more general case in which the liquidity shock ρ is continuously distributed.

[8] In Section 4 we discuss the case in which investment needs are positively correlated.

and Tirole, we define:

$$\rho_0 \equiv p_G(R - \frac{B}{\Delta p}) < \rho_1 \equiv p_G R. \tag{2}$$

The parameter ρ_0 represents the investment's pledgeable income, and ρ_1 its total expected payoff. Using moral hazard to generate limited pledgeability greatly improves the model's tractability. However, we stress that this interpretation does not need to be taken literally. For example, our model's central results would carry through if limited pledgeability was generated by information frictions between firm insiders and outside investors.

If the firm cannot meet the liquidity need, it is liquidated generating an exogenous payoff that does not rely on industry-specific managerial human capital (and thus is fully pledgeable to outside investors). We let this liquidation value be equal to $\tau < I$. In the current model, liquidation should be interpreted as the value of the firm's assets to an "outsider," that is, an investor who does not possess industry-specific human capital. The higher the τ, the lower is the industry-specificity of the firm's assets. We assume that the project is positive NPV, even if it needs to be liquidated in state $(1-\lambda)$:

$$U = (1-\lambda)\rho_1 + \lambda\tau - I > 0. \tag{3}$$

In lieu of liquidation, a firm that cannot meet its liquidity need can attempt to sell its assets to another firm in the industry. Since managers of other industry firms have industry-specific human capital, they may be able to generate higher value from the assets. However, because human capital can also have a *firm-specific* component, industry managers are not perfect substitutes for each other. We assume that an industry manager can produce a cash flow $R - \frac{\delta}{p_G}$ by operating the assets of another industry firm.[9] The parameter δ captures the extent to which industry assets are firm-specific. For simplicity, we assume that the buyer of the assets always makes a take-it-or-leave-it offer to the distressed seller, meaning that the transaction price is always equal to the seller's outside option (τ).[10]

Figure 1 About Here

Figure 1 shows the model's time line and summarizes the sequence of actions from the perspective of firm H. The figure also includes the realizations of the liquidity shocks affecting firm L, to show how the actions of firm H depend on whether firm L is in distress. To simplify the tree, we assume that firm H will only bid for firm L in the state in which firm H does not have to finance its own liquidity shock (i.e., state $(1-\lambda)$). As we show below, this is a natural outcome of the model. In addition, the tree incorporates the fact that managers must exert high effort on the equilibrium path and hence the probability of success at date 2 is always equal to p_G.

[9] The probability of success and the private benefit are assumed to be the same as in the original firm. Thus, the asset generates date-1 pledgeable income equal to $\rho_0 - \delta$ if it is reallocated across firms.

[10] In Section 4 we discuss the more general case in which the seller also has some bargaining power.

2.1.1 Assumptions about pledgeability and net worth

We make the following assumptions about the model parameters:

$$\rho_0 < \rho < \rho_1 - \tau. \tag{4}$$

Given that the liquidity shock occurs, the net benefit of continuation is $\rho_1 - \tau$. This assumption means that it is optimal for the firms to withstand the liquidity shock, but that date-1 pledgeable income is not sufficient to finance the liquidity shock. The model becomes trivial if this assumption does not hold, in that firms will generally not need liquidity insurance (if $\rho_0 \geq \rho$), or that it will never be optimal to survive a liquidity shock or to bid for the other industry firm (if $\rho \geq \rho_1 - \tau$).

We make the following assumption about A_L:

$$\rho_0 - \lambda\rho < I - A_L \leq (1-\lambda)\rho_0 + \lambda\tau. \tag{5}$$

This assumption means that firm L does not have enough pledgeable income to be able to meet the liquidity need ρ in state λ. However, if firm L is liquidated in state λ, it generates total expected date 0 pledgeable income of $(1-\lambda)\rho_0 + \lambda\tau$, which by (5) is larger than $I - A_L$. This assumption allows us to focus on the most interesting case, in which firm L invests at date 0 and may become a target for firm H at date 1.

We make the following assumption about A_H:

$$\rho_0 - 2\lambda\rho - \lambda\left[\tau - (\rho_0 - \delta)\right] < I - A_H \leq \rho_0 - \lambda\rho - (1-\lambda)\lambda\left[\rho + \tau - (\rho_0 - \delta)\right]. \tag{6}$$

This assumption ensures that firm H has enough pledgeable income to withstand the liquidity shock and also bid for firm L in the case firm L is in distress. However, pledgeable income is enough to finance H's bid only in the event that H itself does not have a liquidity need in date 1. The role of this assumption will become clearer below. It captures the idea that firm H will be most likely to bid for L if its internal liquidity is at its highest, which will happen in the case that H does not suffer a liquidity shock. Finally, note that if firm H never has enough pledgeable income to to bid for firm L, there will be no interactions among firms in the model.

2.1.2 External financing and liquidity insurance

In this model, firms raise external funds from external investors to finance the date-0 investment I, the date 1 investment ρ (when it is required), and also the bid for other industry firms that might become distressed. Throughout, we make the usual assumption that contracts are structured such that investors break even from the perspective of date 0.

In order to characterize the best possible financial contract that firms can achieve, we first take a security design approach. Specifically, we assume that firms can write state-contingent contracts with external investors that specify the amount of payments that are made in each state of the world at date 1 and date 2. In Section 3 we will implement this optimal contract using real world securities (such as cash and credit lines). This solution method helps highlight the trade-off between cash and credit lines by comparing them against a benchmark of perfect state-contingent contracts.

In addition to date-1 payments, the optimal date-0 contract specifies the amount of external finance that firms raise at date 0, and the promised payment in case of success at date 2 (which happens with probability p_G). We denote the contractual amounts by $(K_0, K_{1,s}, K_{2,s})$, where s denotes the state of nature that realizes at date 1 (for example, $\lambda(1-\lambda)$).[11]

These contractual amounts must satisfy feasibility and pledgeability constraints. For each firm j we must have that $K_0 \geq I - A_j$, so that firms have enough funds to start their projects. The constraints that $K_{1,s}$ must obey depend on the investment strategy that firms wish to implement at date 1. For example, in order for firms to withstand the liquidity shock in state λ it must be the case that $K_{1,\lambda} \geq \rho$. For a firm to be able to bid for the other firm in state $(1-\lambda)\lambda$, we must have $K_{1,(1-\lambda)\lambda} \geq \rho + \tau$, so that the acquirer can cover both the target's liquidity shock, and the target's liquidation option. The date-2 promised payments must obey the pledgeability constraints. In states in which a firm continues but does not acquire other assets, we must have that $-K_{2,s} \leq R - \frac{B}{\Delta p}$ (or $-p_G K_{2,s} \leq \rho_0$). If a firm acquires the other one in state $(1-\lambda)\lambda$, we must have $-p_G K_{2,(1-\lambda)\lambda} \leq 2\rho_0 - \delta$. Finally, the payments $(K_0, K_{1,s}, K_{2,s})$ must be set such that investors break even from the perspective of date 0.

2.2 Equilibria

In equilibrium, firms choose their optimal investment and financing policies taking into account the optimal actions of the other firm. As we show below, the model generates two different equilibria depending on whether a liquidity merger is profitable or not. The liquidity merger is not profitable if:

$$\rho_1 - \delta < \rho + \tau. \tag{7}$$

Firm H can generate a date-1 expected payoff of $\rho_1 - \delta$ by operating the assets of firm L. However, the merger requires firm H to cover L's liquidity shock and compensate L's investors, which involves an investment of $\rho + \tau$. By the same logic, the liquidity merger is profitable if:

$$\rho_1 - \delta \geq \rho + \tau. \tag{8}$$

We prove the following proposition in the Appendix:

[11] Since firms produce zero cash flows in case of failure at date 2, the realization of uncertainty at date 2 is irrelevant. Firms promise payments out of date-2 cash flows, which are made only in the case of success.

Proposition 1 *Under state-contingent contracting, the model generates the following equilibria:*

- *If condition 7 holds, then the model's unique equilibrium is one in which firm L is liquidated in state λ, and continues its project otherwise. Firm H always continues, and there is no liquidity merger. These equilibrium strategies can be supported by the following state-contingent financial policies. For firm L, $K_0^L = I - A_L$, $-K_{1,\lambda}^L = \tau$, $K_{1,(1-\lambda)}^L = 0$, and $-K_{2,(1-\lambda)}^L \leq \frac{\rho_0}{p_G}$, such that investors break even at date 0. For firm H, $K_0^H = I - A_H$, $K_{1,\lambda}^H = \rho$, $K_{1,(1-\lambda)}^H = 0$, and $-K_2 \leq \frac{\rho_0}{p_G}$, such that investors break even at date 0.*
- *If condition 8 holds, the model's unique equilibrium involves a liquidity merger in state $(1-\lambda)\lambda$, in which firm H acquires firm L. Firm L is liquidated in state λ^2, is acquired by firm H in state $(1-\lambda)\lambda$, and continues its project otherwise. Firm H always continues its project. Firm L's policy is identical to the one above. Firm H's policy is $K_0^H = I - A_H$, $K_{1,\lambda}^H = \rho$, $K_{1,(1-\lambda)\lambda}^H = \rho + \tau$, $K_{1,(1-\lambda)^2}^H = 0$, $-K_{2,(1-\lambda)\lambda}^H \leq \frac{2\rho_0 - \delta}{p_G}$, and $-K_{2,(1-\lambda)^2}^H = -K_{2,\lambda}^H = -K_2^* \leq \frac{\rho_0}{p_G}$, such that investors break even at date 0.*

In order to understand this result, consider first firm L. By condition 5, firm L does not have enough pledgeable income to withstand the liquidity shock when it occurs at date 1. In addition, the assumption that firm H (the potential acquirer) has all the bargaining power in the event of a merger ensures that firm L's payoff is independent of firm H's policies (firm L's payoff is always equal to τ in state λ, independent of whether it is acquired or not). Thus, firm L's policy is unchanged across the different equilibria. It simply entails borrowing enough funds to start the project, and then using pledgeable future cash flows to repay external investors.

Firm H's optimal policies, in turn, will depend on the level of industry- and firm-specificity. The equilibrium with no liquidity merger is more likely to hold when industry specificity is low (τ is high), or firm specificity is high (δ is low). In this equilibrium, firm H's optimal investment policy is to start its own project at date 0 and reinvest ρ in state λ at date 1 (so that it continues until the final date). In order to support this policy, firm H borrows sufficient funds to start the project at date 0 ($K_0^H = I - A_H$), and receives an additional payment of ρ from external investors in state λ ($K_{1,\lambda}^H = \rho$). It promises a date-2 payment K_2 (in both states), so that investors break even.

If condition 8 holds, it becomes optimal for firm H to bid for firm L in state $(1-\lambda)\lambda$, provided that it has enough liquidity in that state. In addition, firm H must have enough liquidity to withstand its own liquidity shock in state λ. This equilibrium requires that $K_{1,\lambda}^H = \rho$, and $K_{1,(1-\lambda)\lambda}^H = \rho + \tau$. Notice also that since firm H is acquiring firm L, as long as $\rho_0 - \delta > 0$ its pledgeable income will increase in state $(1-\lambda)\lambda$. Thus, it can repay up to $2\rho_0 - \delta$ in that state. The assumption in equation 6 guarantees that firm H can finance both its own liquidity shock and the liquidity merger. Finally, equation 6 also implies that firm H cannot finance the liquidity merger in state λ^2 (when it needs to finance its own liquidity shock).

For future reference, the date-0 expected payoffs in the equilibrium with no liquidity merger are:

$$\begin{aligned} U_H^N &= (1-\lambda)\rho_1 + \lambda(\rho_1 - \rho) - I \\ U_L &= (1-\lambda)\rho_1 + \lambda\tau - I. \end{aligned} \tag{9}$$

By conditions 3 and 4 both U_H^N and U_L are positive, so both firms invest at date 0.

The date-0 expected payoffs in the liquidity merger equilibrium are:

$$\begin{aligned} U_H^M &= (1-\lambda)^2\rho_1 + (1-\lambda)\lambda(2\rho_1 - \rho - \delta - \tau) + \lambda(\rho_1 - \rho) - I \\ U_L &= (1-\lambda)\rho_1 + \lambda\tau - I. \end{aligned} \tag{10}$$

Firm H's expected payoff is higher in equation 10 than in equation 9. This happens because H captures the gains from the merger. At the same time, L's expected payoff does not change.

2.3 Main features of the optimal financing policy

Before implementing the financial policies that support each of the above equilibria, it is worthwhile to discuss intuitively their main features. In particular, while firm L's financial policy is simple (it involves only raising funds to finance the initial investment), firm H's financial policy involves state-contingent transfers from external investors to finance the liquidity shock and the bid for firm L.

The key economic feature of these transfers is that they must involve some degree of *pre-commitment* from external investors. External investors will generally not find it optimal to provide sufficient date-1 financing for the firm, after the liquidity need is realized. In order to guarantee that it has enough liquidity, firm H must gain access to a source of liquidity that is under the firm's control and does not require ex-post approval from external investors.

To see this, consider first the equilibrium with no liquidity mergers. The optimal policy in Proposition 1 involves a liquidity infusion in state λ equal to $K_{1,\lambda}^H = \rho$. Notice that this infusion of cash is greater than the firm's pledgeable income in state λ, which is equal to ρ_0 (by condition 4). Thus, the firm will only be able to withstand the liquidity shock if it can access a pre-contracted amount of financing greater than or equal to ρ. As we will argue below, this financing can come, for example, from cash holdings (which the firm puts aside in date 0 and retains until date 1). Or it can come from an irrevocable credit line. In either case, this liquidity injection generates a loss of $\rho - \rho_0$ for external investors. To compensate external investors for this loss, the optimal contract includes a net positive payment from the firm to investors in state $(1-\lambda)$, i.e., the state with no liquidity shock. If that state obtains, the firm receives zero transfers at date 1, $K_{1,(1-\lambda)}^H = 0$, but repays a positive amount to investors in date 2, $K^H_{2,(1-\lambda)} = K_2$. In other words, the optimal contract specifies a transfer of financing capacity from state $(1-\lambda)$, where it is not needed, to state λ, where it is crucial.

A similar intuition holds for the liquidity merger equilibrium. The optimal policy involves liquidity transfers equal to $K^H_{1,\lambda} = \rho$ and $K^H_{1,(1-\lambda)\lambda} = \rho + \tau$. As in the other equilibrium, the firm needs pre-committed financing in state λ to finance its own liquidity shock, since $\rho > \rho_0$. In state $(1-\lambda)\lambda$, the pledgeable income generated by the acquisition of firm L is equal to $\rho_0 - \delta$. Clearly, this is lower than the investment that firm H needs to make in that state, which is equal to $\rho + \tau$. Nevertheless, notice that firm H also has pledgeable income equal to ρ_0 in state $(1-\lambda)\lambda$, which it can use to finance the acquisition of firm L as well. This means that firm H needs pre-committed financing to acquire firm L when:

$$2\rho_0 - \delta < \rho + \tau. \tag{11}$$

This is a sufficient condition for firm H to need pre-committed financing.[12] If this inequality holds, the firm will need to transfer financing capacity into state $(1-\lambda)\lambda$. As in the analysis above, firm H compensates external investors for the provision of pre-committed financing by making payments in states in which such financing is not needed. In particular, in the liquidity merger equilibrium the firm can pledge the cash flows that are produced in state $(1-\lambda)^2$, in which firm H never needs any liquidity (since neither firm is in distress). The optimal contract achieves this by letting $K^H_{1,(1-\lambda)^2} = 0$ and $K^H_{2,(1-\lambda)^2} = K^*_2$.

Finally, notice that a financial contract that provides pre-committed financing is a *liquidity insurance* mechanism for the firm. Essentially, the firm buys liquidity insurance (infusions of liquidity that generate ex-post losses for external investors), by paying an "insurance premium" in the states of the world in which liquidity infusions are not needed. This liquidity insurance intuition will also be useful to understand some of the features of the implementation that we discuss below.

3 Implementation of the Optimal Financing Policy

In Section 2 we assumed that the firms can perfectly contract on state-contingent financing, subject only to investor break-even and pledgeability constraints. In this section, we study the implementation of the equilibrium policies described above with real world financial instruments.

As the discussion in Section 2.3 indicates, the optimal financing policy must involve some form of pre-committed financing, or liquidity insurance. In the real world, there are two main instruments

[12] As we show in more detail below, whether this condition is also necessary depends on the details of the financial policy that implements the optimal contract characterized in this section. In particular, condition 11 is necessary only in the (extreme) case in which firm H is allowed to fully dilute the claims by date-0 external investors, in order to finance the acquisition at date 1. For example, if firm H enters date 1 with some debt in its capital structure (issued at date 0), then condition 11 presumes that the firm can issue date-1 debt that is senior to the date-0 debt. Since this is unlikely to be true in reality, firm H is likely to require pre-committed financing even when $2\rho_0 - \delta > \rho + \tau$.

that firms use to insure their liquidity, namely, cash holdings and bank credit lines. Provided that cash holdings are under the control of the firm, cash is the simplest form of pre-committed financing. Credit lines can also play the role of pre-committed financing, provided that they can be made *irrevocable* (that is, the firm can draw on the credit line even when the bank is not properly compensated for the risk of the loan).

Other financing mechanisms, while important for the firm, may not satisfy this pre-committed feature of the optimal contract. For example, a "debt capacity" strategy of carrying low debt into the future in the expectation that additional debt can be issued in the event of a liquidity shock may fail, because debt capacity will dry up precisely in times when the liquidity shock hits. For similar reasons, post-liquidity-shock equity issuance may fail to provide enough liquidity for the firm.

3.1 Buying liquidity insurance: cash and credit lines

Our main goal is to propose a trade-off between cash and credit lines and to show how this trade-off depends on the particular industry equilibrium predicted by the model. Before we do that, it is useful to understand intuitively how the firm can use cash and credit lines to replicate the financial policies specified in Proposition 1. Details of the implementation are given in Section 3.2.

Besides cash and credit lines, to implement the optimal policy the firm will need to issue standard securities such as debt and equity. For concreteness, we will assume that the firm issues debt.[13] In addition, we assume that if the firm issues debt at date 0, this debt is senior to any additional debt that the firm issues at date 1. While this is a realistic assumption, we also note that the results do not change if we allow the firm to violate priority at date 1.

We let D_0 represent the face value of the debt that firm H issues at date 0, and $D_{1,s}$ represent the face value of debt that firm H issues in state s at date 1. In case of success, the firm repays debt in date 2. For future reference, let D_0^* represent the amount of date 0 debt that firm H needs to issue to be able to start its own project at date 0:

$$p_G D_0^* = I - A_H. \tag{12}$$

To implement the optimal policy using cash, the firm borrows more than D_0^* (call this amount of debt D_0^C) and retains the extra funds in the balance sheet. The firm can then use cash to finance the date 1 liquidity shock and the bid for the other industry firm. Recall that external investors may be unwilling to contribute cash at date 1, due to limited pledgeability. Thus, the firm must be given the right to use cash balances at date 1, without requiring investor approval. Finally, the firm uses its excess liquidity (in states in which cash balances are not required at date 1) to ensure that external investors break even from the point of view of date 0.

[13]The results are unchanged if we allow the firm to issue equity as well.

To implement the optimal policy using a credit line, the firm does not need to borrow more than D_0^* at the initial date. Instead, it enters a contract with date-0 investors of the following form. It commits to make a payment equal to x at date 1 in exchange for the right to borrow an amount w that is lower than a pre-specified amount equal to $w_{\max}$, in case additional liquidity is needed at date 1. Provided that the date-0 investor cannot revoke the contract at date 1, this contract may allow the firm to borrow more than its pledgeable income at date 1. The firm compensates the date-0 investor for this right, by paying the "commitment fee" x in the states in which it does not need additional liquidity. Such a contract closely resembles a real world credit line, which typically requires the firm to pay a fee to keep the line open in exchange for the right to borrow up to a pre-specified amount (the size of the credit facility).

3.2 The trade-off between cash and credit lines

To clarify the trade-offs between cash and credit lines, we start by assuming that the firm can only use one of the instruments in isolation. In Section 4.1 we allow the firm to use both instruments and show when the firm can benefit from using cash and lines of credit simultaneously.

3.2.1 Cash policy

As the discussion in Section 3.1 suggests, cash implementation requires the firm to carry cash balances across time. Existing evidence suggests that carrying cash is costly for the firm, for example because of the existence of a *liquidity premium*. Consistent with this argument, most theoretical papers on cash policy assume a (deadweight) cost of carrying cash across time (see, e.g., Kim et al. (1998) and Almeida et al. (2009)).

In our model, we capture the cost of carrying cash by assuming that the firm loses a fraction ξ of every dollar of cash that is carried across dates. For example, if the firm saves C dollars at date 0, then only $(1-\xi)\,C$ is available to finance investments at date 1. This assumption is similar to those made in the existing literature cited above.

To see how the cash implementation works, consider first the equilibrium without the liquidity merger. That is, assume that condition 7 holds. In this case, the optimal financial policy in state λ involves a transfer from investors of $K_{1,\lambda}^H = \rho$, which allows firm H to finance the liquidity shock. To implement this policy using cash, notice first that for a given amount of debt D_0^C issued at date 0, and given the seniority assumption, the firm has additional debt capacity equal to $\rho_0 - p_G D_0^c$ at date 1. To survive the liquidity shock in state λ, the firm must thus save the following amount of cash:

$$(1-\xi)\,C + \rho_0 - p_G D_0^C = \rho. \tag{13}$$

The firm raises the cash at date 0 by borrowing $I - A_H + C$, and returns cash to investors at date

1 in state $(1-\lambda)$. Because of the cost of carrying cash, the firm can only return $(1-\xi)C$ to investors in that state. Finally, the firm repays D_0^C in case of success at date 2. The date-0 investor break-even constraint becomes:

$$p_G D_0^C + (1-\lambda)(1-\xi)C = I - A_H + C. \tag{14}$$

Finally, the pledgeability constraint requires that $p_G D_0^C \leq \rho_0$.

As we show in the Appendix (in the proof of Proposition 2), if $\xi = 0$ we obtain the same solution as in Proposition 1. As ξ increases, cash implementation may no longer be feasible.[14] Even if cash implementation is feasible, the cost of carrying cash implies a reduction in the firm's payoff. In the Appendix, we derive an exact solution for the optimal amount of cash C that the firm needs to hold if it does not need to finance the merger, and the condition under which holding this cash level is feasible.

Let us consider now the liquidity merger equilibrium. The crucial change in the optimal financial policy of Proposition 1 is that firm H must also finance the bid for firm L in state $(1-\lambda)\lambda$, that is, $K^H_{1,(1-\lambda)\lambda} = \rho + \tau$. If we let C^M denote the amount of cash that firm must hold in the liquidity merger equilibrium and D_0^M the associated date-0 debt issuance, financing the liquidity merger equilibrium with cash requires firm H to finance both its own liquidity shock, and also the bid for firm L.

In the Appendix, we show that as long as the firm requires some amount of pre-committed financing to fund the liquidity merger, it must save more cash in the liquidity merger equilibrium ($C^M > C$). As discussed above (equation 11), firm H may not need pre-committed financing to finance the acquisition of firm L since it can use both its pledgeable income and the pledgeable income from the acquisition to finance the bid (a total of $2\rho_0 - \delta$). In addition to the bid, the firm needs to repay date-0 debt, and therefore it will need pre-committed financing as long as:

$$2\rho_0 - \delta - p_G D_0^C < \rho + \tau, \tag{15}$$

where D_0^C is the amount of debt that allows the firm to carry cash balances equal to C (the minimum amount required to fund the liquidity shock). If condition 15 holds, the firm will need to use cash holdings to finance the liquidity merger, and will return less cash to investors in state $(1-\lambda)$. Investors will then require additional compensation to finance the firm at date 0 (that is, $D_0^M > D_0^C$). Accordingly, the firm must save additional cash to survive the liquidity shock in state λ. In equilibrium, we must then have $C^M > C$ as well.

We summarize the results of this Section in the following proposition:

Proposition 2 *Let C represent the optimal cash balance in the case in which condition 7 holds, such that the liquidity merger is not profitable, and C^M represent the optimal cash balance when 8 holds, such that the liquidity merger is profitable. We have that $C^M \geq C$, with strict inequality if condition*

[14] That is, we may not find a value D_0^C that satisfies both equation 14 and the condition that $p_G D_0^C \leq \rho_0$.

15 holds. In addition, let $\xi_{NM}^{\max}$ be the maximum cost of cash such that C is feasible, and $\xi_{M}^{\max}$ the maximum cost that allows C^M to be feasible. We have that $\xi_{NM}^{\max} \geq \xi_{M}^{\max}$, with strict inequality if condition 15 holds. Finally, firm H's payoff is:

$$U_H^{NC} = U_H^N - \xi C, \tag{16}$$

in the equilibrium with no liquidity mergers if $\xi \leq \xi_{NM}^{\max}$, and $U_H^{NC} = 0$ if $\xi > \xi_{NM}^{\max}$. In the equilibrium with liquidity mergers, the firm's payoff is:

$$U_H^{MC} = U_H^M - \xi C^M \tag{17}$$

if $\xi \leq \xi_M^{\max}$, and $U_H^{MC} = 0$ if $\xi > \xi_M^{\max}$. U_H^N and U_H^M are given, respectively, by equations 9 and 10.

3.2.2 Lines of credit

The advantage of a credit line relative to cash is that it does not force the firm to hoard internal liquidity. Under credit line implementation, the firm raises pre-committed financing only in the states in which such financing is needed, conditional on the realization of the liquidity need. However, and for the same reason, line of credit implementation relies on a commitment by the external investor who provides the line to the firm.

Existing empirical evidence suggests that real-world credit lines are not perfectly irrevocable. In particular, Sufi (2009) shows that if firms' cash flows deteriorate, the firm's access to credit lines is restricted through loan covenants. This result suggests that the firm might not be able to rely on credit lines to provide liquidity insurance in bad states of the world. In terms of our model, line of credit implementation is most likely to create problems in state λ, in which firm H is financially distressed. We capture this feature of credit lines by assuming that the outside investor denies financing in state λ with a probability equal to $q \leq 1$.

While we take the probability q to be exogenous in the solution below, in the Appendix we show that q can be endogenized in a framework in which the probability of the date 1's liquidity shock is endogenously determined by managerial effort. In this framework, line of credit revocability gives incentives for the manager to try to avoid the occurrence of the liquidity shock.

To illustrate the credit line implementation, we proceed as above by analyzing the case of no liquidity mergers. Under credit line implementation, the firm does not need to borrow more than the minimum required to start the project at date 0 (call this debt level D_0^{LC}). If the credit line is revoked in state λ the firm is liquidated, and thus the date-0 investor break-even constraint gives:

$$(1 - \lambda q) p_G D_0^{LC} + \lambda q \tau = I - A_H. \tag{18}$$

We denote the maximum size of the line in this equilibrium by $w_{\max}$, and the commitment fee that the firm pays to the external investor by x. For the firm to survive the liquidity shock in state λ, the credit line must obey:

$$w_{\max} + \rho_0 - p_G D_0^{LC} \geq \rho. \tag{19}$$

This equation incorporates the firm's ability to issue new debt at date 1 up to the firm's date-1 pledgeable income $(\rho_0 - p_G D_0^{LC})$. In state $(1-\lambda)$, the firm does not use the credit line and pays the commitment fee x. The commitment fee is set such that the investor breaks even, given the amount by which the credit line is expected to be used $(w_{\max})$:

$$\lambda(1-q)w_{\max} = (1-\lambda)x. \tag{20}$$

The credit line is feasible as long as the firm has enough pledgeable income to pay the commitment fee $(x \leq \rho_0 - p_G D_0^{LC})$, which gives:

$$I - A_H + \lambda(1-q)\rho \leq (1-\lambda q)\rho_0 + \lambda q\tau. \tag{21}$$

Equation 21 is implied by condition 6. That is, it is always feasible to use a line of credit to withstand the liquidity shock. Intuitively, the revocability of the line in state λ increases pledgeability, since the external investor does not benefit from continuation in that state. The main cost of the credit line comes from its revocability in state L. The firm's payoff becomes:

$$\begin{aligned} U_H^{NLC} &= (1-\lambda)\rho_1 + \lambda(1-q)(\rho_1 - \rho) + \lambda q\tau - I = \\ &= U_H^N - \lambda q(\rho_1 - \rho - \tau) \end{aligned} \tag{22}$$

where U_H^N is given by equation 9. The term $\lambda q(\rho_1 - \rho - \tau)$ represents the expected loss from the revocability of the credit line.

Financing the liquidity merger with the credit line adds one constraint to the problem. In state $(1-\lambda)\lambda$, firm H must have enough liquidity to finance the bid for firm L. This requires:

$$w_{\max}^{LC} + 2\rho_0 - p_G D_0^{LC} - \delta \geq \rho + \tau \tag{23}$$

As we show in the Appendix, the firm chooses a credit line $w_{\max}^{LC}$ that is large enough to ensure that it has enough liquidity to finance both its own liquidity shock, and also the liquidity merger. The firm finances the credit line by paying the commitment fee in the state in which the credit line is not used (state $(1-\lambda)^2$). As in the no-merger equilibrium, the main cost of the credit line is that it can be revoked in state λ. The firm's expected payoff becomes:

$$U_H^{MLC} = U_H^M - \lambda q(\rho_1 - \rho - \tau), \tag{24}$$

where U_H^M is given by equation 10.

We summarize the results on the credit line implementation in the following Proposition:

Proposition 3 *It is always feasible to use a partially revocable line of credit to implement ex-ante liquidity insurance. The amount by which firm H's payoff is reduced (the expected loss from the revocability of the credit line, $\lambda q(\rho_1 - \rho - \tau)$), is the same both when condition 7 holds, such that the liquidity merger is not profitable, and when 8 holds, such that the liquidity merger is profitable.*

3.2.3 Choosing between cash and lines of credit

The firm's choice between cash and credit lines depends on the relative size of the parameters q and ξ. The main cost of the credit line is the possibility that the line might be revoked in the bad state of the world, which happens with probability q. While cash holdings can avoid this problem, they require internal liquidity hoarding whose cost is captured by the parameter ξ. Starting in the equilibrium with no liquidity mergers, we can show the following intuitive result:

Proposition 4 *Suppose condition 7 holds, such that the liquidity merger is not profitable. There exists a function $q_{NM}(\xi)$, satisfying $q'_{NM}(\xi) \geq 0$ and $q_{NM}(0) = 0$, such that if $q > q_{NM}(\xi)$, the firm prefers cash to lines of credit, and if $q < q_{NM}(\xi)$, the firm prefers lines of credit to cash.*

Figure 2 depicts the function $q_{NM}(\xi)$, and the associated regions in which the firm prefers cash or credit lines.[15]

Figure 2 About Here

We can now state one of the main results of the paper:

Proposition 5 *Suppose that condition 8 holds, such that the liquidity merger is profitable. There exists a function $q_M(\xi)$, satisfying $q'_M(\xi) \geq 0$ and $q_M(0) = 0$, such that: (i) if $q > q_M(\xi)$, the firm prefers cash to lines of credit and if $q < q_M(\xi)$, the firm prefers lines of credit to cash; and (ii) $q_M(\xi) \geq q_{NM}(\xi)$. In other words, the firm is more likely to use lines of credit in the liquidity merger equilibrium.*

Figure 2 depicts $q_M(\xi)$, showing that the region under which cash dominates the credit line. This region shrinks as we move from the equilibrium with no mergers to the equilibrium with mergers. In Figure 2, the triangle marked as E depicts the parameter region in which the firm would choose cash if it does not need to finance a liquidity merger, but a line of credit if there is a need to finance the merger.

[15] For q large enough (say $q = q''$), it is possible that the cost of cash that makes the firm indifferent between cash and credit lines is larger than $\xi_{NM}^{\max}$. In this case, the function $q_{NM}(\xi)$ will have a discontinuity at $\xi_{NM}^{\max}$, since the firm will prefer the line of credit for any $\xi > \xi_{NM}^{\max}$. All results continue to hold in this case. Figure 1 depicts the case in which the function $q_{NM}(\xi)$ is continuous.

This result shows that firms are more likely to use lines of credit in the liquidity-merger equilibrium. The intuition can be stated as follows. The cost of implementing the optimal liquidity policy with cash holdings is higher in the equilibrium with liquidity mergers, since firm H must carry more cash in that equilibrium ($C^M > C$). The higher required cash balance reduces the firm's payoff, and tightens the feasibility constraint. In contrast, the cost of using a line of credit is the same in the two equilibria, given that the expected loss from the revocability of the credit line is the same (Lemma 3). This makes the line of credit a preferred liquidity instrument.

4 Extensions

In this section we discuss the role of some of the assumptions that we have made for model tractability. In some cases, our motivation is to discuss the robustness of the model's results. In others, extending the analysis motivates additional implications discussed in Section 5.

4.1 Combining cash and lines of credit

The analysis above assumes that the firm can use either cash or credit lines to implement ex-ante liquidity insurance, but not both. Can the firm benefit from having both cash and a credit line at the same time?

The first point to notice is that such a policy can only benefit the firm in the liquidity merger equilibrium. Suppose that condition 7 holds, such that the liquidity merger is not profitable. If $q < q_{NM}(\xi)$, the firm prefers lines of credit to cash, despite the excessive liquidation in state λ. However, it is not profitable for the firm to use cash to decrease the expected loss from revocability, since this would require the firm to hold an amount of cash equal to C (the same amount that it needs to hold if it chooses only cash to implement liquidity insurance). Similarly, if $q > q_{NM}(\xi)$, the firm uses cash and there is no additional benefit to opening a credit line since the firm is never liquidated in state λ.

If, in contrast, the firm must finance both the liquidity shock and the merger, then there can be a role for a simultaneous cash/credit line policy. For example, consider the region in which $q < q_M(\xi)$, such that the firm prefers lines of credit to cash. If it is feasible for the firm to save enough cash to finance the liquidity shock in state λ, then it might be optimal for the firm to have both cash and a credit line. We analyze this case in the Appendix. Most importantly, we show that allowing for the possibility of a joint policy *does not change* the conclusion that the firm is more likely to use lines of credit in the liquidity merger equilibrium. This implication could become ambiguous if the joint policy reduced the parameter region in which the firm uses credit lines in the liquidity merger equilibrium, relative to the equilibrium with no mergers (this is the region in which $q < q_{NM}(\xi)$). At the same time, we show that the joint policy cannot be optimal if $q < q_{NM}(\xi)$, even in the equilibrium with liquidity mergers.

4.2 Continuum of liquidity shocks

We assumed for simplicity that the liquidity shock had a binomial distribution with mass at ρ and 0. In this case, the model's logic requires firm L not to have any liquidity insurance. If firm L had enough liquidity to pay for ρ, there would be no liquidity mergers. And if L cannot pay for ρ , there is no point in saving any liquidity.

We note that this stark solution is due only to the specific binomial assumption that we used. For example, we could alternatively assume that the liquidity shock ρ is distributed in a range $[0, \rho^{\max}]$. In this case, a firm's optimal liquidity policy states the maximum level of the shock that it can withstand. That is, a firm i saves enough liquidity to withstand shocks below a certain cutoff ρ_i, where $i = L, H$ (see Tirole (2006)). In this case, the optimal solution would clearly have $\rho_L \leq \rho_H$, given H's higher wealth A_H. Thus, firm H would be able to withstand a greater range of liquidity shocks, and firm L would also save some liquidity in equilibrium.

In addition, it would still be the case that firm H would be the natural acquirer in a liquidity merger equilibrium. Its higher initial wealth makes it easier for H to save enough liquidity to bid for firm L (as in the model above). Notice also that, since $\rho_L \leq \rho_H$, firm L is more likely to be financially distressed in equilibrium, increasing the benefit of liquidity hoarding for firm H. Finally if firm L is to save liquidity, its priority would be to survive its liquidity shock rather than being able to bid for the other firm (which yields a lower payoff due to firm specificity).

This analysis suggests the following conjecture. Since firm L is unlikely to save liquidity for a future bid, relatively to firm H it is less likely to demand a line of credit (which is particularly beneficial for the financing of the merger). While the model above also delivers this implication, it may seem trivial since firm L does not demand any liquidity (including cash). The analysis here suggests that if firm L is to demand liquidity, its main goal would be to finance its liquidity shock rather than a bid; relative to firm H, firm L would be less likely to demand a credit line.

4.3 Correlation between liquidity shocks

We assumed that the liquidity shocks were uncorrelated across the two firms in the industry. This assumption raises the incidence of liquidity mergers in the model, since it increases the probability of the state in which only one of the industry firms has a liquidity shock. However, we note that the model is qualitatively identical if the correlation is positive, as long as the correlation is less than one.

Nothing changes in the model if liquidity mergers are not profitable, since in this case there is no interaction among firms. If liquidity mergers are profitable, they are still most likely to happen in the states of the world in which only some industry firms are financially distressed, among firms with industry but not firm specific assets, and to be financed by lines of credit.

In addition, recall that we assumed that firm H did not have enough pledgeable income to bid for firm L if both firms are hit with liquidity shocks. If this assumption is relaxed, liquidity mergers would happen even in states of the world in which the entire industry suffers a liquidity shock. One interesting possibility is that in this case the role for joint cash and credit line policies (as discussed in Section 4.1) should increase, since firm H needs to finance both its own liquidity shock and also the bid for firm L. We conclude that allowing for a positive correlation between liquidity shocks would make liquidity mergers less common, and possibly more costly to finance. But the main conclusions of the model would remain the same.[16]

4.4 Bargaining power

We assumed that in the event of a merger, the acquirer (firm H) makes a take-it-or-leave-it offer to firm L and thus captures the entire rent from the liquidity merger. Clearly, the model's logic requires that firm H has some bargaining power in the event of a merger, or else firm H will not have incentives to alter its liquidity policy in the anticipation of a future acquisition opportunity. However, as long as firm H retains some bargaining power the model is qualitatively identical.

In particular, given the model's assumptions firm L would not have incentives to change its liquidity policy in the event that it captures a fraction of the rents. Since this reduces the costs of financial distress for firm L, its incentives to manage liquidity are even lower in this case. If firm L also has an active liquidity management policy (see, e.g., Section 4.2), then more interesting interactions can arise. For example, L's incentives to save cash to withstand the liquidity shock would generally decrease as it captures a greater fraction of the rent. This effect can also change H's liquidity policy, since it affects the probability that firm L is distressed and that a liquidity merger might occur.

4.5 Aggregate shocks to pledgeability

We assumed that pledgeability of future cash flows (captured by the parameter ρ_0) is unchanged across different states of the world in date 1. However, if a firm enters financial distress in times in which aggregate liquidity is low, it might be more difficult for the firm to raise external financing. This effect would be at play, for example, if there was an aggregate shock that reduced ρ_0 while at the same time increasing the liquidity shock ρ for all industry firms. This sort of scenario is considered in Shleifer and Vishny (1992).

Such a correlation between ρ and ρ_0 potentially increases the role for liquidity mergers and liquidity insurance. Notice that the firm's internal liquidity sources (such as cash holdings and open lines of credit) are not necessarily affected by the pledgeability shock. The reason for this effect is that

[16] In addition, as discussed below, if pledgeability is also affected by this common component of liquidity, liquidity reallocation through mergers would again become more prevalent.

the lines of credit are pre-committed credit agreements. It is interesting to note that there is debate about whether banks renege on their loan commitments. In the real world, virtually all credit lines have a covenant that gives the bank the right to revoke the credit facility (the "materially adverse conditions"). Thakor (2005), however, provides a theory explaining why banks avoid evoking these clauses too often and Roberts and Sufi (2009) show empirically that banks do not invoke that clause, preferring instead other renegotiated alternatives that allow for the credit facility to be used. By most accounts, the recent financial crisis is seen as an episode where pledgeability was negatively shocked. At the same time, the existing evidence suggests that banks are honoring their pre-crisis lines of credit agreements (see Ivashina and Scharfstein (2008) and Campello et al. (2009)).

Thus, the advantage of a liquid industry firm over an outsider can increase in times of aggregate liquidity shocks. This analysis suggests that if the correlation among industry firms' liquidity shocks is caused by an aggregate shock that also affects pledgeability, then the negative effect of correlation on liquidity mergers is mitigated. While within-industry correlation hinders liquidity mergers, economy-wide liquidity shocks can increase the incidence of liquidity mergers.

5 Model Implications

Our model integrates a number of ideas and yields multiple implications. Some of these implications are supported by the available empirical evidence. Others have not yet been documented and are tested later in the paper. This section revisits the model, highlighting and recasting the most interesting testable hypotheses coming out of the analysis.

For ease of reference, we list the main implications of our model:

Implication 1 *Liquidity mergers are more likely to occur in industries with high specificity, but among firms whose assets are not too firm-specific.*

This result follows directly from Proposition 1. Notice that this result is independent of how the liquidity merger is financed (ex-post issuance, cash, or lines of credit). The key economic insight that drives this result is that the industry acquirer has an advantage in liquidity provision relative to the distressed firm because of industry specificity. If the acquirer has enough liquidity to draw on, the merger becomes feasible.

How to identify a "liquidity merger" in the data? The model suggests that it is a merger that might not necessarily happen in the absence of liquidity shocks, but is due to distress in one of the firms in an industry and the advantage another firm has in managing industry specific assets. Thus, mergers and acquisitions of a distressed target by another firm in the same industry are potential candidates. Clearly, the liquidity merger can only happen if firm-level asset specificity is not too high. In the next section, we experiment with an identification exercise of this type in order to guide our empirical work.

Given that the purpose of liquidity reallocation in our model is to overcome the inability of the target to raise external funding, one might wonder why we are focusing specifically in financially *distressed* targets, as opposed to targets that are financially *constrained* in a broader sense.[17] The answer is that a target that is constrained but not distressed does not necessarily face the choice between liquidation and asset sale that we model in the paper. Such a target also has the option to withstand a liquidity shock by investing less than what it would be optimal in the absence of the shock, and waiting for the access to external capital to improve. Given that asset reallocations impose costs due to firm specificity, this option should be attractive for a constrained target.

The other key result of the model comes from Proposition 5:

Implication 2 *If industry asset specificity is high and firm asset specificity is low, then firms are more likely to use lines of credit in their liquidity management.*

This result follows from the insight that the line of credit is a particularly attractive way of financing growth opportunities that arrive in good states of nature, but that may require liquidity insurance. A liquidity-driven acquisition is an example of such an investment.

The following implication follows from the previous two:

Implication 3 *There is a positive relationship between the incidence of liquidity mergers and line of credit usage in an industry.*

Section 4 also suggests the following implication:

Implication 4 *Liquidity mergers are more likely to occur when there is low correlation between the liquidity needs of firms in the industry.*

Naturally, measuring this correlation in the data can be challenging. One option is to use a firm's observed external financing needs (e.g., investments minus internal funds) as a proxy for firm-level liquidity needs (see Acharya et al. (2007) for an empirical proxy). Clearly, the correlation that matters for the model's implications is that among firms in the same industry.

The implications above work mostly at the level of the industry. In addition, the model makes the following firm-level implication:

Implication 5 *Within an industry, "deep-pocket" firms are more likely to use lines of credit in their liquidity management.*

In the model, the firm with high initial wealth (firm H) is more likely to use credit lines than firm L, the firm with low initial wealth. As we discuss in Section 4.2, if firm L is to demand liquidity insurance,

[17] See Almeida et al. (2009) for a discussion of the differences between financial distress and financial constraints.

its main priority is to finance its own liquidity needs, rather than bids for other industry firms. Thus, relatively to firm H, firm L is less likely to demand credit lines (and more likely to use cash).

In order to operationalize this result, notice that the firm's initial wealth A can be broadly interpreted as the stock of internal funds that the firm can draw on to decrease its external financing needs. Empirically, A should be correlated with variables such as the firm's profitability and its stock of retained earnings. Thus, this result can help explain the empirical observation that profitable firms are more likely to use credit lines in their liquidity management (Sufi (2009)).[18] In addition, we note that one should be careful when using stock variables (such as retained earnings and net worth) to proxy for A, since these stock variables are partly the result of the firm's optimal policies. For example, Sufi (2009) finds that net worth (defined as book equity minus cash scaled by assets minus cash) is negatively correlated with the use of credit lines. One simple explanation for this correlation is that firms that use credit lines will also have higher debt (given that credit line debt is recorded as debt in COMPUSTAT) and thus lower book equity.

6 Empirical Evidence

This section reports exploratory tests that focus on the industry-level implications of our model. In particular, we examine the model's predictions related to liquidity-driven acquisitions and to the use of lines of credit that back acquisitions. We first describe the sample construction of mergers and lines of credit. Then, we introduce our proxies for firm asset specificity, industry asset specificity, liquidity mergers, and line of credit usage. Finally, we document the incidence of liquidity mergers across industries, the relation between firm/industry asset specificity and liquidity mergers, and the relation between firm/industry asset specificity and the usage of lines of credit in corporate liquidity management.

6.1 Data description

Our sample of mergers and acquisitions is drawn from the Securities Data Company's (SDC) U.S. Mergers and Acquisitions Database. We obtain accounting and financial data on acquirers and targets from COMPUSTAT. We gather data on domestic mergers and acquisitions with announcement dates between January 1, 1980 and December 31, 2006. Our sample selection process follows the literature requiring that: (1) the transaction is completed; (2) the number of days between the announcement and completion dates is between 0 and 1,000; (3) the target is a firm with accounting data on COMPUSTAT or SDC during the time of the takeover; (4) Due to the need to construct our proxy for liquidity mergers, we drop all targets that have missing data on interest coverage, and/or negative interest coverage. The latter cutoff is due to the fact that such targets are likely to be in economic,

[18] See also the empirical results below, in particular Tables 6 and 7.

rather than financial distress; (5) the deal value is greater than \$1 million; (6) the acquiring firm controls less than 50% of the shares of the target firm before the announcement; (7) the acquiring firm ends up with all the shares of the acquired firm; and (8) the acquirer and the target operate in the same industry, defined by 3-digit SIC codes. We end up with a sample of 1,097 transactions.

We use two alternative sources to construct our line of credit data. Our first sample (which we call *LPC Sample*) is drawn from LPC-DealScan. These data allow us to construct a large sample of credit line initiations, observing the purpose of each credit line. As we explain below, when using these data we keep in the sample only those credit lines which are likely to be used to finance investment and we drop credit agreements that do not correspond to the credit lines characterized in our theory (for example, those that are used as back ups to commercial paper). We note, however, that the LPC-DealScan data have two potential drawbacks. First, they are mostly based on syndicated loans, and thus are potentially biased towards large deals and consequently towards large firms. Second, they do not allow us to measure line of credit drawdowns (the fraction of existing lines that has been used in the past. To overcome these issues, we also construct an alternative sample that contains detailed information on the credit lines initiated and used by a random sample of 300 COMPUSTAT firms between 1996 and 2003. These data are provided by Amir Sufi on his website, and were used on Sufi (2009). We denote these data *Random Sample*. Using these data reduces the sample size for our tests and does not allow us to measure the purpose of the credit line. We regard these two samples as providing complementary information on the usage of credit lines for the purposes of this paper. In addition, this allows us to document that several previously reported patterns prevail in both samples .

To construct the *LPC Sample*, we start from a sample of loans in LPC-DealScan in the period of 1987 to 2008 for which we can obtain the firm identifier *gvkey* (which we later use to match to COMPUSTAT).[19] We drop utilities, quasi-public and financial firms from the sample (SIC codes greater than 5999 and lower than 7000, greater than 4899 and lower than 5000, and greater than 8999). We consider only short-term and long-term credit lines, which are defined as those that have the LPC field "*loantype*" equal to "*364-day Facility*," "*Revolver/Line < 1 Yr*," "*Revolver/Line >= 1 Yr*," or "*Revolver/Line*." In our tests we keep only the credit lines which are likely to be used for the financing of future investments, namely those whose purpose is labeled "*acquisition line*," "*capital expenditures*," "*corporate purposes*," or "*takeover*."

Our unit of observation for the *LPC Sample* is a firm-quarter. In some cases, the same firm has more than one credit line initiation in the same quarter. In these cases, we sum the facility amounts (the total available credit in each line) for each firm-quarter, and average the other variables using the facility amount as weights. We let $AcqLC_{i,t}$ denote the total value of future investment- (acquisition-)

[19] We use several procedures to obtain *gvkeys*, including a file provided by Michael Roberts, which was used in Chava and Roberts (2008), firm tickers (which are available in LPC), and manual matching using firm names.

related credit lines initiated in quarter t by firm i, and let $Maturity_{i,t}$ denote the average maturity of these lines (in quarters).[20]

To construct the *Random Sample*, we start from the "random sample" used in Sufi (2009), which contains 1,908 firm-years (300 firms) between 1996 and 2003. Sufi's data set includes information on the total credit line facilities available to firm j in year t (denoted $Total\ Line_{j,t}$), and the amount of credit in these lines that is still available to firm j in year t ($Unused\ Line_{j,t}$). We use this information to construct our proxies for credit line usage (described below).

6.2 Proxy variables

6.2.1 Identifying liquidity mergers

To identify liquidity-driven acquisitions, we need to stratify the sample according to a measure of financial (not economic) distress. Following Asquith et al. (1984) and Andrade and Kaplan (1998), we employ interest coverage ratios as a measure of financial distress.[21] To identify transactions in which the target is plausibly close to financial distress we require that the target firm has an interest coverage ratio below the median interest coverage in COMPUSTAT for the sample period indicated above ("Definition A"). This is our primary definition and attempts to identify targets that are likely to be financially distressed, while at the same time maintaining a large enough sample of potential liquidity mergers. Alternatively, we also experiment with a classification scheme that requires the target to have below median interest coverage and above median profitability ("Definition B"). The median value of profitability is again drawn from the universe of COMPUSTAT firms. This latter definition helps us to identify targets that are financially, but not economically distressed.

Table 1 reports the number of liquidity-driven and other horizontal deals in our sample by year. Out of 1,097 control transactions, 473 deals (or about 43.1% of the sample) are classified as potential liquidity mergers based on interest coverage only. Under the second classification scheme, we identify 260 deals (or about 23.7% of the sample). The number of deals in our data set does not increase monotonically through time; for example, it declines in the early 1990s and in the early 2000s. The fraction of liquidity mergers also varies over time (and across industries). Finally, we note that the cyclicality of merger events (mergers waves) and hence the availability of SDC data makes it difficult to identify sufficiently many liquidity mergers in some of the industries of our sample of manufacturers. Using Definition A (B) for financial distress, we can identify liquidity mergers in 91 (85) out of

[20] The fraction of credit lines that can potentially be used for capital expenditures and acquisitions is significant. Out of 18,050 unique lines of credit initiated between 1987 and 2008, 9,710 fit LPC's investment/acquisitions definition.

[21] We compute interest coverage ratio as COMPUSTAT's *oibdp* divided by *xint*. If COMPUSTAT data are not available, we use the corresponding data from SDC.

127 industries at the 3-digit SIC level.

Table 1 About Here

Table 2 reports basic summary statistics (mean and medians) for empirical proxies related to deal, acquiring-, and target-firm characteristics in our sample based on our primary classification scheme. We tabulate characteristics for both liquidity- and non-liquidity-type mergers. Panel A collects statistics for deal characteristics. It shows that liquidity mergers tend to have a similar transaction value as non-liquidity deals in absolute terms. Relative to book assets, liquidity-driven acquisitions are, however, valued lower than non-liquidity-driven acquisitions. Liquidity mergers also take longer to complete. According to the statistics in Panel B, *acquirers* in liquidity mergers tend to be smaller (about half of the size), to hold less cash, to hold more fixed assets, and to be slightly less profitable than acquirers in non-liquidity mergers. On the flip side, Panel C shows that *targets* in liquidity mergers tend to be larger, to hold less cash, and to hold more fixed assets than other targets. Notice in particular that the average profitability of target firms is higher for liquidity mergers, indicating that the average target in a liquidity merger is not in economic distress. As in prior studies, acquiring firms are generally larger than target firms and tend to have a higher Q than target firms.

Table 2 About Here

We measure the incidence of liquidity mergers in an industry using the ratio of liquidity mergers to the total number of horizontal mergers in that industry. We call this variable *Liquidity Mergers*. This variable is summarized in Table 3 together with the other industry variables.

6.2.2 Specificity measures and other industry characteristics

A key element of our theory relates the degree to which assets are firm- and industry-specific. The literature does not offer an empirical counterpart for this element of our model, but we are able to operationalize a proxy that summarizes the relation we want to capture.[22] Our empirical implementation is based on two observations. First, we conjecture that industry-specificity is likely to be greater for assets such as machinery and equipment than for buildings and land. Accordingly, we define "machinery intensity," the ratio of machinery and equipment (COMPUSTAT's *ppenme*) to total firm assets (*at*), as a proxy for industry asset specificity.[23] Second, we conjecture that firm-specificity should be inversely related to the degree of activity in asset resale market in a firm's industry: the higher the use

[22] A related construct can be found in Almeida and Campello (2007). Those authors, however, do not seek to operationalize the proxy proposed by our model.

[23] We have verified that our results are robust to the use of alternative definitions for machinery intensity. For instance, in untabulated tests we scale *ppenme* by *ppent* (i.e., property, plant, and equipment instead of total assets). We also use a proxy given by 1 – *(ppneb + ppneli)/at*, where the items in parentheses correspond to buildings and land, respectively. We decided in favor of our measure of asset industry-specificity because it maximizes the sample size.

of second-hand capital amongst different firms in an industry, the less firm-specific is the capital. To construct a measure of "capital salability" within an industry, we hand-collect data for used and new capital acquisitions from the Bureau of Census' *Economic Census*. These data are compiled by the Bureau once every 5 years from 1967 to 1997 and allow us to gauge asset salability by computing the ratio of used to total (i.e., used plus new) fixed depreciable capital expenditures by firms in an industry.

Combining those two observations, we construct our desired proxy as the product of "machine intensity" and "capital salability" proxies. Simply put, we multiply the amount of hard assets needed to operate in an industry by the salability of those assets. As the Bureau of Census' data end in 1997, we create a time-invariant variable by averaging across firms and time within 3-digit SIC industries.[24] We call this composite proxy *Transferable Assets*. We similarly construct proxies for other industry characteristics that we use as controls in our empirical tests. *Industry Concentration* is defined as the 3-digit SIC sales-based industry's Herfindahl index. *Industry Interest Coverage* is defined as the 3-digit SIC-level average firm coverage ratio. *Industry Capacity Utilization* is the 3-digit SIC industry's capacity utilization (available from the Federal Reserve's *Statistical Release G.17*), and *Industry Q* is the 3-digit SIC-level mean firm Q. In some cases, these industry-level variables contain extreme observations. To avoid biases due to outliers, these control variables are also winsorized at the 5% level. The industry-level variables are summarized in Table 3.

<u>TABLE 3 ABOUT HERE</u>

6.2.3 Line of credit usage and other firm-level data

We follow Sufi (2009) in the definitions of the variables that we use for our credit line tests. We use a book asset measure that deducts the amount of cash holdings. Using COMPUSTAT fields, we denote by *Assets* the difference between total assets (*at*) and cash (*che*). The other COMPUSTAT-based variables that we use are defined as follows. *Tangibility* is equal to *ppent* scaled by *Assets*. *Size* is defined as the log of *Assets*. Q is defined as a cash-adjusted, market-to-book asset ratio, $(Assets + prcc\_fc \times sho - ceq)/Assets$.[25] *NetWorth* is defined as $(ceq - che)/Assets$. *Profitability* is the ratio of EBITDA over *Assets*. *Age* is measured as the difference between the current year and the first year in which the firm appeared in COMPUSTAT. Industry sales volatility (*IndSaleVol*) is the (3-digit SIC) industry median value of the within-year standard deviation of quarterly changes in firm sales (*saleq* minus its lagged value) scaled by the average asset value (*atq*) in the year. Profit volatility (*ProfitVol*) is the firm-level standard deviation of annual changes in the level of EBITDA, calculated using four lags, and scaled by average assets in the lagged period. We winsorize the COMPUSTAT

[24] This index is multiplied by 100 to make magnitudes more comparable to the other industry proxies reported below.

[25] Sufi (2009) also deducts deferred taxes from the numerator. When using Sufi's random sample, we also exclude deferred taxes from this calculation because including it causes a significant drop in the number of observations.

variables symmetrically at the 5% level.

When using the *Random Sample*, we measure the fraction of total corporate liquidity that is provided by credit lines for firm i in year t using both total and unused credit lines:

$$Total\ LC\text{-}to\text{-}Cash_{i,t} = \frac{Total\ Line_{i,t}}{Total\ Line_{i,t} + Cash_{i,t}}, \tag{25}$$

and

$$Unused\ LC\text{-}to\text{-}Cash_{i,t} = \frac{Unused\ Line_{i,t}}{Unused\ Line_{i,t} + Cash_{i,t}}. \tag{26}$$

As discussed by Sufi, while some firms may have higher demand for total liquidity due to better investment opportunities, these *LC-to-Cash* ratios should isolate the *relative* usage of lines of credit versus cash in corporate liquidity management.

When using the *LPC Sample* (LPC-DealScan data), we construct a proxy for line of credit usage in the following way. For each firm-quarter, we measure credit line availability at date t by summing all existing (investment-purpose) credit lines that have not yet matured. This calculation assumes that LCs remain open until they mature. Specifically, we define our measure of line of credit availability for each firm-quarter (j, s) as:

$$Total\ Acq\ LC_{j,s} = \sum_{t \leq s} Acq\ LC_{j,t}\Gamma(Maturity_{j,t} \geq s - t), \tag{27}$$

where $\Gamma(.)$ represents the indicator function, and the variables $Acq\ LC$ and $Maturity$ are defined above. We convert these firm-quarter measures into firm-year measures by computing the average value of $Total\ Acq\ LC$ in each year. We then measure the fraction of corporate liquidity that is provided by investment-related lines of credit for firm j in quarter s using the following variable:

$$Acq\ LC\text{-}to\text{-}Cash_{j,t} = \frac{Total\ Acq\ LC_{j,t}}{Total\ Acq\ LC_{j,t} + Cash_{j,t}}. \tag{28}$$

This ratio is closely related to the *Total LC-to-Cash* ratio of equation 25, with the important difference that it includes only credit lines that are used for investment purposes.

Table 4 reports summary statistics on firm-level variables for both samples. Panel A depicts the statistics for the *LPC Sample*. We restrict the sample to the 91 industries for which we can obtain the industry measures described above in Section 6.2.2. Panel B describes the *Random Sample*. The distribution for most of the variables is very similar across the two samples. The main difference between the two samples is that the LPC-DealScan data is biased towards large firms (as discussed above). For example, median assets are equal to 255 million in the *LPC Sample*, and 116 million in the *Random Sample*. Consistent with this difference, firms in the *LPC Sample* are also older, have lower average Qs, and lower income volatility. The measure of line of credit availability in the *LPC Sample* (*Acq LC-to-Cash*) is lower than the corresponding measures in the *Random Sample* (*Total*

LC-to-Cash and *Unused LC-to-Cash*). For example, the average value of *Acq LC-to-Cash* in the *LPC Sample* is 0.22, while the average value of *Total LC-to-Cash* is 0.51. This difference reflects the fact that the *Acq LC-to-Cash* measure includes only investment-related credit lines, and also the possibility that LPC-DealScan may fail to report some credit lines.

TABLE 4 ABOUT HERE

6.3 Liquidity mergers and asset specificity

We start by investigating whether the incidence of liquidity mergers is related to asset specificity in a way that is consistent with our model's prediction. The dependent variable in our analysis is the ratio of liquidity mergers to the total number of mergers in the industry (the variable *Liquidity Mergers*). According to our model, liquidity mergers are more likely to arise in industries with high asset-specificity (high machinery intensity), but among firms whose assets are not too firm-specific (high capital salability). Therefore, the model predicts a positive relation between *Liquidity Mergers* and *Transferable Assets* at the industry level. Our tests control for other industry characteristics that could affect this relation in the data. Adding *Industry Concentration* addresses the alternative explanation for our findings that liquidity mergers are simply due to a higher incidence of horizontal mergers in more concentrated industries (e.g., Hackbarth and Miao (2008)). Similarly, including industry-wide measures of financial distress, measured by *Industry Interest Coverage* addresses the concern that liquidity mergers are by and large consolidating mergers in distressed industries. Another explanation of mergers is that they are due to technological industry shocks and excess industry capacity (e.g., Mitchell and Mulherin (1996), Andrade and Stafford (2004), Hackbarth and Miao (2008), and Harford et al. (2008)). We thus also control for *Industry Capacity Utilization*. Finally, we add *Industry Q* to the empirical specification to control for overall industry prospects. The empirical model that we estimate has the form:

$$\begin{aligned} \textit{Liquidity Mergers}_j \;=\; & a + b_1 \textit{Transferable Assets}_j + b_2 \textit{Industry Concentration}_j \\ & + b_3 \textit{Industry Interest Coverage}_j + b_4 \textit{Industry Capacity Utilization}_j \\ & + b_5 \textit{Industry } Q_j + \epsilon_j, \end{aligned} \tag{29}$$

where the index j denotes a 3-digit SIC industry. The model is estimated via OLS, but since the dependent variable is censored between zero and one we also perform a Tobit estimation.

Table 5 reports coefficient estimates for a set of regressions in which control variables are progressively introduced. Consistent with our model, those estimates show that the effect of our asset-specificity composite on the fraction of liquidity-driven acquisitions is positive and significant. The estimates in column (1) of Panel A, for example, imply that a one-standard deviation change in *Transferable Assets* (=0.296) leads to a 0.043 (= 0.146 × 0.296) increase in the fraction of liquidity mergers in the industry, which is 13.4% of the sample average of liquidity mergers. The economic significance of the coefficient on *Transferable Assets* is even larger when we use the definition of liquidity merger that conditions on both low interest coverage and high profitability (Panel B).

Column (2) estimates indicate that market power gains in concentrated industries do not explain the incidence of liquidity mergers. The industry-wide distress proxy included in the model under column (3) does not weaken the reliably positive relation between *Liquidity Mergers* and *Transferable Assets*. Results in columns (4) and (5) show that industry capacity utilization and Q do not affect the economic or statistical significance of the baseline result of column (1). Next, column (6) combines all industry-wide proxies we consider. The result from this estimation renders a somewhat stronger positive relation between *Liquidity Mergers* and *Transferable Assets* under both classification schemes. Column (7) points to similar findings using a Tobit specification.

<u>TABLE 5 ABOUT HERE</u>

6.4 Lines of credit and asset specificity

Another implication of our model is that firms are more likely to use credit lines if industry asset-specificity is high, but firm asset-specificity is low. We test this implication by relating our three alternative credit line variables (those in equations 25, 26, and 28) to the composite proxy for industry-not-firm specificity that we constructed, *Transferable Assets*. We also include in the empirical model the main determinants of credit line usage suggested by Sufi (2009), in addition to the industry variables that we use in the tests of Section 6.3:

$$\begin{aligned} \textit{LC-to-Cash}_{i,t} \;=\; & \alpha + \beta_1 \textit{Transferable Assets}_j + \beta_2 \ln(\textit{Age})_{i,t} + \beta_3 (\textit{Profitability})_{i,t-1} \\ & + \beta_4 \textit{Size}_{i,t-1} + \beta_5 Q_{i,t-1} + \beta_6 \textit{NetWorth}_{i,t-1} + \beta_7 \textit{IndSalVol}_{j,t} \\ & + \beta_8 \textit{ProfitVol}_{i,t} + \beta_9 \textit{Industry Concentration}_j \\ & + \beta_{10} \textit{IndustryInterest Coverage}_j + \beta_{11} \textit{Industry Capacity Utilization}_j \\ & + \beta_{12} \textit{Industry } Q_j + \epsilon_{i,t}, \end{aligned} \tag{30}$$

where the index j denotes a 3-digit SIC industry, the index i denotes a firm, and the index t denotes a year. Our model predicts that the coefficient β_1 should be positive. Since the dependent variable is censored between zero and one, we also perform a Tobit estimation. Because several of the variables are measured at the industry-level, we cluster standard deviations by 3-digit SIC industry whenever the industry variables are included in the regression. In other cases, the standard errors are clustered at the firm level.

We start by providing some descriptive evidence that shows that the variable *Transferable Assets* is positively correlated with line of credit usage in liquidity management, as predicted by theory. This pattern is shown visually in Figure 3, which uses the *LPC Sample* and depicts the average usage of credit lines as measured by *Acq LC-to-Cash* against *Transferable Assets*, by 3-digit SIC industry.[26] The figure shows that investment-related line of credit usage is more prevalent in industries with firm-specific, but transferable assets.

<u>FIGURE 3 ABOUT HERE</u>

In Table 6 we provide the results of estimating equation 30 for the *LPC Sample*. We start in column (1) by running a specification that is closely related to that in Sufi's (2009) Table 3.[27] The results are very close to those in Sufi. In particular, the coefficients on profitability, size, net worth, and Q are virtually identical to those in Sufi (although the coefficient on profitability is not significant in column (1)). These coefficients indicate that large, low Q, and low net worth firms are more likely to use investment-related credit lines in liquidity management, relative to cash holdings. The signs on the coefficients on the volatility measures are also consistent with those in Sufi, though not significant. In column (2), we run a simple regression of *Acq LC-to-Cash* on *Transferable Assets*. Consistent with Figure 3, the simple correlation between *Acq LC-to-Cash* and *Transferable Assets* is positive and significant. Without controlling for other variables, the coefficient on *Transferable Assets* is 0.17, significant at a 1% level. *Transferable Assets* remains significant after including all firm-level controls (column (3)). The coefficient drops to 0.09, but remains statistically significant. Column (4) shows that firms in industries with high capacity utilization, low interest coverage, and high concentration are more likely to use credit lines relative to cash. In addition, *Transferable Assets* remains statistically significant and similar in economic magnitude after including all of these industry controls together with firm-level variables. Finally, column (5) shows the results of using a Tobit specification. All of the coefficients are consistent with those in the previous columns.

<u>TABLE 6 ABOUT HERE</u>

The correlation between *Acq LC-to-Cash* and *Transferable Assets* that we estimate in Table 6 also appears to be economically significant. For example, the OLS coefficient on columns (3) and (4) (which is approximately equal to 0.09) implies that one standard-deviation increase in *Transferable Assets* (which is equal to 0.30 according to Table 3) increases *Acq LC-to-Cash* by 0.027, or approximately 14% of the mean value of *Acq LC-to-Cash* (which is 0.2 in Table 4).

[26] To construct the measure of line of credit usage at the industry level, we compute the average value of *Acq LC-to-Cash* for each 3-digit SIC industry, over the entire sample period. In addition, we require a 3-digit SIC industry to have more than 5 firms to appear in the figure.

[27] In this regression, we follow Sufi (2009) and also include 1-digit SIC industry dummies. Naturally, we do not include industry dummies in the specifications which contain time-invariant industry variables (those in the other columns).

One potential concern with these results is that they are based on LPC-DealScan measures of line of credit availability, which are biased towards large firms. Another limitation of these data is that they tend to overestimate the amount of credit available to firms (since we cannot measure line of credit drawdowns). To show that the results are not driven by these issues, we experiment in turn with Sufi's (2009) random sample (our *Random Sample*), which addresses both of these problems. The results are presented in Table 7.

<u>Table 7 About Here</u>

In the first four columns of Table 7, we use the variable *Total LC-to-Cash* , which includes both used and unused portions of firms' credit lines. Column (1) replicates the results in column (3) of Sufi's Table 3. The coefficients indicate that profitable, large, low net worth, low Q, seasonal, and less volatile firms are more likely to use credit lines in corporate liquidity management. In column (2) we relate *Total LC-to-Cash* to *Transferable Assets*, without controlling for other variables. Consistent with previous results, this column suggests that firms use more credit lines to manage liquidity when they belong to industries with firm-specific, but transferable assets. Column (3) shows that this relationship continues to hold after controlling for firm-level variables. Finally, column (4) includes industry variables and shows that the relation between *Total LC-to-Cash* and *Transferable Assets* continues to hold.

Similarly to Table 6, the results in columns (1) to (5) in Table 7 do not address the potential overestimation of the amount of credit available to firms at a point in time, since they use total, as opposed to unused credit lines. To this end, columns (6) to (10) in Table 7 use *Unused LC-to-Cash* and show that this measurement issue does not affect the patterns previously reported. In particular, *Unused LC-to-Cash* and *Transferable Assets* continue to be positively related, before and after including firm- and industry-level controls.[28] Finally, we note that the economic magnitude of the correlation between *Transferable Assets* and credit line usage in this sample is also sizeable. For example, using the coefficients in columns (4) and (9) to measure this correlation, we find that a one-standard deviation change in *Transferable Assets* increases *Total LC-to-Cash* by 0.10, and *Unused LC-to-Cash* by 0.08. These magnitudes represent 21% and 18% of their respective sample averages (see Table 4). Overall, these results are consistent with the predictions of our theoretical model.

7 Concluding Remarks

While mergers and asset acquisitions are some of the most important types of corporate investment, we know little about the way firm financial policies are affected by those transactions. Likewise, we know little about how real asset allocations across firms are affected by firm financial policies. Our

[28] Column (5) replicates the results in column (5) of Table 3 in Sufi (2009).

paper sheds light on these matters by modeling the interaction between corporate liquidity and asset reallocation opportunities. The model embeds the Holmstrom and Tirole's (1997, 1998) liquidity demand theory in an industry equilibrium framework that draws on Shleifer and Vishny (1992).

Our model implies that financially distressed firms might be acquired by other firms in the same industry, even when there are no operational synergies. We call such transactions "liquidity mergers." The main purpose of these deals is to reallocate liquidity from firms that have liquidity to those that are about to be inefficiently liquidated due to a liquidity shortfall. Analyzing firms' optimal liquidity policies as a function of future real asset reallocation opportunities, we find that lines of credit are a particularly attractive way of financing liquidity-driven acquisitions. This theoretical finding is interesting because it provides a rationale to the ("counterintuitive") empirical regularity that shows highly profitable, well-capitalized firms as the heaviest users of credit line facilities.

Besides shedding new light on existing empirical findings, our model has several implications that have not yet been examined. For example, our model predicts that liquidity mergers should be more prevalent in industries with high asset specificity, but among firms whose assets are not too firm-specific. The model also predicts that firms in these industries should be more likely to use lines of credit, generating an equilibrium relationship between line of credit usage and the incidence of liquidity mergers. We put together a comprehensive data set (including data from the Bureau of Census, SDC, LPC-Dealscan, and COMPUSTAT) to explore our model's empirical implications. We find evidence that supports those implications. Our empirical tests are, by design, quite basic and meant to motivate future research on the link between mergers and corporate financial policies, with an emphasis on the management of liquid instruments such as cash and lines of credit.

While the link between liquidity mergers and the demand for credit lines underlies our analysis, we stress that the economic rationale for liquidity mergers and the notion that credit lines are an effective way to transfer liquidity across states are of broad interest. The key economic insight behind the liquidity merger story is the advantage that the industry acquirer has in liquidity provision to distressed rivals. Whether the acquirer can supply liquidity to distressed firms depends on whether the acquirer has enough liquidity to draw on, and not on whether the liquidity comes from credit lines. Similarly, our point about credit lines is that they are a particularly effective way to finance investment opportunities that arrive in good states of the world, and for which the firm needs an internal source of liquidity. While a "liquidity merger" strikes us as an interesting, practical example of such investments, it is certainly not the only one.

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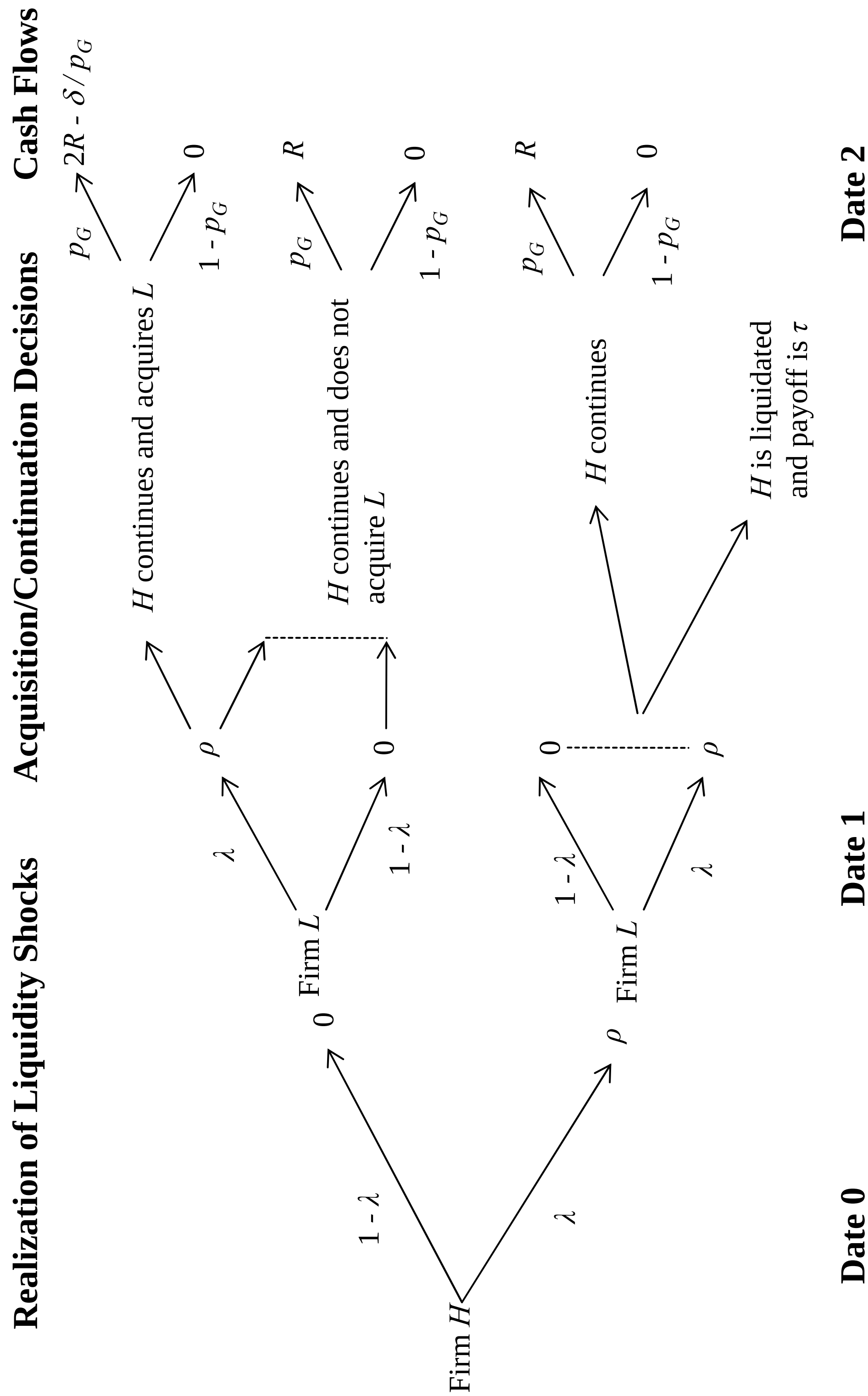

Figure 1. Time line and Sequence of Actions from the Perspective of Firm *H*.

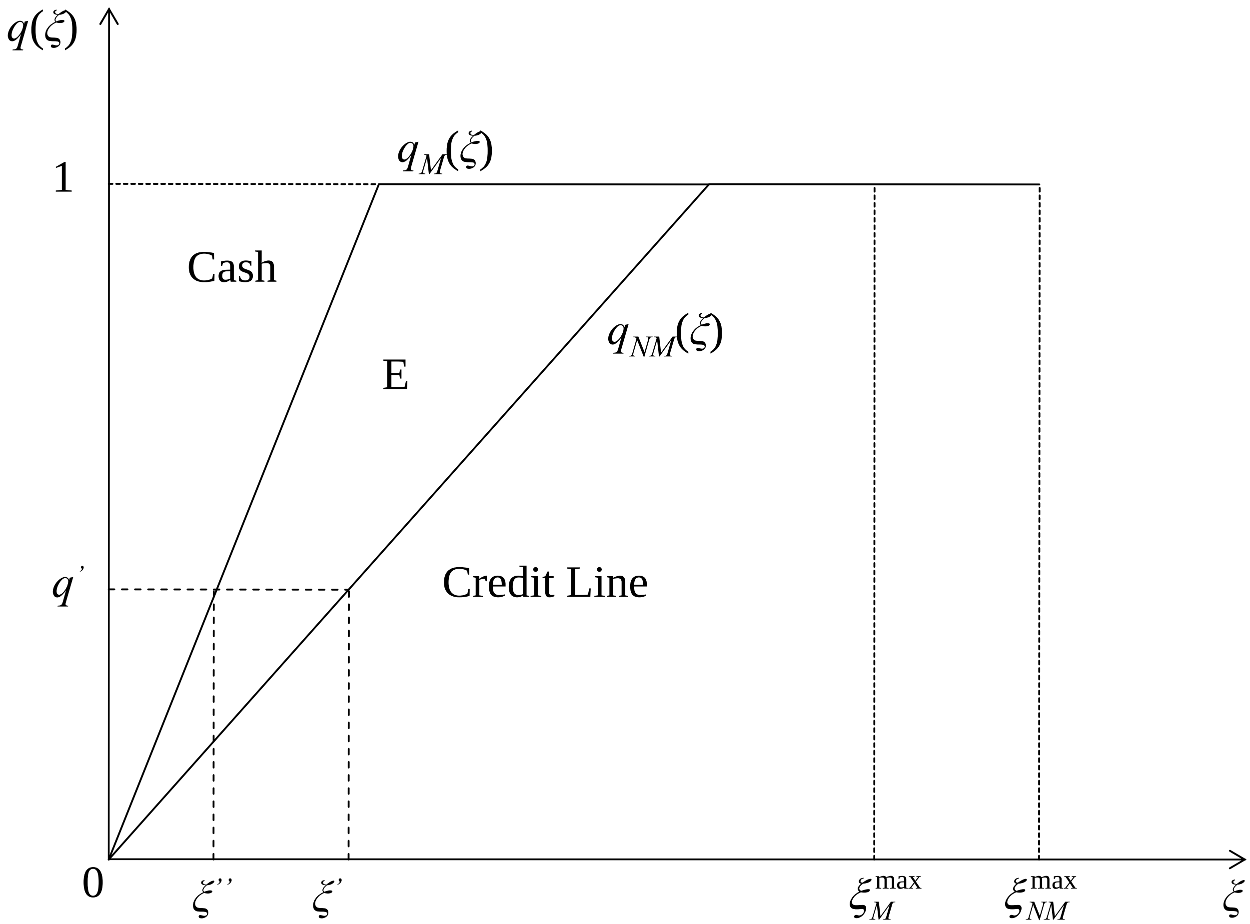

Figure 2. The Choice between Cash and Credit Lines. This figure depicts the functions $q_{NM}(\xi)$ and $q_M(\xi)$ from Propositions 4 and 5. These functions are such that, for a pair (q, ξ) such that $q > q(\xi)$, firm H chooses cash rather than credit lines to implement the optimal liquidity policy. Similarly, for $q < q(\xi)$, firm H prefers credit lines to cash. The function $q_{NM}(\xi)$ depicts this threshold for the equilibrium without a liquidity merger, while the function $q_M(\xi)$ depicts this threshold for the equilibrium with liquidity mergers. The region E is the region in which firm H chooses cash if liquidity mergers are not profitable, but chooses a credit line if the liquidity merger becomes profitable.

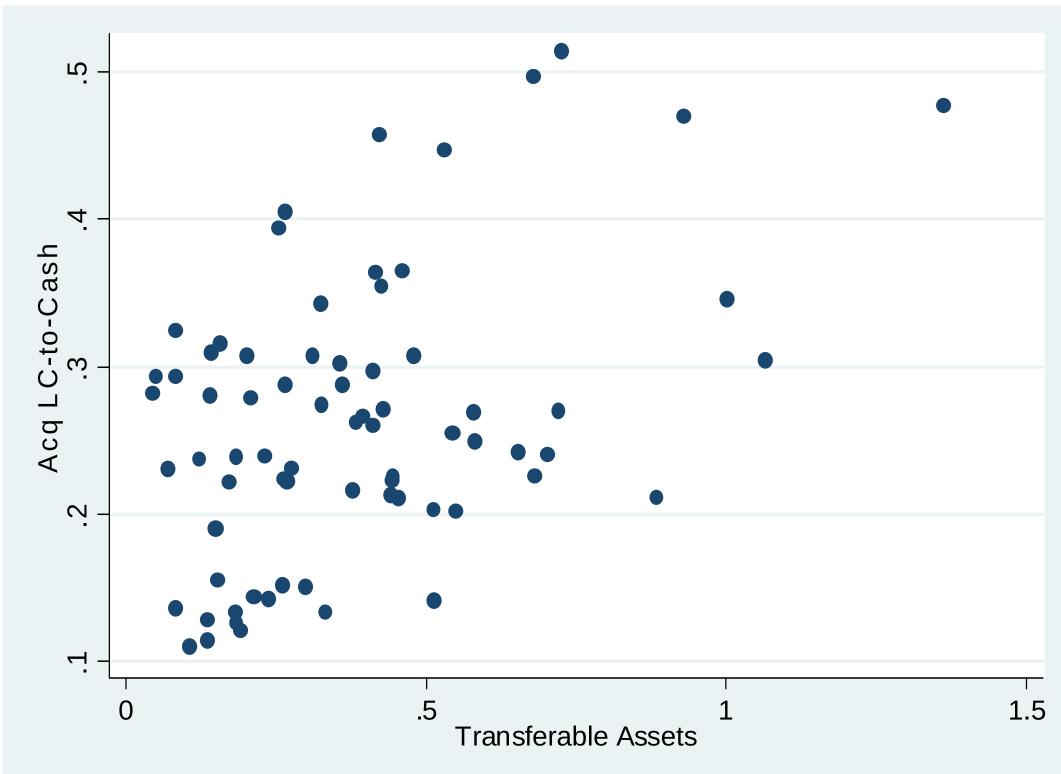

Figure 3. Line of Credit Availability and Transferable Assets. The figure depicts the relationship between line of credit availability and our composite proxy for industry, and not firm specificity (*Transferable Assets*). On the y-axis, we depict the ratio of total credit lines divided by total credit lines plus cash balances (the variable *Acq LC-to-Cash* in equation 32 in the text). On the x-axis, we depict the variable *Transferable Assets*. The data represent 3-digit SIC industry averages over our entire sample period (1987–2008), for industries with five or more firms.

Table 1. Sample Distribution by Announcement Year

The sample contains all domestic mergers and acquisitions with announcement dates between January 1, 1980, and December 31, 2006 (see text for further details). A liquidity merger is defined as a merger or acquisition in which the target has interest coverage below the sample median in COMPUSTAT (Definition A) or as a merger or acquisition in which the target has interest coverage below the sample median and profitability above the sample median in COMPUSTAT (Definition B). Interest coverage is computed as COMPUSTAT's *oibdp* divided by *xint* and profitability is the ratio of *oibdp* over *at*. If COMPUSTAT data are not available, we use the corresponding data items from SDC.

Announcement	Liquidity Merger (A)			Liquidity Merger (B)		
Year	Yes	No	All	Yes	No	All
1980	3	7	10	2	8	10
1981	16	8	24	10	14	24
1982	16	11	27	7	20	27
1983	13	9	22	7	15	22
1984	14	10	24	9	15	24
1985	15	13	28	11	17	28
1986	20	23	43	10	33	43
1987	18	21	39	11	28	39
1988	24	30	54	15	39	54
1989	25	19	44	14	30	44
1990	15	13	28	10	18	28
1991	14	12	26	6	20	26
1992	11	12	23	6	17	23
1993	12	19	31	7	24	31
1994	18	23	41	10	31	41
1995	16	24	40	12	28	40
1996	16	27	43	8	35	43
1997	15	48	63	7	56	63
1998	30	47	77	15	62	77
1999	33	50	83	17	66	83
2000	30	48	78	16	62	78
2001	22	29	51	12	39	51
2002	15	13	28	9	19	28
2003	19	20	39	11	28	39
2004	12	22	34	6	28	34
2005	12	31	43	3	40	43
2006	19	35	54	9	45	54
Total	473	624	1,097	260	837	1,097

Table 2. Summary Statistics for Control Transactions

This table reports means and medians for empirical proxies related to deal, acquiring-, and target-firm characteristics. The sample contains all domestic mergers and acquisitions with announcement dates between January 1, 1980, and December 31, 2006 (see text for further details). A liquidity merger is defined as a merger or acquisition in which the target has interest coverage below the sample median in COMPUSTAT. *Transaction Value* ($ million) is the total value of consideration paid by the acquirer, excluding fees and expenses. *Assets* is defined as total book value of assets. *Days To Completion* is measured as the number of calendar days between the announcement and effective dates. *Cash* includes cash and marketable securities. *EBIT* equals cash flow minus depreciation. *Return On Assets* is defined as cash flow scaled by assets. *PPE* is Property, plant, and equipment.

	Liquidity Merger		
	Yes Mean [Median]	No Mean [Median]	All Mean [Median]
Panel A: Deal Characteristics			
Transaction Value (TV)	544.82	837.07	770.52
	[107.1]	[100.0]	[100.6]
TV/Assets	0.98	2.59	2.17
	[0.63]	[1.33]	[1.13]
Days To Completion	144.78	115.40	122.09
	[120]	[100]	[106]
Panel B: Acquirer Characteristics			
Assets	3,869.8	6,634.7	6,120.0
	[1,113.7]	[1,121.4]	[1,117.8]
Cash/Assets (%)	11.20	15.03	14.30
	[5.23]	[8.49]	[7.66]
EBIT/Assets (%)	7.43	7.36	7.37
	[8.25]	[10.07]	[9.57]
Return On Assets (%)	11.06	11.37	11.31
	[11.82]	[13.90]	[13.51]
PPE/Assets (%)	26.41	23.50	24.04
	[22.02]	[20.20]	[20.52]
Q	1.61	2.46	2.31
	[1.35]	[1.74]	[1.65]
Panel C: Target Characteristics			
Assets	725.21	618.00	646.23
	[191.5]	[82.1]	[100.8]
Cash/Assets (%)	7.13	19.26	15.82
	[2.44]	[11.32]	[6.46]
EBIT/Assets (%)	5.61	3.33	3.99
	[5.17]	[8.68]	[7.24]
Return On Assets (%)	10.45	8.43	9.04
	[9.82]	[13.42]	[11.99]
PPE/Assets (%)	29.06	26.03	27.30
	[28.30]	[22.90]	[24.61]
Q	1.31	2.22	1.84
	[1.13]	[1.49]	[1.33]

Table 3. Summary Statistics for Industry-Level Variables

This table reports summary statistics for time-invariant proxies of industry characteristics during the 1980–2006 period. A liquidity merger is defined as a merger or acquisition in which the target has interest coverage below the sample median in COMPUSTAT (Panel A) or as a merger or acquisition in which the target has interest coverage below the sample median and profitability above the sample median in COMPUSTAT (Panel B). *Liquidity Mergers* is defined as the 3-digit SIC industry's ratio of liquidity mergers to the total number of horizontal mergers in that industry between January 1, 1980, and December 31, 2006 (see text for further details). *Transferable Assets* is defined as machine intensity (*ppenme/at*) multiplied by 100 times the ratio of used divided by used plus new capital, from the Bureau of Census' Economic Census. *Industry Concentration* is defined as the 3-digit SIC industry's Herfindahl index (based on sales). *Industry Interest Coverage* is defined as the 3-digit SIC industry's average interest coverage. *Industry Capacity Utilization* is defined as the 3-digit SIC industry's capacity utilization, which is available from the Federal Reserve's Statistical Release G.17. *Industry Q* is defined as the 3-digit SIC industry's average Q. All variables are time-invariant industry-level averages and winsorized at the 5% level.

	Mean	Median	Std. Dev.	25^{th} Pct.	75^{th} Pct.	Obs.
Panel A: Distress Definition A						
Liquidity Mergers	0.322	0.286	0.152	0.200	0.408	91
Transferable Assets	0.401	0.332	0.296	0.183	0.513	91
Industry Concentration	0.011	0.008	0.009	0.005	0.012	91
Industry Interest Coverage	27.77	22.40	20.71	13.58	36.92	91
Industry Capacity Utilization	0.789	0.783	0.028	0.768	0.808	89
Industry Q	3.210	1.832	3.300	1.375	3.022	91
Panel B: Distress Definition B						
Liquidity Mergers	0.204	0.167	0.125	0.104	0.273	85
Transferable Assets	0.397	0.326	0.299	0.183	0.486	85
Industry Concentration	0.011	0.008	0.008	0.005	0.012	85
Industry Interest Coverage	28.11	23.16	21.11	14.53	36.92	85
Industry Capacity Utilization	0.788	0.782	0.028	0.765	0.808	83
Industry Q	3.306	1.832	3.393	1.375	3.206	85

Table 4. Summary Statistics for Firm-Level Variables

This table reports basic summary statistics for time-variant proxies of firm characteristics during the 1987–2008 period. *Acq LC-to-Cash* is defined as the fraction of corporate liquidity that is provided by investment-related lines of credit. *Assets* are firm assets net of cash, measured in millions of dollars. *Tangibility* is PPE over assets. *Q* is defined as a cash-adjusted, market-to-book assets ratio. *NetWorth* is the book value of equity minus cash over total assets. *Profitability* is the ratio of EBITDA over net assets. Industry sales volatility (*IndSaleVol*) is the (3-digit SIC) industry median value of the within-year standard deviation of quarterly changes in firm sales, scaled by the average quarterly gross asset value in the year. *ProfitVol* is the firm-level standard deviation of annual changes in the level of EBITDA, calculated using four lags, and scaled by average gross assets in the lagged period. Firm *Age* is measured as the difference between the current year and the first year in which the firm appeared in COMPUSTAT. *Unused LC-to-Cash* and *Total LC-to-Cash* measure the fraction of total corporate liquidity that is provided by credit lines using unused and total credit lines.

	Mean	Median	Std. Dev.	25^{th} Pct.	75^{th} Pct.	Obs.
LPC Sample (LPC-DealScan):						
Acq LC-to-Cash	0.215	0.000	0.354	0.000	0.394	22333
Tangibility	0.310	0.281	0.176	0.175	0.414	20955
Assets	2392.38	255.19	12841.67	53.71	1081.43	20968
Q	1.985	1.498	1.302	1.130	2.267	19231
NetWorth	0.360	0.393	0.268	0.228	0.550	20955
Profitability	0.134	0.141	0.122	0.086	0.202	20913
IndSalVol	0.038	0.033	0.023	0.025	0.043	22589
ProfitVol	0.066	0.049	0.052	0.027	0.089	22593
Age	19.435	14.000	15.525	7.000	31.000	22593
Random Sample (Sufi (2009) sample):						
Unused LC-to-Cash	0.450	0.455	0.373	0.000	0.822	1906
Total LC-to-Cash	0.512	0.569	0.388	0.000	0.900	1908
Tangibility	0.332	0.275	0.230	0.146	0.481	1908
Assets	1441.41	116.41	7682.26	23.98	522.20	1908
Q	2.787	1.524	3.185	1.069	2.726	1905
NetWorth	0.426	0.453	0.300	0.284	0.633	1905
Profitability	0.015	0.126	0.413	0.040	0.198	1908
IndSalVol	0.043	0.036	0.026	0.024	0.051	1908
ProfitVol	0.089	0.061	0.078	0.028	0.126	1908
Age	16.04	10.00	13.40	6.00	23.00	1908

Table 5. Liquidity Mergers and Transferable Assets

The dependent variable *Liquidity Mergers* is the fraction of liquidity mergers by 3-digit SIC industry as a fraction of the total number of mergers in that industry between January 1, 1980, and December 31, 2006 (see text for further details). A liquidity merger is defined as a merger or acquisition in which the target has interest coverage below the sample median in COMPUSTAT (Panel A) or as a merger or acquisition in which the target has interest coverage below the sample median and profitability above the sample median in COMPUSTAT (Panel B). Interest coverage is computed as *oibdp* divided by *xint*. If COMPUSTAT data are not available, we use the corresponding data items from SDC. *Transferable Assets* is defined as machine intensity (*ppenme/at*), multiplied by 100 times the ratio of used divided by used plus new capital, from the Bureau of Census' *Economic Census*. *Industry Concentration* is defined as the 3-digit SIC industry's Herfindahl index (based on *sale*). *Industry Interest Coverage* is defined as the 3-digit SIC industry's average interest coverage. *Industry Capacity Utilization* is defined as the 3-digit SIC industry's capacity utilization, which is available from the Federal Reserve's *Statistical Release G.17*. *Industry Q* is defined as the 3-digit SIC industry's average *Q*. All variables are time-invariant industry-level averages and winsorized at the 5% level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, and t-statistics based on robust standard errors are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Distress Definition A							
Transferable Assets	0.146***	0.159***	0.158***	0.157***	0.128**	0.161***	0.173***
	(3.08)	(3.26)	(3.24)	(3.33)	(2.44)	(2.91)	(3.18)
Industry Concentration		2.662				1.589	1.532
		(1.42)				(0.79)	(0.83)
Industry Interest Coverage			-0.001			-0.001	-0.001
			(1.31)			(1.42)	(1.35)
Industry Capacity Utilization				0.675		0.609	0.499
				(1.14)		(1.04)	(0.89)
Industry Q					-0.011**	-0.009*	-0.010**
					(2.39)	(1.98)	(2.11)
Constant	0.263***	0.228***	0.282***	-0.278	0.305***	-0.191	-0.105
	(10.83)	(6.87)	(9.39)	(0.61)	(8.95)	(0.42)	(0.23)
Specification	OLS	OLS	OLS	OLS	OLS	OLS	TOBIT
Observations	91	91	91	89	91	89	89
R^2	0.07	0.08	0.07	0.09	0.11	0.13	0.31
Panel B: Distress Definition B							
Transferable Assets	0.141***	0.164***	0.154***	0.139***	0.129***	0.165***	0.170***
	(2.66)	(3.13)	(2.84)	(2.70)	(2.22)	(3.03)	(3.99)
Industry Concentration		4.562***				5.087***	5.453***
		(3.45)				(3.32)	(3.38)
Industry Interest Coverage			-0.001			-0.001*	0.001
			(1.45)			(1.78)	(1.47)
Industry Capacity Utilization				0.871*		1.085**	1.112**
				(1.78)		(2.21)	(2.50)
Industry Q					-0.008**	-0.004	-0.004
					(2.01)	(1.07)	(1.14)
Constant	0.148***	0.0901***	0.165***	-0.539	0.178***	-0.730*	-0.763**
	(6.52)	(3.44)	(5.82)	(1.42)	(5.58)	(1.89)	(2.13)
Specification	OLS	OLS	OLS	OLS	OLS	OLS	TOBIT
Observations	85	85	85	83	85	83	83
R^2	0.12	0.21	0.13	0.16	0.16	0.30	0.35

Table 6. Line of Credit Availability and Transferable Assets

The dependent variable is *Acq LC-to-Cash*, the fraction of corporate liquidity that is provided by investment-related lines of credit. The data for lines of credit come from LPC DealScan, for the period of 1987 to 2008. *Profitability* is the ratio of EBITDA over net assets. *Tangibility* is PPE over assets. *Assets* are firm assets net of cash, measured in millions of dollars. *NetWorth* is the book value of equity minus cash over total assets. *Q* is defined as a cash-adjusted, market-to-book assets ratio. Industry sales volatility (*IndSaleVol*) is the (3-digit SIC) industry median value of the within-year standard deviation of quarterly changes in firm sales, scaled by the average quarterly gross asset value in the year. *ProfitVol* is the firm-level standard deviation of annual changes in the level of EBITDA, calculated using four lags, and scaled by average gross assets in the lagged period. Firm *Age* is measured as the difference between the current year and the first year in which the firm appeared in COMPUSTAT. *Transferable Assets* is defined as machine intensity (*ppenme/at*) multiplied by 100 times the ratio of used divided by used plus new capital, from the Bureau of Census' Economic Census. *Industry Concentration* is defined as the 3-digit SIC industry's Herfindahl index (based on sales). *Industry Interest Coverage* is defined as the 3-digit SIC industry's average interest coverage. *Industry Capacity Utilization* is defined as the 3-digit SIC industry's capacity utilization, which is available from the Federal Reserve's Statistical Release G.17. *Industry Q* is defined as the 3-digit SIC industry's average *Q*. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, and t-statistics based on robust standard errors are in parentheses.

Dep. Var.: *Acq LC-to-Cash*	(1)	(2)	(3)	(4)	(5)
Profitability	0.0270		0.00493	0.0128	0.226**
	(0.84)		(0.17)	(0.38)	(2.07)
Tangibility	-0.0394		-0.0331	-0.0595*	-0.207**
	(1.29)		(1.00)	(1.89)	(2.43)
Assets	0.0257***		0.0277***	0.0275***	0.0921***
	(7.43)		(6.73)	(6.71)	(9.81)
NetWorth	-0.100***		-0.0953***	-0.0932***	-0.2663***
	(5.63)		(4.89)	(4.96)	(4.88)
Q	-0.0425***		-0.0378***	-0.0378***	-0.0936***
	(14.51)		(12.28)	(11.85)	(9.73)
IndSalVol	0.336		0.382	0.237	0.2415
	(1.58)		(1.50)	(0.87)	(0.36)
ProfitVol	-0.181**		-0.150*	-0.108	0.1077
	(2.00)		(1.79)	(1.24)	(0.43)
Age	-0.0181**		-0.0191**	-0.0190**	-0.0545**
	(2.33)		(2.22)	(2.23)	(2.55)
Transferable Assets		0.165***	0.0947***	0.0867***	0.1347**
		(4.23)	(3.14)	(3.10)	(2.12)
Industry Concentration				3.171***	7.291***
				(2.97)	(3.42)
Industry Interest Coverage				-0.001***	-0.001**
				(2.66)	(2.14)
Industry Capacity Utilization				0.512**	0.848
				(2.19)	(1.51)
Industry Q				-0.0012	-0.003
				(0.65)	(0.69)
Constant	0.261***	0.162***	0.218***	-0.167	-1.717***
	(8.47)	(8.04)	(6.27)	(0.90)	(3.90)
Cluster	FIRM	SIC3	SIC3	SIC3	SIC3
SIC Dummies	YES	NO	NO	NO	NO
Year Dummies	YES	YES	YES	YES	YES
Specification	OLS	OLS	OLS	OLS	TOBIT
Observations	19034	22333	19034	18922	18922
R^2	0.10	0.07	0.10	0.11	0.07

Table 7. Line of Credit Availability and Transferable Assets: Random Sample

The dependent variables are *Total LC-to-Cash* and *Unused LC-to-Cash*, which measure the fraction of total corporate liquidity that is provided by credit lines using total and unused credit lines respectively. The data for lines of credit are provided by Amir Sufi, for the period of 1996 to 2003. *Profitability* is the ratio of EBITDA over net assets. *Tangibility* is PPE over assets. *Assets* are firm assets net of cash, measured in millions of dollars. *NetWorth* is the book value of equity minus cash over total assets. Q is defined as a cash-adjusted, market-to-book assets ratio. Industry sales volatility (*IndSaleVol*) is the (3-digit SIC) industry median value of the within-year standard deviation of quarterly changes in firm sales, scaled by the average quarterly gross asset value in the year. *ProfitVol* is the firm-level standard deviation of annual changes in the level of EBITDA, calculated using four lags, and scaled by average gross assets in the lagged period. Firm *Age* is measured as the difference between the current year and the first year in which the firm appeared in COMPUSTAT. *Transferable Assets* is defined as machine intensity (*ppenme/at*) multiplied by 100 times the ratio of used divided by used plus new capital, from the Bureau of Census' Economic Census. *Industry Concentration* is defined as the 3-digit SIC industry's Herfindahl index (based on sales). *Industry Interest Coverage* is defined as the 3-digit SIC industry's average interest coverage. *Industry Capacity Utilization* is defined as the 3-digit SIC industry's capacity utilization, which is available from the Federal Reserve's Statistical Release G.17. *Industry Q* is defined as the 3-digit SIC industry's average Q. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, and t-statistics based on robust standard errors are in parentheses.

Panel A – Dep. Var.: *Total LC-to-Cash*	(1)	(2)	(3)	(4)	(5)
Profitability	0.0778**		0.0670*	0.0821***	0.266***
	(2.27)		(1.97)	(2.69)	(3.52)
Tangibility	0.0399		0.104	0.0974	0.173
	(0.56)		(1.17)	(1.12)	(1.43)
Assets	0.0472***		0.0389***	0.0390***	0.0519***
	(5.12)		(3.30)	(3.23)	(3.50)
NetWorth	-0.0971**		-0.185***	-0.173***	-0.233**
	(2.30)		(3.06)	(3.17)	(2.51)
Q	-0.0362***		-0.0386***	-0.0389***	-0.0658***
	(8.51)		(8.83)	(8.64)	(7.61)
IndSalVol	1.094*		1.301	1.630*	2.314**
	(1.69)		(1.49)	(1.84)	(2.26)
ProfitVol	-0.596***		-0.550*	-0.489*	-0.338
	(3.22)		(1.85)	(1.88)	(0.90)
Age	-0.0386*		-0.0475*	-0.0402	-0.0595*
	(1.85)		(1.75)	(1.58)	(1.88)
Transferable Assets		0.723***	0.318**	0.321**	0.353**
		(4.39)	(2.33)	(2.20)	(2.07)
Industry Concentration				1.229	0.459
				(0.37)	(0.12)
Industry Interest Coverage				-0.0016*	-0.0023**
				(1.88)	(2.08)
Industry Capacity Utilization				1.046	1.119
				(1.08)	(1.00)
Industry Q				0.0009	0.0023
				(0.14)	(0.26)
Constant	0.239**	0.272***	0.524***	-0.299	-0.530
	(2.42)	(4.46)	(4.91)	(0.38)	(0.59)
Cluster	FIRM	SIC3	SIC3	SIC3	SIC3
SIC Dummies	YES	NO	NO	NO	NO
Year Dummies	YES	YES	YES	YES	YES
Specification	OLS	OLS	OLS	OLS	TOBIT
Observations	1905	900	900	900	900
R^2	0.40	0.11	0.40	0.41	0.37

Panel B – Dep. Var.: *Unused LC-to-Cash*	(6)	(7)	(8)	(9)	(10)
Profitability	0.0613*		0.0439	0.0587**	0.252***
	(1.96)		(1.48)	(2.17)	(3.55)
Tangibility	0.0252		0.0787	0.0706	0.127
	(0.37)		(0.90)	(0.82)	(1.01)
Assets	0.0527***		0.0466***	0.0464***	0.061***
	(6.12)		(3.81)	(3.68)	(4.15)
NetWorth	-0.0541		-0.138***	-0.127***	-0.165*
	(1.40)		(2.87)	(2.88)	(1.86)
Q	-0.0288***		-0.0341***	-0.0343***	-0.0607***
	(7.28)		(9.35)	(9.07)	(7.71)
IndSalVol	1.042		1.051	1.285	1.948*
	(1.55)		(1.20)	(1.40)	(1.82)
ProfitVol	-0.554***		-0.541**	-0.479**	-0.357
	(3.17)		(2.01)	(2.09)	(0.99)
Age	-0.0232		-0.0443*	-0.0373	0.0569*
	(1.13)		(1.68)	(1.51)	(1.79)
Transferable Assets		0.645***	0.260**	0.254*	0.289*
		(4.13)	(2.05)	(1.91)	(1.84)
Industry Concentration				1.444	0.717
				(0.42)	(0.18)
Industry Interest Coverage				-0.0016*	-0.0022**
				(1.85)	(2.01)
Industry Capacity Utilization				0.977	1.062
				(0.97)	(0.91)
Industry Q				-0.0001	0.0011
				(0.01)	(0.12)
Constant	0.148	0.244***	0.428***	-0.330	-0.580
	(1.38)	(4.22)	(4.52)	(0.40)	(0.62)
Cluster	FIRM	SIC3	SIC3	SIC3	SIC3
SIC Dummies	YES	NO	NO	NO	NO
Year Dummies	YES	YES	YES	YES	YES
Specification	OLS	OLS	OLS	OLS	TOBIT
Observations	1903	900	900	900	900
R^2	0.37	0.10	0.39	0.40	0.36

Appendix A Proof of Proposition 1

Suppose first that condition 7 holds. In order to prove the proposed equilibrium, let us analyze what happens in each state at date 1, given the proposed liquidity policies. Then we will show that firms do not benefit from deviating from the optimal liquidity policies at date 0.

In state $(1-\lambda)^2$, both firms continue since they do not need additional liquidity. In state $(1-\lambda)\lambda$, only firm L has a liquidity shock, and it is liquidated. Firm H continues, but does not bid for L. In state $\lambda(1-\lambda)$, only firm H has a liquidity shock. It can finance its liquidity shock and continues. Finally, in state λ^2 both firms have a liquidity shock. Firm H can continue, while firm L is liquidated.

These strategies generate enough date-0 pledgeable income for investors, so that projects can start. Consider first firm L. It makes $K_0^L = I - A_L$ (so that it can finance the initial investment), $K_{1,\lambda}^L = -\tau$ (liquidation or merger proceeds are fully pledged to external investors), and a payment $K_{2,(1-\lambda)}^L$ such that investors break even from the perspective of date 0. This payment must be such that:

$$I - A_L = (1-\lambda)p_G K_{2,(1-\lambda)}^L + \lambda\tau. \tag{31}$$

Equation 5 guarantees that we can find a $K_{2,(1-\lambda)}^L$ such that $p_G K_{2,(1-\lambda)}^L \leq \rho_0$, thereby satisfying the pledgeability constraint.[29]

Firm H's optimal investment policy is to start its own project at date 0 and reinvest ρ in state λ at date 1 (so that it continues until the final date). In order to support this policy, firm H borrows sufficient funds to start the project at date 0 ($K_0^H = I - A_H$), and receives an additional payment of ρ from external investors in state λ ($K_{1,\lambda}^H = \rho$). It promises a date-2 payment K_2 (in both states), so that investors break even. This payment is such that:

$$I - A_H + \lambda\rho = p_G K_2. \tag{32}$$

Equation 6 guarantees that this payment satisfies the pledgeability constraint.

Are these strategies optimal given the other firm's strategy? By condition 4. it is efficient for both firms to withstand the liquidity shock. Firm L would benefit from saving more liquidity to withstand its own shock, but it is constrained by its low net worth A_L (condition 5). Formally, since $\rho_0 - \lambda\rho < I - A_L$, one cannot find a date-2 payment $K_2^L \leq \frac{\rho_0}{p_G}$ such that $I - A_L + \lambda\rho = p_G K_2^L$.

Firm H could deviate from the equilibrium strategy by bidding for firm L. However, condition 7 implies that it does not pay for firm H to deviate. H needs to pay a minimum price of τ to firm L's investors, and finance L's liquidity shock, ρ. Because the maximum that it can generate out of firm L's assets is $\rho_1 - \delta$, bidding is not profitable for firm H. Thus, no firm benefits from deviating from the equilibrium strategies.

Now suppose now that 8 holds. Given the proposed financial policies, in state λ^2 firm H would benefit from bidding for the assets of firm L, but does not have enough liquidity to finance the bid. In state $(1-\lambda)\lambda$, firm H does not have a liquidity shock, and uses its liquidity $\rho + \tau$ to bid for the assets of firm L. Given 8, the liquidity merger is efficient since firm H can generate $\rho_1 - \delta$ from the assets of firm L. Firm H pays the liquidation value τ to firm L's investors, and assumes the other liabilities of L (the liquidity shock ρ). The outcomes in the other states are identical to those above.

We now show that firms have sufficient pledgeable income to support the equilibrium strategies. The analysis for firm L is identical to that above. Firm H must have enough liquidity to withstand

[29] The financial policy is generally not unique. For example, the firm can also set $K_{1,\lambda}^L > -\tau$, and increase $K_{2,(1-\lambda)}^L$ (as long as the pledgeability constraint is satisfied).

its own liquidity shock in state λ. This equilibrium requires that $K^H_{1,\lambda} = \rho$, and $K^H_{1,(1-\lambda)\lambda} = \rho + \tau$. Notice also that since firm H is acquiring firm L, as long as $\rho_0 - \delta > 0$ its pledgeable income will increase in state $(1-\lambda)\lambda$. The break-even constraint in this case is:

$$I - A_H + \lambda\rho + (1-\lambda)\lambda(\rho + \tau) = (1 - \lambda(1-\lambda))p_G K^*_2 + \lambda(1-\lambda)p_G K^H_{2,(1-\lambda)\lambda}. \tag{33}$$

By equation 6, we can find a solution such that $p_G K^*_2 \leq \rho_0$, and $p_G K^H_{2,(1-\lambda)\lambda} \leq 2\rho_0 - \delta$. Thus, firm H can finance both its own liquidity shock, and also the liquidity merger.

Firm L cannot deviate from the equilibrium strategy since it does not have enough pledgeable income to withstand the liquidity shock (as above). Firm H would benefit from hoarding additional liquidity to bid for the assets of firm L in state λ^2, but it is constrained by date-0 pledgeable income as we show now. If firm H deviates and demands enough liquidity to bid for firm L also in state λ^2, it would require a transfer $K^H_{1,\lambda^2} = K^H_{1,(1-\lambda)\lambda} = \rho + \tau$. Thus, in order for investors to break even at date 0 we would require:

$$I - A_H + \lambda\rho + (1-\lambda)\lambda\left[\rho + \tau - (\rho_0 - \delta)\right] + \lambda^2\left[\rho + \tau - (\rho_0 - \delta)\right] \leq \rho_0 \tag{34}$$

which violates 6. Thus, the proposed strategies are optimal given the pledgeability constraints.

Appendix B Proof of Proposition 2

Let us first derive C and D^c_0, the optimal cash balance and debt level in the equilibrium without a liquidity merger. Equations (13) and (14) imply that:

$$C = \frac{I - A_H + \rho - \rho_0}{(1-\xi)(1-\lambda) - \xi} \tag{35}$$

$$D^c_0 = \frac{\rho_0 - \rho + (1-\xi)C}{p_G} \tag{36}$$

This solution is feasible as long as $p_G D^c_0 \leq \rho_0$, which implies the following constraint:

$$I - A_H + \frac{\lambda + \xi(1-\lambda)}{1-\xi}\rho \leq \rho_0. \tag{37}$$

Not surprisingly, this constraint becomes tighter as the cost of holding cash increases. If $\xi = 0$, we have the same feasibility condition as in the security design case (Proposition 1), which is always obeyed by condition 6. The parameter $\xi^{\max}_{NM}$ can be defined as the maximum cost of cash that is consistent with condition 37. Finally, given that creditors break even, firm H's payoff is given by the project's total value minus the cost of carrying the cash balance C (equation 16), provided that $\xi < \xi^{\max}_{NM}$.

Let us move now to the equilibrium with a liquidity merger. C^M must fund both the liquidity shock in state λ, and the liquidity merger. Thus, we must have:

$$(1-\xi)\,C^M + \rho_0 - p_G D^M_0 \geq \rho, \tag{38}$$

$$(1-\xi)\,C^M + 2\rho_0 - \delta - p_G D^M_0 \geq \rho + \tau. \tag{39}$$

Finally, the debt level D^M_0 must satisfy $p_G D^M_0 \leq \rho_0$.

Notice first that since (C^M, D^M_0) must obey the same constraints as in the equilibrium with no liquidity merger, we must have $C^M \geq C$, and $D^M_0 \geq D^C_0$. If this was not the case, then C and D^C_0 would not be the optimal cash/debt combination in the equilibrium with no mergers. The firm has incentives to minimize the amount of cash that it carries, and thus we know that C and D_0^c are the lowest amounts of cash and debt that satisfy the constraints in the equilibrium with no liquidity merger.

We now show that when condition 15 holds, we must have $C^M > C$. Suppose for contradiction that $C^M = C$, and $D_0^M = D_0^C$. Since condition 15 holds, the firm needs to use some of its cash to finance the liquidity merger. Formally, if we let y be the minimum amount of funds that the firm needs to use in state $(1-\lambda)\lambda$:

$$y + 2\rho_0 - \delta - p_G D_0^C = \rho + \tau, \tag{40}$$

then it is clear that when condition 15 holds, $y > 0$. Thus, the firm returns only $(1-\xi)\,C - y$ to date-0 investors in this state. Investors' date-0 break-even constraint would then require:

$$p_G D_0^C + (1-\lambda)^2(1-\xi)C + (1-\lambda)\lambda\left[(1-\xi)\,C - y\right] = I - A_H + C, \tag{41}$$

which cannot hold by equation 14 (which is equivalent to 41, for $y = 0$). In order for equation 41 to hold, the amount of debt D_0 must increase from D_0^C to $D_0^C + \varepsilon$. But then, equation 38 would require:

$$(1-\xi)\,C + \rho_0 - p_G\left[D_0^C + \varepsilon\right] \geq \rho. \tag{42}$$

This cannot hold, since $(1-\xi)\,C + \rho_0 - p_G D_0^C = \rho$. Thus, the firm must save an amount of cash that is greater than C. In equilibrium, we must then have that $C^M > C$, and $D_0^M > D_0^C$. In addition, the firm uses as little cash as possible in state $(1-\lambda)\lambda$. If we let y^M represent this minimum amount of cash that the firm needs to use, then the equilibrium is defined by:

$$y^M + 2\rho_0 - \delta - p_G D_0^M = \rho + \tau \tag{43}$$

$$(1-\xi)\,C^M + \rho_0 - p_G D_0^M = \rho \tag{44}$$

$$p_G D_0^M + (1-\lambda)^2(1-\xi)C^M + (1-\lambda)\lambda\left[(1-\xi)\,C^M - y^M\right] = I - A_H + C^M. \tag{45}$$

This solution is feasible as long as $p_G D_0^M(\xi) \leq \rho_0$, where we expressed the optimal debt level as a function of the cost of carrying cash. Since $D_0^M \geq D_0^C$, this condition is less likely to hold for the same cost of carrying cash ξ, and thus if we let $\xi_M^{\max}$ denote the maximum possible cost of cash we must have that $\xi_{NM}^{\max} \geq \xi_M^{\max}$. The firm's payoff is reduced by ξC^M, as long as $\xi < \xi_M^{\max}$. This completes the proof of the Proposition.

Appendix C Proof of Lemma 3

The analysis of the case without the liquidity merger is in the text. In the equilibrium with the merger, the credit line $w_{\max}^{LC}$ must satisfy equation 23, and also be sufficient to finance the liquidity shock in state λ (if the line is not revoked):

$$w_{\max}^{LC} + \rho_0 - p_G D_0^{LC} \geq \rho. \tag{46}$$

Thus, in the liquidity merger equilibrium the total size of the credit line depends on the firm's relative need for pre-committed financing in states λ and $(1-\lambda)\lambda$. If we define the amount by which the firm expects to use the credit line in state λ as:

$$w_\lambda = \rho + p_G D_0^{LC} - \rho_0, \tag{47}$$

and the amount by which the firm expects to use the credit line in state $(1-\lambda)\lambda$ by:

$$w_{(1-\lambda)\lambda} = \max\left[\rho + \tau + p_G D_0^{LC} - 2\rho_0 + \delta, 0\right], \tag{48}$$

then the optimal size of the credit line is given by the maximum of these two values:

$$w_{\max}^{LC} = \max(w_\lambda, w_{(1-\lambda)\lambda}). \tag{49}$$

A credit line of size $w_{\max}^{LC}$ ensures that the firm has enough liquidity to finance both its own liquidity shock, and also the liquidity merger. Notice that while w_λ is always greater than zero, $w_{(1-\lambda)\lambda}$ might be equal to zero.

As in the no-merger equilibrium, the firm finances the credit line by paying the commitment fee in the state in which the credit line is not used (state $(1-\lambda)^2$):

$$\lambda(1-q)w_\lambda + (1-\lambda)\lambda w_{(1-\lambda)\lambda} = (1-\lambda)^2 x^M, \tag{50}$$

where x^M (the commitment fee in the liquidity merger equilibrium) must be lower than the firm's pledgeable income in state $(1-\lambda)^2$, that is, $x^M \leq \rho_0 - p_G D_0^{LC}$. This implies the following feasibility constraint:

$$I - A_H + \lambda(1-q)\rho + (1-\lambda)\lambda(\rho + \tau - \rho_0 + \delta) \leq (1-\lambda q)\rho_0 + \lambda q \tau. \tag{51}$$

This inequality is implied by assumption (6), so that the credit line is always feasible. Thus, the credit line is always feasible in both equilibria.

As in the no-merger equilibrium, the main cost of the credit line is that it can be revoked in state λ. The firm's expected payoff is then given by equation 24.

Appendix D Endogenizing line of credit revocability

The analysis of line of credit implementation in Section 3.2.2 takes the probability q as an exogenous parameter. We now show that this probability can be endogenized in a framework in which the probability of the liquidity shock λ is partly determined by managerial actions. For that purpose, we add another date to the model between date 0 and date 1 in which the manager must choose between two actions. The good action produces a probability of the date-1 liquidity shock equal to λ_G, and the bad action produces a probability $\lambda_B > \lambda_G$, but a private benefit equal to B_0 for the manager. The optimal contract must be designed to induce the good action.

Denote the manager's continuation utilities following the realization of the liquidity shock by U_λ (if the firm is hit with the liquidity shock), and $U_{1-\lambda}$ (if the liquidity shock does not occur). Then, the manager's incentive constraint requires that:

$$(1-\lambda_G)U_{1-\lambda} + \lambda_G U_\lambda \geq (1-\lambda_B)U_{1-\lambda} + \lambda_B U_\lambda + B_0, \tag{52}$$

which implies that:

$$U_{1-\lambda} - U_\lambda \geq \frac{B_0}{\lambda_G - \lambda_B}. \tag{53}$$

In order to induce the manager to take the right action, the optimal credit line must ensure that the manager's continuation utility depends on whether the liquidity shock is realized or not. As we now show, revoking the credit line in state λ allows the credit line to satisfy condition 53.

Consider first the equilibrium without the liquidity merger. In that case, the continuation utilities for H's manager are:

$$\begin{aligned} U_{1-\lambda} &= \rho_1 - p_G D_0^{LC} \\ U_\lambda &= (1-q)(\rho_1 - p_G D_0^{LC}). \end{aligned} \quad (54)$$

At date 1, the initial investment I is sunk and thus does not need to be considered. In the line or credit implementation of Section 3.2.2, the manager pays for the liquidity shock in state λ by raising capital from date-1 investors and the credit line. Thus, the manager's payoff at that point is equal to the project's total expected payoff, minus what was promised to date-0 investors. Finally, if the firm is liquidated (with probability q), the manager receives a zero payoff. We conclude that to induce managerial behavior the probability q must satisfy:

$$q^* = \frac{B_0}{\lambda_G - \lambda_B(\rho_1 - p_G D_0^{LC})} > 0. \quad (55)$$

Notice that the probability that the credit line is revoked is as low as possible to minimize liquidation costs.

The analysis is similar for the liquidity merger equilibrium. The main difference is that the continuation utility in state $(1-\lambda)$ is higher than $U_{1-\lambda}$ due to the expected payoff from the merger:

$$U_{1-\lambda}^M = \rho_1 - p_G D_0^{LC} + \lambda(\rho_1 - \rho_0). \quad (56)$$

To understand this expression, notice that the merger happens with probability λ (the probability that L is distressed). If the merger happens, it produces total expected cash flows equal to $\rho_1 - \delta$, and pledgeable cash flows equal to $\rho_0 - \delta$ which are entirely used by the manager to finance the required investment of $\rho + \tau$ (and in addition, the manager may use the credit line). Thus, the manager's expected payoff from the merger is equal to $\lambda(\rho_1 - \rho_0)$. The expression for $U_{1-\lambda}^M$ implies that the expression for q is now:

$$0 < q^M = \frac{\frac{B_0}{\lambda_G - \lambda_B} - \lambda(\rho_1 - \rho_0)}{\rho_1 - p_G D_0^{LC}} < q^*. \quad (57)$$

Notice that the line of credit can be revoked less often in the liquidity merger equilibrium, because the possibility of acquiring firm L (which happens only in state $(1-\lambda)$) improves managerial incentives.

Appendix E Proof of Proposition 4

Cash implementation is always feasible when $\xi = 0$, and it is not feasible when $\xi = 1$ (see equation 37) so $\xi_{NM}^{\max} > 0$. If $\xi > \xi_{NM}^{\max}$ the firm cannot use cash, and will prefer the credit line (recall that the credit line is always feasible). If $\xi < \xi_{NM}^{\max}$, cash implementation is feasible. If $\xi = q = 0$, then the firm is indifferent between cash and the credit line, so that $q_{NM}(0) = 0$. Now, take a $q^{'} > 0$. For ξ small enough, the firm prefers cash to the credit line if $q = q^{'}$, because of the expected loss from the revocability of the credit line, $\lambda q^{'}(\rho_1 - \rho - \tau)$. As ξ increases, U_H^{NC} decreases monotonically until the point at which $\lambda q^{'}(\rho_1 - \rho - \tau) = \xi^{'} C(\xi^{'})$, such that the firm is again indifferent between cash and credit lines. We can then define $q_{NM}(\xi^{'}) = q^{'}$. A similar procedure will produce the cost of cash ξ that makes the firm indifferent between cash and credit lines, for all $q \leq 1$. Clearly, $q_{NM}^{\prime}(\xi) \geq 0$.

Appendix F Proof of Proposition 5

The proof of the existence of the function $q_M(\xi)$ is identical to the proof above. For all $q \leq 1$, we take the value of ξ that makes the firm indifferent between cash and the credit line. Clearly, $q_M'(\xi) \geq 0$. To show that $q_M(\xi) \geq q_{NM}(\xi)$, take again $q = q^{'}$ as above. The cost of cash that makes the firm indifferent can be defined as $\lambda q^{'}(\rho_1 - \rho - \tau) = \xi^{''} C^M(\xi^{''})$. Since $C^M > C$, and $\frac{\partial \xi C^M(\xi)}{\partial \xi} > 0$, it must be that $\xi^{''} < \xi^{'}$. Since the same point holds for all $q \leq 1$, we must have that $q_M(\xi) \geq q_{NM}(\xi)$ (see Figure 1).

Appendix G Combining cash and credit lines (Section 4.1)

Denote C^J the amount of cash that the firm would need to hold in such a joint policy, and D^J the associated promised repayment at date 2. Let the credit line be big enough such that the firm can finance the bid for the other firm using the credit line. It only pays for the firm to deviate from the line of credit-only policy if it saves enough cash to survive the liquidity shock in state λ with probability 1. Since the line of credit will not be available in some states of the world, this condition requires:

$$(1 - \xi)\, C^J + \rho_0 - p_G D^J = \rho. \tag{58}$$

The promised payment must in turn satisfy:

$$p_G D^J = I - A_H + \lambda C^J + (1 - \lambda)\xi C^J + (1 - \lambda)\lambda[\rho + \tau - \rho_0 + \delta] \leq \rho_0 \tag{59}$$

Notice that the firm uses cash to withstand the liquidity shock, and the credit line to pay for the liquidity merger. This means that the firm can return $(1 - \xi)\, C^J$ to investors in state $(1 - \lambda)$. The line of credit–cash joint policy implies the following payoff:

$$U_H^J = U_H^M - \xi C^J \tag{60}$$

The joint policy dominates the line of credit-only policy if it is feasible, and if the cost of carrying cash ξC^J is lower than the expected loss from revocability, $\lambda q(\rho_1 - \rho - \tau)$. The cash balance C^J is higher than in an equilibrium with no mergers, because the firm must take into account that opening the line of credit will cost some debt capacity for the firm in state λ. However, the required cash balance is generally lower than C^M, given that the firm does not need to save additional cash with the specific purpose of financing the liquidity merger. Thus, it is possible that this joint policy dominates a line of credit-only in the liquidity merger equilibrium.

Allowing for the possibility of a joint policy does not change the conclusion that the firm is more likely to use lines of credit in the liquidity merger equilibrium. Consider the region in which $q < q_{NM}(\xi)$. For these parameter values, the firm chooses the line of credit in both equilibria. In particular, this implies that the cost of carrying cash ξC is higher than the expected loss from revocability, $\lambda q(\rho_1 - \rho - \tau)$ in that region. Thus, the firm will not find it optimal to implement the joint policy in this region, even in the equilibrium with liquidity mergers. As derived above the cost of carrying cash in such a case is $\xi C^J > \xi C$, which is necessarily larger than the expected loss from revocability. We conclude that the joint policy can only be optimal if $q > q_{NM}(\xi)$, which is the region in which cash is optimal in the equilibrium with no liquidity mergers.