

## Pledgeability, Industry Liquidity, and Financing Cycles

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### Abstract

Why are downturns following high valuations of firms long and severe? Why do firms choose high debt when they anticipate high valuations, and underperform subsequently? We propose a theory of financing cycles where the importance of creditors' control rights over cash flows ("pledgeability") varies with industry liquidity. Firms take on more debt when they anticipate higher future industry liquidity. However, both high anticipated liquidity and the resulting high debt limit their incentives to enhance pledgeability. This has prolonged adverse effects in a downturn. Higher anticipated liquidity can, in fact, reduce a firm's current access to finance.

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Why do downturns following episodes of high firm valuations result in more protracted recessions (see Krishnamurthy and Muir (2017) and López-Salido, Stein and Zakrajšek (2017))?<sup>2</sup> One traditional rationale is based on the idea of “debt overhang” – the debt built up during the boom serves to restrict investment and borrowing during the bust. However, if everyone knows that debt is holding back investment, debt holders have an incentive to write down the debt in return for a stake in the firm’s growth. For debt overhang to be a serious concern, the firm and debt holders must be unable to undertake value enhancing contractual bargains. Another view is that borrowers cannot be trusted to take only value enhancing investments, even in a downturn. So debt overhang is needed to constrain the borrower’s investment – overhang is a second best solution to a fundamental moral hazard problem (see Hart and Moore (1995) or Shleifer and Vishny (1992)). The immediate question raised by such an analysis is why we want to constrain borrowers more in bad times following high valuations, when the constraints imposed by debt are already high. Moreover, why would the moral hazard problem be so much more serious in such episodes?

In this paper, we provide an explanation of the causes of high debt and show why its consequences are more acute following periods of high valuations and rational optimism about the future values of firms. In doing so, we differentiate between financier control rights that are due solely to high resale prices for assets and control rights that are also based on pledging of cash flows. The former are especially useful in enforcing claims in an asset price boom, while the latter facilitate the enforcement of external claims at other times, including downturns. The transition between regimes where the importance of control rights associated with cash flows differ significantly, causes the debt build up during the boom to have long-drawn adverse effects in the downturn.

Let us be more specific. Consider an industry that requires special industry knowledge to produce. Within the industry, there are firms run by incumbents. There are also industry experts (those who know the industry well enough to be able to run firms as efficiently as the incumbents). Industry outsiders (such as financiers who don’t really know how to run industry firms but have general managerial/financial skills) are the other agents in the model.

Financiers have two sorts of control rights; first, control through the right to repossess and sell the underlying asset being financed if payments are missed and, second, control over cash flows generated by the asset. The first right only requires the frictionless enforcement of property rights in the economy,

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<sup>2</sup> Krishnamurthy and Muir (2017) document a negative correlation between pre-crisis spreads and credit growth, as well as a positive correlation between the change in spread as the crisis hits and the severity of the prolonged subsequent crisis. López-Salido, Stein and Zakrajšek (2017) show that narrow credit spreads predict slowing down of the real activity in subsequent years, including GDP growth, investment, consumption, and employment.

which we assume. It has especial value when there are a large number of capable potential buyers willing to pay a high price for the firm's assets. Greater wealth amongst industry experts (which we term *industry liquidity*) increases the availability of this *asset-sale-based* financing. Because we analyze a single industry, high levels of this industry liquidity can be interpreted as an economy-wide boom.

The second type of control right is more endogenous, and conferred on creditors by the firm's incumbent manager as she makes the firm's cash flows more appropriable by, or pledgeable to, creditors over the medium term, for example by improving accounting quality or setting up escrow accounts so that cash flows are hard to divert.

Let us understand an incumbent firm manager's incentives while choosing cash flow pledgeability for the next period. Let us assume she may have some reason to sell some or all of the firm next period with some probability – either because she is no longer capable of running it, or because she needs to raise finance for new investment. From her perspective, enhancing *cash flow pledgeability* is a double-edged sword. It generally increases the price at which she can sell the firm when she is no longer capable of running it, because experts can borrow against future pledgeable cash flows to finance their bids for the firm. However, the higher bid from experts also enables the existing creditors to collect more if the incumbent stays in control because the creditors have the right to seize assets and sell them when not paid in full. In such situations, she has to “buy” the firm from creditors, by outbidding experts (or paying debt fully), which reduces her incentive to enhance pledgeability. The tradeoff in setting pledgeability depends both on the probability she will need to sell and on the amount that she has promised to pay creditors (as well as the wealth of industry experts, which we will explain next). A higher promised payment increases the amount that she needs to pay to “buy” the firm from creditors but reduces the residual proceeds that she receives if she sells the firm. Therefore, higher promised payments exacerbate the incumbent's moral hazard associated with pledgeability, and when they exceed a threshold, the incumbent will set pledgeability low. Anticipating this, creditors will limit how much they will lend to the incumbent up front.

Now consider the effect of industry liquidity on pledgeability choice. When anticipated industry liquidity is sufficiently high, increased pledgeability has no effect on how much industry experts will bid to pay for the firm; they have enough wealth to buy the firm at full value without needing to borrow much against the firm's future cash flows. Higher pledgeability is not needed for enhancing bids in the highly liquid state. When anticipated liquidity is lower so that industry experts have to borrow substantially to bid for the firm, higher pledgeability does enhance their bids, so the moral hazard tradeoff in choosing pledgeability arises. Therefore, we have two influences on pledgeability – the level of outstanding debt

and the anticipated liquidity of industry experts. The key results of the paper stem from the interaction between the two.

Consider a prospective boom, which is anticipated with high probability, where industry experts will have plenty of wealth. Repayment of any corporate borrowing today is enforced by the potential high resale value of the firm – at the future date, wealthy industry experts will bid full value for the firm as in Shleifer and Vishny (1992), without needing high pledgeability to make their bid. The high anticipated resale value increases the promised payment that a firm can credibly repay and thus the amount it can borrow today (see Acharya and Vishwanathan (2011)).

Since pledgeability is not needed to enforce repayment in a future highly liquid state, a high probability of such a state encourages high borrowing up front, which crowds out the incumbent's incentive to enhance pledgeability, even if there is a possible low liquidity state where pledgeability is needed to enhance creditor rights. Therefore, if the low liquidity state is realized, the enforceability of the firm's debt, as well as its borrowing capacity will fall significantly because pledgeability has been set low. Industry experts, also hit by the downturn, no longer have much personal wealth, nor does the low cash flow pledgeability of the firm allow them to borrow against future cash flows to pay for acquiring the firm. The adverse effect of anticipated liquidity on pledgeability via higher leverage is a key new focus of this paper.

Since external claims are high in these low liquidity episodes, the firm may be sold to outsiders. While industry outsiders have little ability to operate the firm themselves, this may be a virtue – outsiders have a strong incentive to improve cash flow pledgeability because they do not want to own the firm long term, but instead want to sell the firm back to industry experts at a high price. Outsiders play a critical role, therefore, not because they are flush with funds but because they are not subject to moral hazard over pledgeability in the face of substantial debt.

Importantly, financiers have little incentive to renegotiate down fixed debt claims in a downturn, since the reallocation of the firm to industry outsiders may be the outcome that maximizes their claims, given past pledgeability choices. Consequently, in a downturn following a boom, a larger number of the new asset owners will be less-productive industry outsiders, reducing average productivity. Eisfeldt and Rampini (2006, 2008) provide evidence consistent with this.

Eventually, as the economy recovers, outsiders sell the assets back to the more productive industry experts, as the higher pledgeability they set increases the experts' ability to raise money against future cash flows. Recoveries following periods of an asset price boom and high leverage are thus

delayed, not just because debt has to be written down – and undoubtedly frictions in writing down debt would increase the length of the delay – but also because firms have to restore the pledgeability of their cash flows to cope with a world where liquidity is scarcer. It is the need to raise pledgeability which may make the downturn more prolonged. Higher anticipated liquidity in some future states can therefore induce more eventual misallocation in less liquid states, a spillover effect between states that operates through leverage and pledgeability!

Interestingly, when anticipated liquidity is lower, the credit market will naturally limit the amount an incumbent promises, so as to ensure she has the incentive to keep pledgeability high. Indeed, in normal times, moderate debt enforced with the aid of high pledgeability is the norm. Importantly, we will show that higher anticipated liquidity, through its effect on leverage and pledgeability, can *reduce* the amount of funding that can be raised up front.

The leverage overhang on pledgeability choice resembles traditional debt-overhang (Myers (1977)), where decisions of equity-maximizing managers, such as investment, are distorted whenever they cause an increase in the value of outstanding debt. The pledgeability decision we model is also similarly distorted because while benefiting the incumbent by raising resale value, it also helps creditors collect payments. We characterize the trade-off for relevant parties in normal circumstances and explain how it is affected by industry liquidity. Our model also modifies Jensen (1986), where leverage alone is sufficient to get managers to pay out free cash flow. Instead, we argue that the extent of “free” cash flow is endogenous, and one of the effects of high debt might be for firm managers to tunnel even more cash flow out of the firm thus “freeing” it. As Jensen (1997) argues, and our model suggests, the prospective future sale of the firm in management buyouts may be what is needed to incentivize management to not tunnel.

Our paper is most closely related to Shleifer and Vishny (1992) and Eisfeldt and Rampini (2008). We will describe how once we lay out the model. Our paper also explains why asset price booms based on a combination of liquidity and leverage can be fragile (see, for example, Borio and Lowe (2002), Adrian and Shin (2010), and Rajan and Ramcharan (2015)). It also suggests a reason why credit cycles emerge, though a dynamic extension to the model is needed to explain the properties of such cycles fully (see, for example, Kiyotaki and Moore (1997)).<sup>3</sup> More broadly, it suggests theoretical underpinnings for financing cycles (Borio (2014)), where a simultaneous and sustained rise in asset prices and leverage could significantly augment, and increase the persistence of business cycle downturns.

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<sup>3</sup> See Benmelech and Bergman (2011), Coval and Stafford (2007), and Shleifer and Vishny (2011) for comprehensive reviews.

The rest of the paper is as follows. In Section I, we describe the basic framework and the timing of decisions in a two period model. In Section II, we analyze the implications of pledgeability choice when financing is via debt contracts. The maximum amount that can be pledged to outside investors is characterized, and the fundamental tradeoffs in the model are explained. In Section III, we discuss the robustness of the model to alternative assumptions. In Section IV, we discuss empirical implications and the relationship to the literature. We conclude in Section V.

## I. The Framework

### A. The Industry and States of Nature

Consider an industry with 3 dates (0, 1, 2) and 2 periods between these dates, with date  $t$  marking the end of period  $t$ . A period is a phase of the financing cycle (see Borio (2014), for example), which extends over several years. At the beginning of each period, the state of the industry is realized. The industry either can prosper in good state  $G$  with probability  $q^G$ , or it can be distressed in bad state  $B$  (see Figure 1). In period 2, we assume the industry returns to state  $G$  for sure – this is meant to represent the long run state of the industry (we model economic fluctuations but not apocalypse).

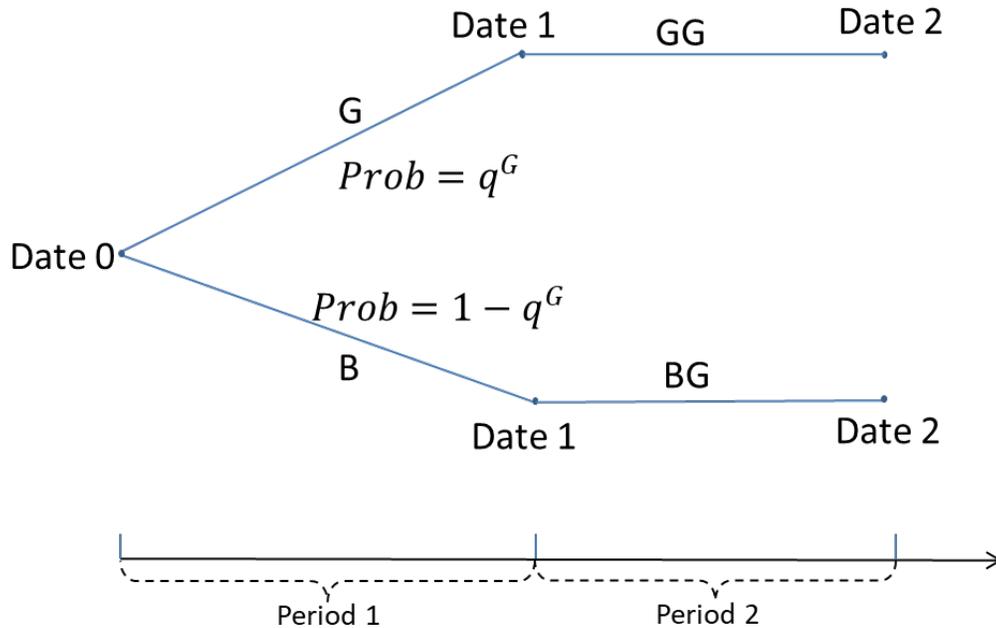


Figure 1: States of Nature

### B. Agents and the Asset

There are two types of agents in the economy. Expert *industry experts* have *high* (H) ability to produce with an asset, which we call the firm. There is some mutual specialization established over the

period between the incumbent manager and the firm, which creates a value to incumbency. Therefore, when the state is G, only the high ability manager in place at the beginning of that period  $t$  can produce cash flows  $C_t$  with the asset over the period. In the B state, however, even a high ability manager cannot produce cash flows. There are also inexpert *industry outsiders* who are *low* (L) ability managers. They cannot produce cash flows regardless of the state. *Financiers* could be thought of as low ability managers who have funds to lend provided they break even. All agents are risk neutral. We ignore time discounting, which is just a matter of rescaling the units of cash flows.

A high ability incumbent manager retains her ability into the next period only with probability  $\theta^H < 1$ , otherwise she turns into a low ability manager. Think of  $\theta^H$  as the degree of stability of the firm. Intuitively, the critical capabilities for success are likely to be stable in a mature firm, or a firm in an industry with little technological innovation. However, in a young firm which has yet to settle into its strategic niche, or in an industry with significant innovation, the critical capabilities for success can vary over time. A manager who is very appropriate in a particular period may be ineffective in the next. This is the sense in which an incumbent can lose ability and this occurs with higher probability in a young firm or a changing industry. As we will see later, an alternative interpretation is that  $(1 - \theta^H)$  is the probability of arrival of an investment opportunity or a funding need. So stability  $\theta^H$  under that interpretation would be the degree to which the firm has no future funding needs.

The incumbent's loss of ability in the next period becomes known to all shortly before the end of the current period. Loss of ability is not an industry wide occurrence and is independent across managers. So even if a manager loses her ability, there are a large number of other industry experts equally able to take her place next period. If a new industry expert takes over at the end of the current period, she will shape the firm towards her idiosyncratic management style, so she can produce cash flows with the firm's assets in future periods in good states. The manager's (both the incumbent and other bidders) type next period is observable but not verifiable and cannot be written into contracts.

### C. Financial Contracts

Any manager can raise money from financiers against the asset by writing one period financial contracts. We will focus on debt contracts with promised payments at the end of period  $t$  denoted by  $D_t$ . for most of our analysis. We can justify this by assuming that the aggregate state  $s_t$  is observable but not verifiable. We will discuss later how the analysis changes when the aggregate state  $s_t$  is verifiable and contracts can be state-contingent.

Having acquired control of the firm, the incumbent manager would like to keep the realized cash flow for herself rather than share it with financiers. Two sorts of control rights force the manager to repay the external claims. First, the financier automatically gets paid the “*pledgeable*” portion of the cash flows produced over the period, up to the amount of the financier’s claim. Second, just before the end of the period, the financier gets the right to seize and auction the firm to the highest bidder if he has not been paid in full. As in Hart and Moore (1994), giving financiers this right in case of default can induce the borrower to pay more than the pledgeable cash flow this period. Below, we describe the two control rights in detail.

#### *D. Control Rights over Cash Flow: Pledgeability*

Let us define cash flow *pledgeability* as the fraction of realized cash flows that are automatically directed to an outside financier. The incumbent chooses pledgeability this period, but it is embedded only by next period, and will then persist for the entire period. So *pledgeability*  $\gamma_{t+1}$  chosen in period  $t$  is the fraction of period  $t+1$ ’s cash flows that can be automatically paid to outside financiers. The range of feasible pledgeability levels is  $\gamma_{t+1} \in [\underline{\gamma}, \bar{\gamma}]$ , where  $\underline{\gamma}$  and  $\bar{\gamma}$  satisfy  $0 \leq \underline{\gamma} < \bar{\gamma} \leq 1$ . In general, the range of feasible pledgeability levels is determined by the economy’s institutions supporting corporate governance (such as regulators and regulations, investigative agencies, laws and the judiciary). To set  $\gamma_{t+1} > \underline{\gamma}$ , it costs  $\varepsilon \geq 0$ . Our results will be presented primarily for the case where  $\varepsilon \rightarrow 0$ , and positive  $\varepsilon$  will only alter the results quantitatively. While any level of pledgeability between  $\underline{\gamma}$  and  $\bar{\gamma}$  is feasible, in equilibrium the incumbent will choose either  $\gamma_{t+1} = \underline{\gamma}$  or  $\gamma_{t+1} = \bar{\gamma}$  because, as will be clear shortly, the incumbent’s payoff is always linear in pledgeability  $\gamma_{t+1}$ .

A manager has a number of ways of tunneling cash flow out of the firm into her pocket. Increasing pledgeability means closing off tunnels for cash flows generated by a future manager. For example, by moving to a simpler corporate structure today, or by making contracting with suppliers more transparent with stricter rules on dealing with related parties, the incumbent ensures future cash flows cannot be diverted to some non-transparent entity (see, for example, Rajan (2012)). By improving the quality of the accounting systems in place, including the detail and timeliness of disclosures, and by hiring a reputable auditor, the incumbent restricts the scope for future managers to play accounting games to hide cash flow. Any rapid shift from such a transparent accounting procedure to one less transparent, or from a reputable auditor to one less reputable, would be noticed and invite closer scrutiny, defeating the objective of tunneling. Similarly, by taking on debt with strict financial covenants, such as minimum liquidity ratios, minimum collateral requirements, or sinking fund requirements, the incumbent ensures

that the firm is positioned in the future to raise debt with similar tough covenants when current debt matures, giving future lenders the confidence that cash flow will not be tunneled. Broadly, any structure that enhances future corporate governance and cannot be fully reversed quickly is a means of enhancing future pledgeability.

The laxity of the general governance environment in the country determines  $\underline{\gamma}$ , while the scope for an individual corporation to improve on it determines  $\bar{\gamma}$ . Finally, while we assume pledgeability can be fixed for the next period, we do not assume it is fixed permanently. Over time, accountant quality can be reduced when accountants come up for rotation, for example, and the environment itself will change so that new ways of tunneling emerge. Allowing pledgeability to be chosen for only the next period captures the sense of fixity over the medium term but not for the long run.

While a low ability incumbent does not have industry-specific managerial ability to generate cash flows, he has general governance capabilities and can set next period's pledgeability. We will see that his inability to generate cash flows can sometimes be a benefit.

#### *E. Control Rights over Assets: Auction and Resale*

If creditors have not been paid in full from the pledged cash flow and any additional sum the incumbent voluntarily pays, then they get the right to auction the firm to the highest bidder at date  $t$ . One can think of such an auction as a form of bankruptcy. The incumbent manager who has failed to make the full payment may also bid in this auction. Therefore, the incumbent can retain control by either paying off the creditors in full (possibly by borrowing once again against future pledgeable cash flows) or by paying less than the full contracted amount and outbidding other bidders in the auction. The precise format of the auction does not matter, so long as what the incumbent is forced to pay rises with what other bidders are willing to bid. We assume the incumbent can always bid using other proxies, so contracts that ban the incumbent from participating in the auction for non-payment are infeasible. Essentially by doing so, as in Hart and Moore (1994), we rule out "take-it-or-leave-it" threats from the lender that would allow him to extract all the cash the incumbent has without invoking the outside option of selling the asset to others.

#### *F. Initial Conditions and Wealth*

Let  $\omega_1^{I,S_1}$  and  $\omega_1^{H,S_1}$  respectively be the wealth levels of the incumbent and industry experts, with the latter also termed *industry liquidity*. The wealth level of the incumbent is augmented by the unpledged cash flow she generates within the firm  $(1-\gamma_1)C_1$  in state G but not in B, so  $\omega_1^{I,G} \geq \omega_1^{I,B}$ . We assume  $\omega_1^{H,G} > \omega_1^{H,B}$  because industry prosperity lifts the private income of industry experts as they work as contractors, consultants, or employees in the industry.

We assume at date 0, the firm has been put together by an earlier entrepreneur who has to sell. The reason for this sale is unimportant – it could be the entrepreneur wants to retire, she has lost ability, or she is bankrupt and the firm is being sold by the receiver. All that matters is she sells out entirely and thus wants the highest price. To simplify notation, we assume that each bidder must always raise the largest amount from financiers to avoid being outbid. A sufficient condition to guarantee this is that all potential bidders have no wealth at date 0 and compete by promising creditors the largest possible payment that is credible.

### G. Efficiency

The measure of unconstrained economic efficiency we use through the rest of this paper is the extent to which the asset is in the hands of the most productive owner at that time. We do not model investment, instead assuming that the asset exists and can be bought by a bidder in an up-front auction. What is determined in that auction is the price of the asset (determined by the highest bid) and the type of the incumbent. An alternative approach, which follows easily from the analysis, is to put a minimum scale on the value of real inputs to be assembled into the firm at the initial date 0, and assume the firm starts at that date only if enough funding is available to buy those inputs. As a result, inefficient underinvestment may occur if moral hazard (which we analyze shortly) pushes available funds at date 0 below this floor. We illustrate this channel later with an example showing that higher liquidity ex post, working through anticipatory leverage and lower pledgeability, can actually reduce the amount raised up front.

### H. Timing

The timing of events is described in Figure 2. After the initial auction, the incumbent takes on debt  $D_1$  that is due at date 1. We assume that the incumbent sets pledgeability  $\gamma_2$ , only knowing the probability of state G and B. Next, the state is realized, then her ability in period 2 is known. Subsequently, production takes place and the pledgeable fraction  $\gamma_1$  of cash flows (set in the previous period) goes to financiers automatically if state G is realized. She either pays the remaining due or enters the auction. The period ends with potentially a new incumbent in place.

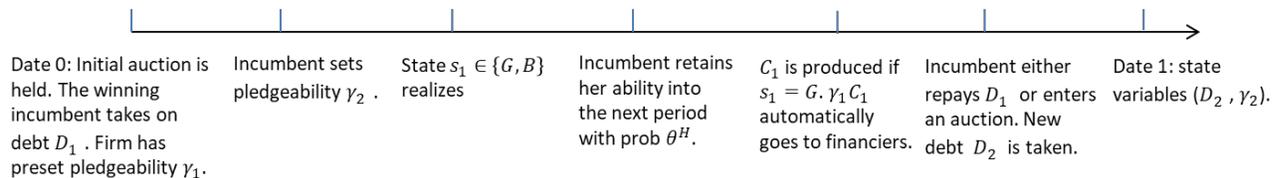


Figure 2: Timing and Decisions in Period 1

## II. Solving the Model

In subsection IIA, we start with examples where exogenous debt is due at date 1 to illustrate the main trade-off in this model. We will show that increased pledgeability is sometimes not needed because of plentiful anticipated industry liquidity, but when it is needed, the incumbent has to be appropriately incentivized. In all three examples, to keep matters simple, we eliminate the uncertainty in ex-post aggregate state and therefore the level of industry liquidity. The examples will motivate the more formal analysis with debt contracts when there is uncertainty about the state.

### A. Illustrative Examples with Certainty About Future State and Liquidity

Let the parameters for this subsection be:

$$\theta^H = 0.7, \bar{\gamma} = 0.6, \underline{\gamma} = 0.3, \gamma_1 = \bar{\gamma}, C_1 = C_2 = 1, \omega_1^{I,G} = 0.4, \varepsilon \rightarrow 0.$$

Case 1: Plentiful Industry Liquidity:  $\omega_1^{H,G} = 0.8$ ,  $D_1 = 1.5$ , and  $q^G = 1$

This case illustrates that when anticipated industry liquidity is sufficiently high, pledgeability has no effect on bids and also the equilibrium outcome, because industry experts have enough wealth to buy the firm at full value without requiring additional pledgeability to enhance their borrowing capacity.

With  $q^G = 1$ , the good state G, in which industry experts have high liquidity, will happen for sure. In any possible date 1 auction, industry experts each have personal wealth  $\omega_1^{H,G} = 0.8$  and can borrow at least  $\underline{\gamma}C_2 = 0.3$ . No lender will lend more since the asset is worthless at the end of period 2 and the incumbent in that period cannot be forced to repay more than the pledged cash flows. Therefore, industry experts have at least  $\omega_1^{H,G} + \underline{\gamma}C_2 = 1.1$  in funds, which exceeds the full date-1 value of the asset  $C_2 = 1$ . As a result, industry experts have enough funding with even low asset pledgeability to pay full price for the asset. With high pledgeability, industry experts have more funds:  $\omega_1^{H,G} + \bar{\gamma}C_2 = 1.4$ . Since no one will bid more than  $C_2 = 1$ , pledgeability has no effect on the auction price – the price at which the incumbent can sell the asset. On the other hand, pledgeability does not affect the price that the incumbent needs to “buy” the asset from creditors either. To see this, note that at date 1, the incumbent will pay the pledged cash flow  $\gamma_1 C_1 = 0.6$ , leaving 0.9 remaining to be paid. In this case, if the incumbent retains ability, she needs to pay off the remaining 0.9 or default and initiate the auction.

If the incumbent had set date-2 pledgeability  $\gamma_2$  low, at date 1 she will be able to pay her own funds  $\omega_1^{I,G} = 0.4$ , as well as the amount she can borrow at date 1 against the asset,  $\underline{\gamma}C_2 = 0.3$ . Since this is

less than the remaining amount owed, she will precipitate the auction. Alternatively, she incurs a cost  $\varepsilon$  if she chose  $\gamma_2 = \bar{\gamma} = 0.6$ , after which she will be able to borrow 0.6, which together with her own wealth of 0.4, will allow her to match the auction bid. However, since the industry expert bids the full value of future cash flows, holding on to the firm does not benefit the incumbent. So she chooses low pledgeability, the firm is sold to industry experts in the auction, the initial lender is paid the remaining due of 0.9 from the auction proceeds, and the incumbent walks away with 0.1 from the auction proceeds in addition to her date-1 wealth 0.4. Higher pledgeability is not needed (and has no effect on auction bids) because there is ample liquidity. This of course implies that the level of debt does not affect the incumbent's choice of pledgeability.

Case 2: Moderate Industry Liquidity which is less than the incumbent's liquidity:

$$\omega_1^{H,G} = 0.2, D_1 = 1.2, \text{ and } q^G = 1$$

We see in this example that when anticipated industry liquidity is only moderate, and the incumbent can retain control if she retains ability but will want to sell if not, there is moral hazard in choosing pledgeability. High pledgeability increases the industry experts' bids, which the incumbent likes when she has to sell, but not when she retains ability and seeks to retain control. High levels of debt reduce the incumbent's incentive to choose high pledgeability. Let us explain.

After paying  $\gamma_1 C_1 = 0.6$ , the incumbent owes 0.6 to creditors. Consider first that she retains her ability after choosing pledgeability. Then she has funds plus borrowing capacity of at least  $\omega_1^{I,G} + \underline{\gamma} C_2 = 0.7$  as before, which means she can pay off the debt and retain control at date 1, without triggering the auction. With industry liquidity  $\omega_1^{H,G} = 0.2$ , industry experts can bid up to at most  $0.2 + \gamma_2 C_2$  in state G. If the incumbent chose low pledgeability, they will bid only 0.5 for the asset. The incumbent would then default strategically and lower the additional repayment to creditors from 0.6 to 0.5, even while outbidding industry experts in the auction and retaining control of the asset. If she chose high pledgeability, however, industry experts will bid 0.8 for the asset if the auction is triggered, in which case the incumbent is better off not triggering the auction and repaying the remaining debt 0.6. So if the incumbent knew she would retain her ability for sure, an increase in pledgeability would simply increase the payment she would have to make to hold on to the firm – she is always a buyer of the firm in the auction, and loses by raising the auction price.

What happens if she loses her ability? Now she will, perforce, trigger the auction since she has only 0.4 and she cannot raise any additional money herself against period 2 cash flows (since she cannot generate any) to pay the lender the 0.6 owed. If she had set pledgeability low, the amount industry experts

will bid does not cover the outstanding amount owed ( $0.5 < 0.6$ ), and the lender would take the entire proceed of the auction. However, if she had set pledgeability high, the auction would raise 0.8, of which 0.6 would go to pay the lender, leaving the incumbent to walk away with 0.2 in addition to her date-1 wealth. The point is that when she loses her ability, the incumbent is a seller of the firm's assets, and if she knew this would occur with certainty, she would prefer setting pledgeability high given its small cost,  $\varepsilon$ .

Clearly then, the benefit of setting pledgeability high depends on the probability of her being a buyer of the firm from creditors (that is, the probability of retaining ability, which is  $\theta^H$ ) as opposed to being a seller (losing ability). It also depends on what she obtains in each case, which in turn depends on the level of debt  $D_1$ . With higher contracted debt, by enhancing pledgeability she has to repay more conditional on being a buyer, and keeps less conditional on being a seller. As a result, higher debt reduces the incentive to raise pledgeability. For the given parameters, it turns out that for  $D_1 > 1.19$ , she is better off in expectation choosing low pledgeability, and this is what she does in this example. The high debt reduces the incentive to increase pledgeability.

Case 3, Low industry liquidity which exceeds the incumbent's liquidity:

$$D_1 = 0.8, \omega_1^{I,B} = 0, \omega_1^{H,B} = 0.1, \text{ and } q^G = 0$$

In this example, we see that when anticipated industry liquidity is low but exceeds that of the incumbent, the incumbent is a seller of the firm. As a result, the severity of moral hazard in choosing pledgeability is reduced.

With  $q^G = 0$ , state B will occur for sure, and no cash flow is generated in period 1, and no debt is repaid before date 1. Industry experts have higher wealth than the incumbent since  $\omega_1^{H,B} = 0.1 > \omega_1^{I,B} = 0$ , and thus they can always outbid the incumbent in an auction regardless of the pledgeability choice  $\gamma_2$ . In this case, the incumbent can never retain control: she can neither borrow enough to repay the debt nor outbid industry experts in the auction. Therefore, she is always a seller who aims to sell the firm for as high a price as possible, provided she retains something after paying off debt. Since an industry expert will bid up to  $\omega_1^{H,B} + \bar{\gamma}C_2 = 0.7$  when pledgeability is set high, any  $D_1$  below  $0.7 - \varepsilon$  will incentivize the incumbent to choose high pledgeability. The only downside to increased pledgeability is the cost  $\varepsilon$ . Any  $D_1$  above  $0.7 - \varepsilon$  implies the incumbent will get less from the sale proceeds, after repaying debt, than the cost  $\varepsilon$  of setting pledgeability high. So she will choose low pledgeability. Once again, high debt can

reduce pledgeability, in this case because it transforms the incumbent from being a motivated seller to being indifferent before consideration of the cost,  $\varepsilon$ .

*Remark:* The points to take away from these examples are (i) High industry liquidity makes industry experts bid full value for the firm without resort to high-pledgeability-based borrowing. So there is no need for the incumbent to increase pledgeability. (ii) With more moderate liquidity, the incumbent's incentive to increase pledgeability depends on whether she is more likely to be a buyer (she prefers a lower bid price and lower pledgeability) of the firm from the lender or a seller to other bidders (she prefers a higher bid price and higher pledgeability). Whether she is a buyer or seller depends on her ability, as well as her own wealth relative to industry experts. (iii) Finally, the higher the level of outstanding debt, the lower the net benefits of additional pledgeability if she turns out to be a seller, and higher the costs of additional pledgeability if she turns out to be a buyer. When liquidity is not plentiful and pledgeability affects the auction bids, higher debt reduces the incentive to increase pledgeability.

We now formally analyze the model. Because there is a single state in period 2, and the economy ends after that, both the high type industry expert as well as the incumbent who retains ability can only commit to repay  $D_2 = \gamma_2 C_2$  in period 2, where  $\gamma_2$  is the pledgeability set by the incumbent in period 1. As a result, they can borrow up to  $D_2 \equiv \gamma_2 C_2$  when bidding for control at date 1. In subsection IIB, we impose parametric assumptions which resemble the industry after a period of sustained prosperity. We show that if prosperity is likely to continue, high anticipated liquidity supports high leverage and leads to low pledgeability choice. If prosperity does not continue and liquidity falls, access to finance will drop more than proportionally. We describe the outcomes when the states resemble more normal circumstances in subsection IIC. The comparison between prosperity and normal circumstances highlights the effect of anticipated industry liquidity on pledgeability. In IID, the parametric assumptions describe an industry after a period of distress, when low anticipated liquidity restricts the amount of leverage and encourages high pledgeability choice. The cases in subsections IIB, IIC, and IID cover all the possible state-specific situations that could arise and thus generalize our three numerical examples introduced in IIA.

### *B. Case 1: The Industry after a period of prosperity*

In this subsection, we formalize the analysis highlighted in the example with more general parameters. The following parametric assumptions allow us to focus on a case that highlights a key result of the paper.

#### **Assumption 1:**

- a.  $\omega_1^{H,G} \geq (1-\underline{\gamma})C_2$
- b.  $\omega_1^{H,B} < (1-\underline{\gamma})C_2, \omega_1^{I,B} \geq \omega_1^{H,B}$

Assumption 1a ensures that in state G, industry liquidity is high enough that industry experts can afford to pay the full price of the asset even if pledgeability is set as low as  $\underline{\gamma}$ . Industry experts have wealth  $\omega_1^{H,G}$  and can borrow up to  $\underline{\gamma}C_2$ . Their maximum bid is therefore  $\omega_1^{H,G} + \underline{\gamma}C_2$ , which exceeds the full value of the asset  $C_2$ . Assumption 1b ensures there is limited industry liquidity in the bad state B so that industry experts cannot bid the full value of the asset if pledgeability is set low. Meanwhile, the incumbent has more wealth than industry experts in that state, so she can retain control by outbidding industry experts in a possible date-1 auction (since pledgeability increases what both parties can borrow by the same amount). The states here, given the assumptions, represent situations following a time where the industry has prospered. In state G, prosperity continues into a *boom*, while in state B, prosperity turns to temporary distress. We now solve the model backwards, having already determined what happens in period 2.

### B.1. Date 1

Consider now the payments and decisions made in period 1. We will focus on the incumbent's incentive in setting pledgeability and how it is affected by the promised payment  $D_1$ . We will then solve for the maximum amount a high-ability manager can raise, and therefore bid, at date 0.

If state G is realized in period 1, cash  $\gamma_1 C_1$  is verifiable and directly goes to the financier (up to the value of the promised claim  $D_1$ ), where  $\gamma_1$  is the pledgeability that has been set in period 0. Let us define  $\widehat{D}_1^{s_1}$  as the remaining payment due at date 1. Clearly,  $\widehat{D}_1^G = D_1 - \gamma_1 C_1$  if  $\gamma_1 C_1 < D_1$ ,<sup>4</sup> and  $\widehat{D}_1^B = D_1$ . In any date-1 auction for the firm, industry outsiders do not bid to take direct control of the firm since the firm generates no cash flow in their hands in the last period, and the firm has no residual value. Therefore, to retain control, the incumbent needs to either pay off her debt  $D_1$  entirely or outbid

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<sup>4</sup>  $\widehat{D}_1^G = 0$  if  $\gamma_1 C_1 \geq D_1$ . We have assumed that the incumbent always fully levers up so that in equilibrium,  $\gamma_1 C_1$  is less than  $D_1$ .

industry experts in the date-1 auction. Next, we show how the bids by industry experts are affected by the incumbent through her setting pledgeability  $\gamma_2$ .

#### Industry Experts' Bid

In any auction for the firm held at date 1, industry experts bid using their date 1 wealth,  $\omega_1^{H,s_1}$  and the amount of future cash flow  $\gamma_2 C_2$  that can be borrowed against at date 1. Therefore, the total amount that they each can bid is  $\omega_1^{H,s_1} + \gamma_2 C_2$ . Of course, they will not bid more than the total value of future cash flow,  $C_2$ . So the maximum auction bid at date 1 is  $B_1^{H,s_1}(\gamma_2) = \min[\omega_1^{H,s_1} + \gamma_2 C_2, C_2]$ . In order to retain control, the incumbent pays the minimum of the remaining debt or outbids industry experts. That is, she pays  $\min\{\widehat{D}_1^{s_1}, B_1^{H,s_1}(\gamma_2)\} = \min\{\widehat{D}_1^{s_1}, \omega_1^{H,s_1} + \gamma_2 C_2, C_2\}$ . Clearly, through the choice of pledgeability,  $\gamma_2$ , the incumbent could potentially affect the amount of payment needed for her to stay in control.

A measure which will help characterize the model is *potential underpricing*, which is the difference between the present value of future cash flows accruing to an industry expert if he buys the firm and the amount that he can bid if the incumbent has set period-2 pledgeability low. It equals  $C_2 - B_1^{H,s_1}(\underline{\gamma}) = \max\{(1 - \underline{\gamma})C_2 - \omega_1^{H,s_1}, 0\}$  at date 1. By choosing a higher level of period-2 pledgeability, the incumbent can increase the industry experts' bids from  $B_1^{H,s_1}(\underline{\gamma})$ , thus altering the *realized underpricing*, which is the difference between the present value of future cash flows and the actual bid, i.e.,  $C_2 - B_1^{H,s_1}(\gamma_2) = \max\{(1 - \gamma_2)C_2 - \omega_1^{H,s_1}, 0\}$ .

#### Incumbent Bid

The cash that the incumbent has at date 1 is  $\omega_1^{I,s_1}$  in state  $s_1$ . In addition, she can also raise funds against period 2's output,  $\gamma_2 C_2$ . Therefore, the incumbent can pay as much as

$B_1^{I,s_1}(\gamma_2) = \min\{\omega_1^{I,s_1} + \gamma_2 C_2, C_2\}$  to the financier. Comparing  $B_1^{I,s_1}(\gamma_2)$  and  $B_1^{H,s_1}(\gamma_2)$ , we see that the incumbent will outbid industry experts whenever she has (weakly) more wealth ( $\omega_1^{I,s_1} \geq \omega_1^{H,s_1}$ ), since both parties can borrow up to  $\gamma_2 C_2$  if needed. Of course, she will outbid by paying a vanishingly small

amount over  $B_1^{H,s_1}(\gamma_2)$ . The incumbent is always willing to hold on to the asset if she is able to, since the continuation value of the asset,  $C_2$ , is identical for the incumbent and industry experts.

### Pledgeability Choice

Let us now see how the promised remaining payment  $\widehat{D}_1^{s_1}$  affects pledgeability choice. Let  $V_1^{I,s_1}(\widehat{D}_1^{s_1}, \gamma_2)$  be the incumbent's payoff in state  $s_1$  when she chooses  $\gamma_2$ , given the remaining required payment  $\widehat{D}_1^{s_1}$ . If state  $s_1$  is known to be realized for sure, and if the remaining payment is  $\widehat{D}_1^{s_1}$ , the incumbent's benefit from choosing high versus low pledgeability is

$\Delta_1^{s_1}(\widehat{D}_1^{s_1}) = V_1^{I,s_1}(\widehat{D}_1^{s_1}, \bar{\gamma}) - V_1^{I,s_1}(\widehat{D}_1^{s_1}, \underline{\gamma})$ . If state  $s_1$  is known to be realized for sure, the incumbent chooses high pledgeability  $\gamma_2 = \bar{\gamma}$  if and only if  $\Delta_1^{s_1}(\widehat{D}_1^{s_1}) > 0$ . Given the probability of the good state being  $q^G$ , the risk-neutral incumbent will choose high pledgeability for any given  $D_1$  if and only if  $q^G \Delta_1^G(\widehat{D}_1^G) + (1 - q^G) \Delta_1^B(\widehat{D}_1^B) \geq 0$ , where  $\widehat{D}_1^G = D_1 - \gamma_1 C_1$  and  $\widehat{D}_1^B = D_1$  are the remaining payments in different states. Below, we solve for  $V_1^{I,s_1}$  and  $\Delta_1^{s_1}$  separately.

### State G - The Continued Boom: Pledgeability does not matter for repayment (no potential underpricing)

Assumption 1a guarantees  $B_1^{H,G}(\underline{\gamma}) = \min\{\omega_1^{H,G} + \underline{\gamma} C_2, C_2\} = C_2$ . In this case, industry liquidity is sufficiently high that high-ability experts can pay the full price of the asset, even if the incumbent has chosen low pledgeability. Therefore, there is no potential underpricing and raising pledgeability does not change enforceable payments, while resulting in cost  $\varepsilon$ . External payments are committed to through the high resale price of the asset, and high pledgeability is neither needed nor desired by anyone. Indeed, no incentive to raise pledgeability can emanate from this state – liquidity crowds out any value from pledgeability.

**Lemma 2.1:** Under Assumption 1a and given the remaining payment  $\widehat{D}_1^G \leq C_2$ , the incumbent expects

$$V_1^{I,G}(\widehat{D}_1^G, \gamma_2) = C_2 - \widehat{D}_1^G - \varepsilon \cdot \mathbf{1}_{\gamma_2 > \underline{\gamma}} \text{ for } \gamma_2 \in [\underline{\gamma}, \bar{\gamma}]. \text{ Therefore } \Delta_1^G(\widehat{D}_1^G) \equiv -\varepsilon \text{ for any } \widehat{D}_1^G.$$

In words, if state G were to occur for sure, the incumbent would lose  $\varepsilon$  for sure by choosing high pledgeability over low pledgeability. Now consider the incentives emanating from state B.

State B - Temporary Distress: Incumbent always can outbid industry experts

Assumption 1b implies industry liquidity in state B is limited so that the firm is *potentially underpriced* and, therefore, there are potential rents to high-ability experts in the auction. Moreover, since  $\omega_1^{I,B} \geq \omega_1^{H,B}$  and both the incumbent and industry experts can borrow up to  $\gamma_2 C_2$  in the date-1 auction, the incumbent can outbid the industry experts regardless of her choice of pledgeability. In this case, if the incumbent retains ability, she receives output  $C_2$  but repays  $\min\{\widehat{D}_1^B, B_1^{H,B}(\gamma_2)\}$  to stay in control for net continuation payoff  $C_2 - \min\{\widehat{D}_1^B, B_1^{H,B}(\gamma_2)\}$ . By contrast, if she loses her ability and has to sell the firm at price  $B_1^{H,B}(\gamma_2)$ , her continuation payoff is  $B_1^{H,B}(\gamma_2) - \min\{\widehat{D}_1^B, B_1^{H,B}(\gamma_2)\}$ . As a result,

$V_1^{I,B}(\widehat{D}_1^B, \gamma_2)$ , the incumbent's payoff in state  $B$  is

$$V_1^{I,B}(\widehat{D}_1^B, \gamma_2) = \theta^H \left( C_2 - \min\{\widehat{D}_1^B, B_1^{H,B}(\gamma_2)\} \right) + (1 - \theta^H) \left( B_1^{H,B}(\gamma_2) - \min\{\widehat{D}_1^B, B_1^{H,B}(\gamma_2)\} \right) - \varepsilon 1_{\{\gamma_2 > \underline{\gamma}\}},$$

which is a weighted average of the payoff if she retains her ability and stays in control and the payoff if she loses ability and has to sell the firm. Clearly, she chooses  $\gamma_2 = \bar{\gamma}$  iff

$$\begin{aligned} & \theta^H \left( C_2 - \min\{\widehat{D}_1^B, B_1^{H,B}(\bar{\gamma})\} \right) + (1 - \theta^H) \left( B_1^{H,B}(\bar{\gamma}) - \min\{\widehat{D}_1^B, B_1^{H,B}(\bar{\gamma})\} \right) - \varepsilon \\ & \geq \theta^H \left( C_2 - \min\{\widehat{D}_1^B, B_1^{H,B}(\underline{\gamma})\} \right) + (1 - \theta^H) \left( B_1^{H,B}(\underline{\gamma}) - \min\{\widehat{D}_1^B, B_1^{H,B}(\underline{\gamma})\} \right), \end{aligned} \quad (1)$$

where the left hand side is the incumbent's continuation value if she chooses  $\gamma_2 = \bar{\gamma}$ , while the right hand side is if she chooses  $\gamma_2 = \underline{\gamma}$ . Constraint (1) can be equivalently written in terms of primitives:

$$\begin{aligned} & \theta^H \max\{C_2 - \widehat{D}_1^B, (1 - \bar{\gamma})C_2 - \omega_1^{H,B}, 0\} + (1 - \theta^H) \max\{\min\{\omega_1^{H,B} + \bar{\gamma}C_2, C_2\} - \widehat{D}_1^B, 0\} - \varepsilon \\ & \geq \theta^H \max\{C_2 - \widehat{D}_1^B, (1 - \underline{\gamma})C_2 - \omega_1^{H,B}, 0\} + (1 - \theta^H) \max\{\min\{\omega_1^{H,B} + \underline{\gamma}C_2, C_2\} - \widehat{D}_1^B, 0\}. \end{aligned}$$

Note that a higher  $\gamma_2$  (weakly) increases the amount the incumbent has to pay the financier when she retains capability and control, therefore (weakly) decreasing the first term, while it (weakly) increases the amount the incumbent gets in the auction if she loses capability, thus (weakly) increasing the second term. In choosing to increase  $\gamma_2$ , the incumbent therefore trades off higher possible repayments when she *buys* the firm from the lender against higher possible resale value when she *sells* the firm after losing ability.

Importantly, a higher outstanding promised remaining payment  $\widehat{D}_1^B$  reduces the incumbent's incentive to choose higher  $\gamma_2$ . This result is easily seen from inequality (1). When  $\widehat{D}_1^B \geq B_1^{H,B}(\bar{\gamma})$ , the inequality reduces to  $\theta^H (C_2 - B_1^{H,B}(\bar{\gamma})) - \varepsilon \geq \theta^H (C_2 - B_1^{H,B}(\underline{\gamma}))$ , which never holds. In this case, the incumbent always chooses low pledgeability. When  $\widehat{D}_1^B \leq B_1^{H,B}(\underline{\gamma})$ , however, the inequality reduces to  $\theta^H (C_2 - \widehat{D}_1^B) + (1 - \theta^H)(B_1^{H,B}(\bar{\gamma}) - \widehat{D}_1^B) - \varepsilon \geq \theta^H (C_2 - \widehat{D}_1^B) + (1 - \theta^H)(B_1^{H,B}(\underline{\gamma}) - \widehat{D}_1^B)$ , which always holds when  $\varepsilon$  is small. When  $\widehat{D}_1^B \in (B_1^{H,B}(\underline{\gamma}), B_1^{H,B}(\bar{\gamma}))$ , the inequality reduces to  $\theta^H (C_2 - \widehat{D}_1^B) + (1 - \theta^H)(B_1^{H,B}(\bar{\gamma}) - \widehat{D}_1^B) - \varepsilon \geq \theta^H (C_2 - B_1^{H,B}(\underline{\gamma}))$  so that high pledgeability  $\gamma_2 = \bar{\gamma}$  is chosen if and only if  $\widehat{D}_1^B \leq D_1^{B,\text{PayIC}}$ , where  $D_1^{B,\text{PayIC}} = \theta^H B_1^{H,B}(\underline{\gamma}) + (1 - \theta^H)B_1^{H,B}(\bar{\gamma}) - \varepsilon$ . Superscript "PayIC" indicates the required payment makes the choice of high pledgeability incentive compatible. Intuitively, with higher debt, more of the pledgeable cash flows are captured by financiers if the incumbent stays in control, and more of the resale value also goes to financiers if the asset is sold. This is the source of moral hazard over pledgeability. Note that it is easier to incentivize the incumbent, and thus raise the incentive compatible level of debt, when the probability she loses skills ( $1 - \theta^H$ ) is higher, for this enhances the likelihood of sale. It follows from the discussion that

**Lemma 2.2:** Under Assumption 1b and given the remaining payment  $\widehat{D}_1^B$ , the incumbent expects

$V_1^{I,B}(\widehat{D}_1^B, \gamma_2) = \theta^H (C_2 - \min\{\widehat{D}_1^B, B_1^{H,B}(\gamma_2)\}) + (1 - \theta^H)(B_1^{H,B}(\gamma_2) - \min\{\widehat{D}_1^B, B_1^{H,B}(\gamma_2)\}) - \varepsilon \cdot \mathbf{1}_{\gamma_2 > \underline{\gamma}}$   
for  $\gamma_2 \in [\underline{\gamma}, \bar{\gamma}]$ . It follows that

$$\Delta_1^B(\widehat{D}_1^B) = \begin{cases} -\theta^H [B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma})] - \varepsilon & \text{if } \widehat{D}_1^B > B_1^{H,B}(\bar{\gamma}) \\ \theta^H B_1^{H,B}(\underline{\gamma}) + (1 - \theta^H)B_1^{H,B}(\bar{\gamma}) - \varepsilon - \widehat{D}_1^B & \text{if } B_1^{H,B}(\underline{\gamma}) < \widehat{D}_1^B \leq B_1^{H,B}(\bar{\gamma}) \\ (1 - \theta^H)[B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma})] - \varepsilon & \text{if } \widehat{D}_1^B \leq B_1^{H,B}(\underline{\gamma}). \end{cases}$$

$\Delta_1^B(\widehat{D}_1^B) \geq 0$  if and only if  $\widehat{D}_1^B \leq D_1^{B,\text{PayIC}} = \theta^H B_1^{H,B}(\underline{\gamma}) + (1 - \theta^H)B_1^{H,B}(\bar{\gamma}) - \varepsilon$ .

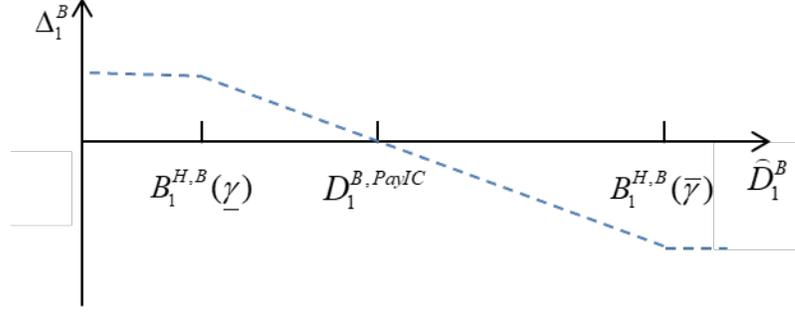


Figure 3  $\Delta_1^B(\widehat{D}_1^B)$  as a function of  $\widehat{D}_1^B$

In Figure 3, we plot  $\Delta_1^B(\widehat{D}_1^B)$  against  $\widehat{D}_1^B$ . For  $\widehat{D}_1^B \leq B_1^{H,B}(\underline{\gamma})$ , debt repayment is not increased by higher pledgeability because of the low value of outstanding debt. Instead higher pledgeability only increases outside bids, which is beneficial when the incumbent loses ability and sells the asset. The benefits of high pledgeability are capped at  $(1 - \theta^H) [B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma})] - \varepsilon$ . As  $\widehat{D}_1^B$  rises to  $D_1^{B,PayIC}$ , the incumbent has to pay more in expectation to debt holders when she raises pledgeability, so  $\Delta_1^B(\widehat{D}_1^B)$  falls to zero and then goes negative as the face value of debt increases further. When  $\widehat{D}_1^B > B_1^{H,B}(\bar{\gamma})$ , the incumbent has to pay the entire increment in sale price from increasing pledgeability to debt holders when she loses ability – she gets nothing from increasing pledgeability under those circumstances – while she has to pay  $B_1^{H,B}(\bar{\gamma})$  instead of  $B_1^{H,B}(\underline{\gamma})$  if she retain ability. Hence there is no benefit but only cost to the incumbent by increasing pledgeability, and the cost is capped at  $\theta^H [B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma})] - \varepsilon$ .

Given  $\Delta_1^G(\widehat{D}_1^G)$  and  $\Delta_1^B(\widehat{D}_1^B)$ , we can check the incumbent's incentive to choose pledgeability for any  $D_1$ . Recall that the incumbent will choose high pledgeability if and only if  $q^G \Delta_1^G(D_1 - \gamma_1 C_1) + (1 - q^G) \Delta_1^B(D_1) \geq 0$ . Since there is never any incentive to increase pledgeability coming from the future liquid state G, i.e.  $\Delta_1^G(\widehat{D}_1^G) \equiv -\varepsilon \approx 0$  for any  $\widehat{D}_1^G$ , the constraint therefore depends on the incumbent's incentive in state B. We have:

**Proposition 2.1** Given Assumption 1a and 1b, there exists a unique threshold  $D_1^{IC}$  such that the incumbent manager sets high pledgeability if and only if  $D_1 < D_1^{IC}$ . Moreover, as  $\varepsilon \rightarrow 0$ ,  $D_1^{IC} \rightarrow D_1^{B,PayIC}$ .

Proof: Directly follows Lemma 2.1 and 2.2. ■

### Optimal Debt Level

$D_1^{B,PayIC}$  can be written as  $D_1^{B,PayIC} = \theta^H \min \{ \omega_1^{H,B} + \underline{\gamma} C_2, C_2 \} + (1 - \theta^H) \min \{ \omega_1^{H,B} + \bar{\gamma} C_2, C_2 \} - \varepsilon$ .

Under Assumption 1b,  $D_1^{B,PayIC}$  is well below  $\gamma_1 C_1 + C_2$ , the most that can be paid in state G. As a result,

$D_1^{IC}$ , the highest level of debt which provides incentives for high pledgeability, keeping in mind both future states, may not be the face value that enables the incumbent to raise the most upfront. This is most easily seen when liquidity is plentiful, as in state G with no potential underpricing. In this case, the incumbent can issue debt with face value  $\gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) = \gamma_1 C_1 + C_2$ , which she will repay in full in state G, and she will repay only  $B_1^{H,B}(\underline{\gamma})$  in state B, because the high face value induces low pledgeability. Even with low pledgeability choice, the incumbent is able to raise

$q^G (C_2 + \gamma_1 C_1) + (1 - q^G) B_1^{H,B}(\underline{\gamma})$  at date 0. However, to incentivize high pledgeability, the promised payment cannot exceed  $D_1^{IC} = D_1^{B,PayIC}$ , which will raise  $D_1^{B,PayIC}$  up front. If the difference between

$\gamma_1 C_1 + C_2$  and  $D_1^{B,PayIC}$  is large and if the probability of the good state  $q^G$  is sufficiently high, the

incumbent could raise more by setting  $D_1 = \gamma_1 C_1 + C_2$ . The broader point is that the prospect of a highly liquid future state not only makes feasible greater promised payments, but these payments also eliminate incentives to enhance pledgeability that only emanates from the low liquidity state. To restore those incentives, debt may have to be set so low that funds raised are greatly reduced – something the incumbent will not want to do if she is bidding at date 0 for the firm. Note that this can happen even if the probability of the low state is significant, and even if the direct cost  $\varepsilon$  of enhancing pledgeability is infinitesimal. Proposition 2.2 states the results.

**Proposition 2.2** Under Assumption 1a and 1b and  $\varepsilon \rightarrow 0$ , let  $D_1^{Max}$  be the face value of the debt that raises the maximum amount at date 0,

- a. If  $q^G (C_2 + \gamma_1 C_1) + (1 - q^G) B_1^{H,B}(\underline{\gamma}) > D_1^{B,PayIC}$ , then  $D_1^{Max} = \gamma_1 C_1 + C_2$ . For any promised payment  $D_1^{B,PayIC} < D_1 \leq D_1^{Max}$ ,  $\gamma_2 = \underline{\gamma}$ . For any promised payment  $D_1 \leq D_1^{B,PayIC}$ ,  $\gamma_2 = \bar{\gamma}$ .
- b. If  $q^G (C_2 + \gamma_1 C_1) + (1 - q^G) B_1^{H,B}(\underline{\gamma}) \leq D_1^{B,PayIC}$ , then  $D_1^{Max} = D_1^{IC} = D_1^{B,PayIC}$ . For any promised payment  $D_1 \leq D_1^{Max}$ ,  $\gamma_2 = \bar{\gamma}$ .

Interestingly, debt will not be renegotiated before, or after, the state  $s_1$  is realized, even if renegotiation is feasible – it will not be renegotiated before because the level of debt is set to raise the maximum amount possible even if it will result in low pledgeability, and it will not be renegotiated after, because relevant parties will not write down their claims given that pledgeability  $\gamma_2$  has already been set.<sup>5</sup> Interestingly, both the fixed promised debt payments across states, and the act of choosing pledgeability before the state is known, have the effect of causing a spillover between anticipated states. An analysis of non-renegotiable debt when pledgeability choice is made after the state is realized is available in the online appendix. The results are similar to those in this section.

### *B.2. Discussion: The Liquidity Leverage Pledgeability Nexus*

We have expositied the first important result in the paper. If prosperity is likely to continue, liquidity will be high and the credit market allows high debt. When borrowers finance with such high debt, however, they do not have the incentive to set pledgeability high, even if the direct costs of doing so are zero and the probability of a low liquidity state non-negligible. Pledgeability is neglected, which nevertheless will be acceptable to lenders who anticipate a high probability of continued high liquidity. Liquidity, asset prices (bids in the auction), and leverage follow each other up, while pledgeability falls. If prosperity does not continue, and liquidity falls, access to finance will drop significantly. The underinvestment in pledgeability resulting from liquidity-induced leverage cannot be renegotiated away – in competitive markets for assets, the highest bids for the assets when future liquidity is anticipated to be high involve substantial leverage. Higher anticipated liquidity is therefore not an unmitigated blessing, and can worsen ex-post outcomes in less liquid realized states. Moreover, as we will see shortly, it can reduce the overall amount raised up front. To the extent that government or central bank policies create anticipation of liquidity, these are concerns that have to be kept in mind.

Another way of thinking about anticipated situations of high liquidity is that the prospect of repaying the high level of debt in full is high enough that both borrower and lender neglect the loss given default.

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<sup>5</sup> If the incumbent chooses low pledgeability, then debt repayment will be  $B_1^{H,B}(\underline{\gamma})$  in state B since the incumbent defaults and there will be an auction. An interesting issue is knowing this, would the incumbent not have the incentive to set pledgeability high since  $B_1^{H,B}(\underline{\gamma}) < D_1^{B,PayIC}$ ? The answer is no. Suppose the incumbent sets pledgeability high with outstanding debt face value  $D_1 = \gamma_1 C_1 + C_2$ . Then if state B occurs, creditors will not agree to renegotiate  $D_1$  to any level below  $B_1^{H,B}(\bar{\gamma})$ . Anticipating this, the incumbent would not have incentive to set high pledgeability ex-ante. In this case, the incumbent will have an incentive to set pledgeability high only if creditors can commit to renegotiate the debt payment in state B down to some level  $D_1 \leq D_1^{B,PayIC}$ , which is tantamount to being able to set state contingent payments, which we have ruled out.

This can be much more severe than if initial debt were lower, because of neglected pledgeability. As a related aside, when the B state is realized, and debt capacity turns out to be low because of low liquidity and low pledgeability, it might seem as if the incumbent neglected the possibility of that state occurring (see, for example, Gennaioli, Shleifer, and Vishny (2011)). In reality, though, the high level of debt, optimally taken on in full knowledge of the prospective states, may crowd out pledgeability. There is a spillover between states caused by debt, which may then appear as if particular states were neglected.

### B.3. Low-ability Incumbent Manager

The analysis so far has assumed a high-ability incumbent manager was in place at date 0. Now consider the bid of a low-ability manager (or equivalently a financier) for the firm at date 0. Clearly, the low-ability manager is always a seller at date 1 (since he cannot produce in period 2), so he sets pledgeability high ( $\gamma_2 = \bar{\gamma}$ ) to maximize the amount that he can sell the firm for. As a result, he sells the firm for  $C_2$  in state G and  $B_1^{H,B}(\bar{\gamma})$  in state B. With slightly abuse of notation, we also use  $D_1^{Max}$  to denote the face value of the debt that enables a low-ability manager to raise the maximum amount at date 0.

**Proposition 2.3** If a low-ability manager bids at date 0 and if  $\varepsilon \rightarrow 0$ , then  $D_1^{Max} \rightarrow C_2$ . For any

$$D_1 < D_1^{Max}, \gamma_2 = \bar{\gamma}.$$

### B.4. Date 0

Finally, we compare the bids made by high- and low-ability managers during the date-0 auction and determine who will acquire control of the firm. According to Proposition 2.2, a high-ability manager can borrow up to  $\max\{q^G(\gamma_1 C_1 + C_2) + (1 - q^G)B_1^{H,B}(\underline{\gamma}), D_1^{B,PayIC}\}$ . Together with cash  $\omega_0^H$ , a high-ability manager bids  $B_0^H(\gamma_1) = \omega_0^H + \max\{q^G(\gamma_1 C_1 + C_2) + (1 - q^G)B_1^{H,B}(\underline{\gamma}), D_1^{B,PayIC}\}$ , provided this is less than  $q^G C_1 + C_2$ , the full expected value of the asset. This is assured if  $\omega_0^H$  is sufficiently small, say  $\omega_0^H = 0$ , since both  $B_1^{H,B}(\underline{\gamma})$  and  $D_1^{B,PayIC} = \theta^H B_1^{H,B}(\underline{\gamma}) + (1 - \theta^H) B_1^{H,B}(\bar{\gamma}) - \varepsilon$  are strictly less than  $C_2$ . As a result, a high-ability manager always gets rents upon acquiring control, and being constrained in bidding by the amount of liquidity she has, she will always lever up fully at date 0.

A low-ability manager can borrow up to  $B_0^L = q^G C_2 + (1 - q^G) B_1^{H,B}(\bar{\gamma}) - \varepsilon$ , which is also what he will bid. Unlike high-ability bidders, he will never augment his bid using his personal wealth since, in

expectation, he cannot resell the firm for more than he can borrow. A simple comparison between  $B_0^H(\gamma_1)$  and  $B_0^L$  shows that a low-ability bidder may win the initial auction when  $\omega_0^H$  is low,  $q^G$  is low,  $\gamma_1$  is low, and  $\theta^H$  is high, that is when an industry expert has low initial liquidity with which to bid, believes there is a low probability of high industry liquidity at date 1 so she knows setting debt high is dominated, and the moral hazard in setting pledgeability restricts the amount she can borrow at date 0 severely even if she sets debt at a lower level to incentivize pledgeability. Note that it is precisely because she has the ability to produce that a high-ability manager's moral hazard over pledgeability arises – she wants to keep the firm for herself when she retains ability, and hence is likely to be a buyer, while the low-ability manager is always a seller and does not suffer from moral hazard.

Acquisition by a low-ability manager is reminiscent of leveraged buyout transactions (see, for example, Jensen (1997)), where firms in stable industries (where moral hazard over pledgeability is high) are taken over, and the revamped management team, which is motivated by the prospect of selling the asset by going public soon, focuses on finding and blocking tunnels -- free cash flow that has been eaten up either through inefficiency or misappropriated by staff (the proverbial company jet). The management team does not really make fundamental changes to the firm's earning prospects in the time the firm is private, and may not be particularly good at it, but it significantly enhances the pledgeability of future cash flows, thus enhancing bids for the firm when it goes public. Our model suggests that the leveraged buyout is a means to check moral hazard at a time of moderate to low industry liquidity, and when pledgeability has been low (poor governance) so that outright takeovers by industry operators are difficult. Furthermore, our model suggests debt alone will not be sufficient, that an explicit commitment to sell is important for management to have the right incentives to set pledgeability high. Outright takeovers of such firms are more likely when industry liquidity is higher (and voluntary mergers would occur only when there is no underpricing, because our model has no synergies). This is consistent with the results in Harford (2005) showing merger waves are more likely after high industry valuations.

### *C. Case 2: Normal Times*

#### *C.1. Assumption and Equilibrium Outcome*

In the previous subsection II B, we studied the industry after a period of prosperity. In this subsection, we study the industry during more normal times. We will show that under some conditions, the borrower is always able to raise the largest amount by limiting the leverage to the level that is consistent with incentives for setting pledgeability high.

To proceed, we impose the following parametric assumptions.

**Assumption 2 (normal times where pledgeability always improves date-1 bids):**

- a.  $\omega_1^{H,G} + \bar{\gamma}C_2 < C_2, \omega_1^{H,B} + \bar{\gamma}C_2 < C_2;$
- b.  $\omega_1^{I,G} \geq \omega_1^{H,G}, \omega_1^{I,B} \geq \omega_1^{H,B}$

Assumption 2a ensures that in both states, increased pledgeability always improves industry experts' date-1 bids. Assumption 2b guarantees the incumbent will outbid industry experts in an auction in both states.

We offer easily interpretable sufficient conditions under which the borrower can always raise the most at the level of debt that is consistent with high pledgeability, which we call  $D_1^{IC}$ . Clearly, the incentive compatible level of debt  $D_1^{IC}$  will lie between  $\gamma_1 C_1 + D_1^{G,PayIC}$ , the incentive compatible level assuming the G state occurred for sure, and  $D_1^{B,PayIC}$ , the incentive compatible level assuming the B state occurred for sure. Moreover, because the benefit of higher pledgeability is decreasing in leverage in Figure 3, there will be net incumbent benefits from increasing pledgeability emanating from state G (because  $D_1^{IC} < \gamma_1 C_1 + D_1^{G,PayIC}$ ) and net incumbent costs emanating from state B (because  $D_1^{IC} > D_1^{B,PayIC}$ ).

We can show, first, if liquidity in two states is not too far apart,  $D_1^{IC}$  is the probability-weighted average of the two conditional debt levels that are consistent with high pledgeability in the respective states ( $D_1^{IC} \rightarrow q^G (\gamma_1 C_1 + D_1^{G,PayIC}) + (1 - q^G) D_1^{B,PayIC}$ ). In this case, by setting debt any higher, the borrower will repay strictly less in both states (since she will set pledgeability low) and thus borrow less upfront.

The second sufficient condition requires the probability of the good state  $q^G$  to be higher than the degree of moral hazard in setting pledgeability, proxied by the probability of the incumbent keeping her ability  $\theta^H$ . The intuition depends on the cost versus benefit of high pledgeability, as illustrated by Lemma 2.2. Intuitively,  $D_1^{IC}$ , the unconditional leverage level that still promotes high pledgeability ex ante, trades off high pledgeability's benefit in state G versus the cost in state B. The benefit of high pledgeability in the good state is realized when the incumbent loses ability, which occurs with unconditional probability  $q^G (1 - \theta^H)$ , whereas the cost in the bad state is realized when the incumbent

keeps her ability, which occurs with unconditional probability  $(1 - q^G)\theta^H$ . If  $q^G(1 - \theta^H) > (1 - q^G)\theta^H$  so that the benefit in the good state dominates the cost in the bad state, the incumbent would never want to violate the pledgeability constraint by taking on too much debt.

In the appendix, we derive sufficient and necessary conditions for when the maximum up front borrowing is incentive compatible so that competition for credit will always lead to high pledgeability. Under these conditions, the lending market will limit leverage to the level consistent with incentives to increase pledgeability. Proposition 2.4 summarizes the two conditions.

**Proposition 2.4** Under Assumption 2a and 2b and  $\varepsilon \rightarrow 0$ ,  $D_1^{Max} = D_1^{IC}$  if one of the two following conditions hold: i)  $q^G \leq \theta^H$  and  $(\gamma_1 C_1 + \omega_1^{H,G}) - \omega_1^{H,B} \leq \frac{1 - \theta^H}{1 - q^G} (\bar{\gamma} - \underline{\gamma}) C_2$  and ; ii)  $q^G > \theta^H$  ;

Proof: See Appendix.

The analysis is slightly different when pledgeability is not fully utilized to increase bids, for example, when there is no underpricing under high pledgeability. In such cases, the net incumbent benefits from increasing pledgeability emanating from state G get squeezed and therefore  $D_1^{IC}$  must get further reduced to incentivize high pledgeability. As a result, it becomes more likely that competitive pressures to raise the most from the market will not limit leverage to the amount consistent with incentives for high pledgeability. In such cases, simply increasing the amount of industry liquidity in good times can lower both the level of debt consistent with incentives to increase pledgeability and the amount that the incumbent can raise from financiers. We illustrate this in the next subsection.

### *C.2. The Effect of Anticipated Liquidity on Pledgeability and Access to Finance*

The assumptions in subsections II B and in this subsection differ only in the amount of liquidity assumed in the future state G,  $w_1^{H,G}$ . Now let us combine the results from both subsections in an example, to see how optimal leverage, pledgeability, and upfront borrowing vary as  $w_1^{H,G}$  increases from a low level. We assume the incumbent's liquidity  $\omega_1^{I,G} = 0.8$  always (weakly) exceeds industry expert's liquidity.

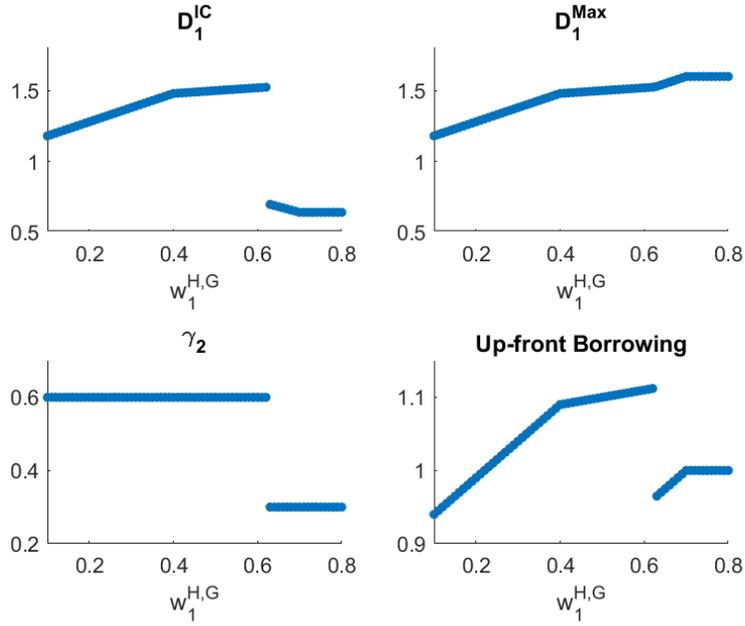


Figure 4: The Effect of Anticipated Liquidity

The other parameters are as follows:  $q^G=0.5$ ,  $\theta^H=0.2$ ,  $\bar{\gamma}=0.6$ ,  $\underline{\gamma}=0.3$ ,  $C_1=C_2=1$ ,  $\omega_1^{I,B}=0.2$ ,  $\omega_1^{H,G}=0.8$ ,  $\omega_1^{H,B}=0.1$ ,  $\varepsilon \rightarrow 0$ ,  $\gamma_1 = \bar{\gamma}$ .

In Figure 4, we plot how  $D_1^{IC}$ ,  $D_1^{Max}$ ,  $\gamma_2$ , and maximum up-front borrowing vary with anticipated liquidity  $w_1^{H,G}$ . Initially when  $\omega_1^{H,G}$  is low ( $\omega_1^{H,G} < 0.4$ ), the maximum debt level that still incentivizes high pledgeability,  $D_1^{IC}$ , increases with  $\omega_1^{H,G}$  (with slope  $q^G=0.5$ ). Intuitively, when there is underpricing in both states even with high pledgeability, an enhancement in pledgeability increases the committed payout in both future state G and B by the same amount  $(\bar{\gamma} - \underline{\gamma})C_2$ . In this case, a small increase in future industry liquidity, for example in state G, always increases incentive compatible leverage and the amount raised up front, but does not affect pledgeability.

Once, however, industry liquidity in state G exceeds the level where, with high pledgeability, bidders can bid full value for the asset (Assumption 2a no longer holds), high pledgeability then increases their bid by less than the amount  $(\bar{\gamma} - \underline{\gamma})C_2$ , and increased industry liquidity reduces the benefit of high pledgeability in state G, without changing the cost to the incumbent of high pledgeability in state B. As a result,  $D_1^{IC}$  still increases with  $\omega_1^{H,G}$ , but the slope is much flatter. As  $\omega_1^{H,G}$  continues to increase, the benefit of high pledgeability in state G falls further. When the benefits get sufficiently low ( $\omega_1^{H,G}$

increases from 0.62 to 0.63 under given parameters),  $D_1^{IC}$  has to drop discontinuously to reduce the cost that emanates from state B, given the low benefit in the G state, to encourage high pledgeability. Consequently, the face value of the debt must drop discontinuously, so  $D_1^{IC}$  actually starts to decrease with  $\omega_1^{H,G}$ . More interestingly, the debt level that raises the most upfront no longer encourages high pledgeability. By choosing a high debt level and pledging out more in the good state, the borrower is able to borrow more even though pledgeability is disincentivized. Finally, as  $\omega_1^{H,G}$  rises above 0.7, there is no potential underpricing of the firm. In this extreme case where in state G high liquidity guarantees the full value is bid even with low pledgeability, we are back to subsection II B, where liquidity can crowd out pledgeability.

The bottom-right panel on upfront borrowing illustrates an adverse consequence of higher anticipated liquidity. In particular, higher anticipated liquidity may reduce the amount that a borrower can raise today by sharply reducing the level of debt which provides incentives for the incumbent to increase pledgeability, and thus causing the incumbent to forego pledgeability. So at a high level of liquidity, the face value of debt goes up with industry liquidity, but the amount raised falls, raising the effective spread.

Higher industry liquidity in booms can make highly levered non-incentive compatible capital structures dominate lower leverage incentive-compatible capital structures, and this can reduce the amount that a borrower can raise from financiers. All of this assumes that conditions are good enough that the liquidity of incumbents exceeds that of industry experts, so only variation in industry liquidity is relevant. The next subsection shows what happens if, in a period of distress, incumbents have less liquidity than industry experts

#### *D. Case 3: The Industry After a Period of Distress*

Consider now a final case, where we assume state G and B follow a period of distress, and there is less liquidity all round. If the incumbent has less liquidity than industry experts, as is likely after sustained hard times, the moral hazard problem may be much alleviated.

##### *D.1. Assumption and Equilibrium Outcome*

We make the following parametric assumptions in this subsection

#### **Assumption 3:**

- a.  $\omega_1^{H,G} < (1-\underline{\gamma})C_2, \omega_1^{I,G} \geq \omega_1^{H,G}$
- b.  $\omega_1^{H,B} < \omega_1^{H,G} < (1-\underline{\gamma})C_2, \omega_1^{I,B} < \omega_1^{H,B}$ .

We assume in 3a and 3b that industry liquidity is low enough in both states that bidders underprice the firm if pledgeability is set low. Furthermore, in state G, the incumbent, if capable, always retains control by outbidding industry experts, while in state B, the incumbent is outbid. The idea is that when good states follow bad ones, industry liquidity is moderate, and the incumbent, with one period of strong production, has more liquidity than industry experts, while when a bad state has followed a bad state, the incumbent is in more distress in this bust than are industry experts.

Since the incumbent retains control under Assumption 3a,

$D_1^{G,PayIC} = \theta^H B_1^{H,G}(\underline{\gamma}) + (1-\theta^H)B_1^{H,G}(\bar{\gamma}) - \varepsilon$ . Next, we describe  $\Delta_1^B(\widehat{D}_1^B)$ . Under Assumption 3b, the industry expert can always outbid the incumbent for any level of pledgeability.<sup>6</sup> Therefore, if the promised remaining payment  $\widehat{D}_1^B$  exceeds the incumbent's bid  $B_1^{I,B}(\gamma_2)$ , the incumbent can never retain control of the firm and therefore becomes a seller, as long as the proceeds from selling recoups the cost of setting pledgeability. In other words, her payoff is  $V_1^B(\widehat{D}_1^B, \gamma_2) = \max\{B_1^{H,B}(\gamma_2) - \widehat{D}_1^B, 0\} - \varepsilon \cdot 1_{\{\gamma_2 > \underline{\gamma}\}}$  if  $\widehat{D}_1^B > B_1^{I,B}(\gamma_2)$ . By setting remaining payments at or below  $\widehat{D}_1^{B,Max} = B_1^{H,B}(\bar{\gamma}) - \varepsilon$ , the incumbent will have incentives to increase next period's pledgeability to  $\bar{\gamma}$ . She recoups the cost  $\varepsilon$  of setting pledgeability high because the promised payment is at least  $\varepsilon$  below the auction bid. Lemma 2.3 formalizes the results.

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<sup>6</sup> Strictly speaking, there is one more case because we break ties in favor of the incumbent. If  $C_2 = B_1^{H,B}(\bar{\gamma}) = B_1^{I,B}(\bar{\gamma})$  and  $B_1^{H,B}(\underline{\gamma}) > B_1^{I,B}(\underline{\gamma})$ , the incumbent retains control if she chooses high pledgeability and continues to be a high type, because she is able to pay the full value of the asset  $C_2$ , and experts will not outbid her. By contrast, if she chooses low pledgeability and debt is above  $B_1^{I,B}(\underline{\gamma})$ , she loses control because the high promised remaining payment is enforceable and higher than what she can pay. The maximum level of debt is as in this case.

**Lemma 2.3:** Under Assumption 2b,  $\Delta_1^B(\widehat{D}_1^B) = 0$  if  $\widehat{D}_1^B = B_1^{H,B}(\bar{\gamma}) - \varepsilon$ . Moreover,  $\Delta_1^B(\widehat{D}_1^B) \geq -\varepsilon$

Proof: See Appendix, where we also lay out the full expression for  $\Delta_1^B(\widehat{D}_1^B)$ . ■

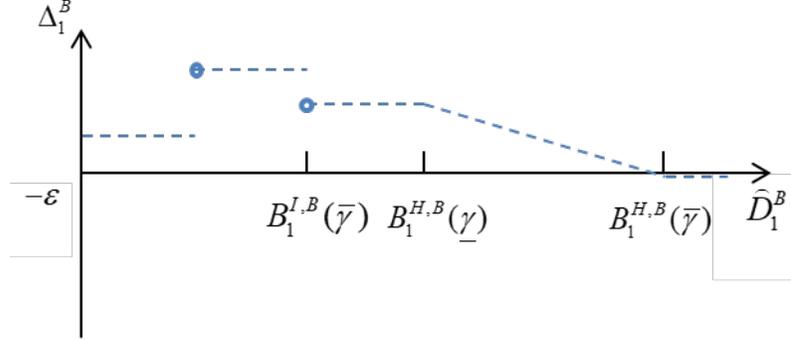


Figure 5  $\Delta_1^B(\widehat{D}_1^B)$  as a function of  $\widehat{D}_1^B$

In Figure 5, we plot the function  $\Delta_1^B(\widehat{D}_1^B)$  against  $\widehat{D}_1^B$ . We assume  $B_1^{H,B}(\underline{\gamma}) \geq B_1^{I,B}(\bar{\gamma})$  in the plot (the case  $B_1^{H,B}(\underline{\gamma}) < B_1^{I,B}(\bar{\gamma})$  is very similar). Importantly,  $\Delta_1^B(\widehat{D}_1^B) > 0$  for all levels of debt below  $B_1^{H,B}(\bar{\gamma}) - \varepsilon$ . Even if debt exceeds  $B_1^{H,B}(\bar{\gamma}) - \varepsilon$ ,  $\Delta_1^B(\widehat{D}_1^B) \geq -\varepsilon$ , that is, the cost of increasing pledgeability is not significantly negative for any level of debt unlike in Figure 3. Since there is potential underpricing and the incumbent has no hope of retaining control once she enters an auction except at very low levels of debt, the incumbent sees only the upside of increasing pledgeability. At very low levels of debt, the incumbent will retain control if she retains ability, but at that low level of debt, the expected benefit of selling at a higher price when she loses ability outweighs the cost of higher repayment when she retains it, so she benefits from setting pledgeability high. Even for very high promised values of  $\widehat{D}_1^B$ —above the most the asset could be sold for, the only disadvantage of choosing high pledgeability is its cost,  $\varepsilon$ . The more general point is lower incumbent liquidity relative to the industry reduces moral hazard over pledgeability since the incumbent is more likely to be a seller of assets.

### Pledgeability Choices

Recall that the incumbent will choose high pledgeability if and only if

$q^G \Delta_1^G(D_1 - \gamma_1 C_1) + (1 - q^G) \Delta_1^B(D_1) \geq 0$ . In state B, as we see above,  $\Delta_1^B(\widehat{D}_1^B) \geq -\varepsilon$  for any  $\widehat{D}_1^B$ . Therefore, the incentive constraint depends only on the incumbent's incentive stemming from state G (provided she

recovers cost  $\varepsilon \rightarrow 0$ ). The incumbent has ex-ante incentives to increase pledgeability whenever there are incentives in state G (i.e., whenever  $\Delta_1^G(\widehat{D}_1) \geq 0$ ).<sup>7</sup> We have

**Proposition 2.5:** Under Assumption 2 and with  $\varepsilon \rightarrow 0$ , there exists a unique threshold  $D_1^{IC}$  such that the incumbent manager sets high pledgeability if and only if  $D_1 \leq D_1^{IC}$ , where  $D_1^{IC} \rightarrow \gamma_1 C_1 + D_1^{G,PayIC}$ .

Finally, in contrast again to the case in subsection II B,  $D_1^{IC}$  is indeed the face value that enables the incumbent to raise the most at date 0. In this case, she repays  $\gamma_1 C_1 + D_1^{G,PayIC}$  in state G and  $B_1^{H,B}(\bar{\gamma})$  in state B. Any  $D_1$  above  $D_1^{IC}$  will induce low pledgeability, and the incumbent can commit to pay strictly less: she repays  $\gamma_1 C_1 + B_1^{H,G}(\underline{\gamma})$  in state G and  $B_1^{H,B}(\underline{\gamma})$  in state B. Any  $D_1$  below  $D_1^{IC}$  will lead to lower payment in state G, and can never increase the payment in state B. Therefore,

**Proposition 2.6:** Under Assumption 2 and with  $\varepsilon \rightarrow 0$ , the face value that enables the incumbent to raise the maximum amount at date 0 is  $D_1^{Max} = D_1^{IC} = \gamma_1 C_1 + D_1^{G,PayIC}$ . In this case, she raises

$q^G (\gamma_1 C_1 + D_1^{G,PayIC}) + (1 - q^G) B_1^{H,B}(\bar{\gamma})$  at date 0. For any promised payment  $D_1 \leq D_1^{Max}$ ,  $\gamma_2 = \bar{\gamma}$ .

## D.2. Discussion

Moral hazard over pledgeability stems from the incumbent wanting to hold on to assets when they sell for less than full value (or equivalently, wanting to reduce the threat industry experts will outbid her using the firm's enhanced borrowing capacity). In state B of Case 3, the incumbent has lower personal liquidity, so she knows she cannot outbid industry experts, and therefore is resigned to a sale. This reduces moral hazard over pledgeability, and elevates the debt that she can take on up front, relative to what would be possible if she had more liquidity and could have stayed in control (state B of Case 2).

## III. Robustness

We discuss the robustness of the basic model in this section.

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<sup>7</sup> We implicitly assume that  $\gamma_1 C_1 + D_1^{G,PayIC} > B_1^{H,B}(\bar{\gamma})$ . Since

$\gamma_1 C_1 + D_1^{G,PayIC} = \gamma_1 C_1 + \theta^H \min\{\omega_1^{H,G} + \underline{\gamma} C_2, C_2\} + (1 - \theta^H) \min\{\omega_1^{H,G} + \bar{\gamma} C_2, C_2\} - \varepsilon$  and  $B_1^{H,B}(\bar{\gamma}) = \min\{\omega_1^{H,B} + \bar{\gamma} C_2, C_2\}$ , this condition is automatically satisfied if  $\gamma_1 = \bar{\gamma}$  and  $C_1 = C_2$ .

### *A. Dynamic Effects*

In subsection II B.4, we show that low-ability manager can win the initial auction and acquire control of the firm in illiquid states. In the online appendix, we add one more period and study the dynamic implications of selling the asset to low types. In particular, we show the prospect of selling to low types actually elevates the level of debt under which high pledgeability is incentive compatible. The reason is as follows. The presence of low types in illiquid states increase the sale price of the asset when low pledgeability has been chosen. As a result, the incremental cost of choosing high pledgeability in the relatively illiquid state is reduced, so that higher debt can be sustained without violating the pledgeability constraint. The presence of low types can therefore improve the choice of pledgeability and increase incentive compatible leverage. As a result, when the illiquid state actually is realized, pledgeability may still be high and misallocation to low types is avoided. Somewhat paradoxically, the potential presence of outsider bidders can improve pledgeability incentives and reduce their actual use in managing firms. Nevertheless, similar to what is in section II B.4, outsiders will sometimes take over the firm in our model in states of low liquidity and they will typically be drafted to enhance pledgeability.

### *B. Different Assumptions on Ability Loss*

We have seen the moral hazard over pledgeability is mitigated by low firm stability -- because if the incumbent loses ability with high probability, in which case she will have to sell, she has an incentive to choose high pledgeability. What if she could lose some ability but not all? As we show in the online appendix, if she can retain control even after choosing low pledgeability, this increases the moral hazard over pledgeability — specifically, given sufficient ability to stay in control, the more ability she retains, the lower is the incentive compatible level of debt. The intuition is straightforward. When she loses some ability but not all, there is more of a chance she can stay in control and earn rents from underpriced assets, rather than selling. Given that she is more likely to be a buyer than if she lost all ability, she has lower incentive to enhance pledgeability.

This also means there is an additional source of allocative inefficiency in this case; when the incumbent stays on and refuses to sell the firm, even when she loses ability vis-a-vis industry experts. Low pledgeability reduces what she has to pay to stay on, thus enhancing her rents from doing so, and can outweigh any loss in production from her relative disability.

### *C. Setting Current Pledgeability*

We have assumed the incumbent only affects future pledgeability. What if she could also affect current pledgeability? Because current period debt is already in place, the incumbent manager has no incentive to enhance current period pledgeability. If she could reduce it, she always would do so, again because

current period debt is already contracted and her action will have no effect on the interest rate charged. So we could allow the incumbent manager to reduce currently set pledgeability somewhat, so as to reduce committed payment and increase her wealth, but our analysis would again focus on her choice of future pledgeability, where the range she chooses from,  $[\underline{\gamma}, \bar{\gamma}]$ , is computed as the pledgeability she sets for the future, net of the maximum amount the future incumbent can push inherited pledgeability down by.

#### *D. Financing Need with probability $(1 - \theta^H)$*

An alternative to the incumbent's loss of ability as a reason for her to be a seller of the firm is the need for her to raise funds. Suppose the incumbent does not lose ability but with probability  $1 - \theta^H$ , the firm gets a liquidity shock which requires it to raise  $L$  units of capital and inject it by the beginning of next period. Otherwise, it loses its ability to survive and thus cannot produce cash flows during the next period (a shock similar to that in Holmstrom and Tirole (1998)). This requirement of  $L$  does not change the pledgeable payoffs in the future; it simply reduces their Net Present Value by  $L$ . We assume that if cash flows were fully pledgeable, it would make sense to raise and invest  $L$ , but that this can't be financed if pledgeability is low. An alternative narrative for this situation would define the shock as an investment opportunity that needs funding which would not be financeable if the firm's assets had low pledgeability.

It turns out that the need to raise finance has similar effects to the loss of ability – it converts the incumbent into a seller of (part of) the firm, and gives her incentive to raise pledgeability. While the precise analysis obviously differs in detail from what we have already presented (see the online appendix), the main conclusions from such an analysis are qualitatively similar.

An interesting extension would be to consider state-contingent investment opportunities. If there are fewer funding requirements in bad states, while the industry is very liquid in good states, the incentive to increase pledgeability would be even lower than what we have analyzed in our model.

#### *E. Long Term Debt Contracts*

We have assumed short term debt contracts, where the borrower must pay each period to retain control, as opposed to long-term contracts where large date-2 payments are specified and only small (or zero) date-1 payments are promised. An initial bidder at date 0 who borrows long-term debt with no required payment on date 1 has similar incentives in choosing pledgeability as low types. If she acquires control of the firm, no payments will be due at date 1 so she always prefers high pledgeability, conditional on potential underpricing in at least one of the two states. Therefore, she can credibly commit to repay  $\bar{\gamma}C_2$  at date 2 and therefore can borrow  $\bar{\gamma}C_2$  upfront. This is clearly dominated by the amount that low

types can borrow, so long as the level of date 1 industry liquidity is positive in at least one of the two states. Intuitively, short-term debt enables low types to sell the asset at a price that incorporates both the high pledged cash flow in period 2 and industry experts' liquidity at date 1.

In general, if the incumbent could dilute the value of old debt (issued at date 0) by issuing new debt at date 1, long-term debt with coupon promised on date 1 is never used. Such dilution can happen due to new debt issued at date 1, or due to an incumbent's strategic default that accelerates all claims to date 1, followed by an auction with a new capital structure (as would happen in a bankruptcy). With all claims accelerated, long-term debt becomes essentially short term. Therefore, if the goal is to raise the maximum upfront proceeds, it is without loss of generality to assume that initial bidders only borrow short-term debt.

#### *F. Public Equity Contracts*

With debt contracts, the firm is auctioned off only if the incumbent misses a payment. We have assumed no equity takeover threats can displace the incumbent. Suppose instead that there is a takeover threat with given probability each period and that takeover bids are increased by an increase in pledgeability (so assume there is potential underpricing if liquidity is moderate). If the probability of a takeover bid is sufficiently high and outside shareholders own a sufficient fraction of equity, then the incumbent's incentives in setting pledgeability are similar to those with short-term debt: if the incumbent is likely to be a buyer (she has the potential to outbid others in a takeover), she will have little incentive to increase pledgeability. If she is likely to be a seller (lose her skills or have the need to raise future funding), she will have an incentive to increase pledgeability. This would suggest that young firms with large future funding needs or possible needs to sell out will maintain high pledgeability even if they issue only outside equity. As with our analysis with debt contracts, higher anticipated liquidity in some states will crowd out the incentive to enhance pledgeability. The disincentive to raise pledgeability will occur if the incumbent retains too small a stake in the firm, which is the analogous situation to having too much debt.

Cross-sectionally, in growing industries, firms are likely to be cash-constrained. These are firms that would want to enhance pledgeability. Of course, these are also likely to be young firms without much of a governance record. So the empirical implication would be, *ceteris paribus*, firms with greater growth opportunities in need of funding are likely to have higher pledgeability.

#### *G. State-Contingent Contracts*

What aspects of our analysis is preserved when we consider state contingent contracts instead of debt contracts? It turns out that much of it is preserved, including the sale of the firm to outsiders because moral hazard over pledgeability limits how much experts can raise. The focus on state contingent

contracts also allows us to consider the comparative statics in more detail (see online appendix); We can show the maximum credible payment in state  $s_1$ ,  $\widehat{D}_1^{s,Max}$ , decreases (weakly) with incumbent wealth  $\omega_1^{I,s_1}$ , because higher  $\omega_1^{I,s_1}$  means the incumbent is more likely to be a buyer, which increases moral hazard over pledgeability and reduces the maximum feasible payment. Similarly, an increase in stability,  $\theta^H$ , reduces the maximum feasible payment for similar reasons. Finally, an increase in *industry liquidity*  $\omega_1^{H,s_1}$  always raises  $\widehat{D}_1^{s,Max}$ . There are two channels at work here. An increase in industry liquidity pushes up the amount industry experts can pay,  $B_1^{H,s}(\gamma_2)$ , for any level of pledgeability. It also expands the parameter ranges in which either there is no potential underpricing or the incumbent cannot retain control. Consequently, again, the maximum pledgeable payment increases.

What does not carry over to state-contingent contracts is the spillover between future states that is induced by debt contracts. High liquidity in one future state will not necessarily induce low pledgeability for other states. This is why we emphasize debt, though the concept of pledgeability applies more generally.

#### **IV. Empirical Implication and Related Literature**

##### *A. Empirical Implications*

What are the empirical implications of our work? Our primary novel implication is that overlaid on the positive correlation between liquidity and leverage that other papers have predicted has an adverse effect on pledgeability. In general, leverage levels are set to also encourage the increase of pledgeability, but in times of great liquidity, pledgeability might be abandoned in favor of greater leverage. At such times, we would observe a negative correlation between measures of liquidity and proxies for pledgeability.

A second implication is that in a downturn following a period of great liquidity, we should find leverage to be “excessive” given the availability of liquidity. Not only was leverage set to be repayable given the possible high liquidity where added pledgeability was not needed, but given neglected pledgeability, even normal levels of leverage corresponding to the reduced liquidity are unsustainable. Therefore, corporate asset sale prices will have a larger-than-usual discount, and the process of de-leveraging will tend to overshoot on the downside, giving scope for re-leveraging once pledgeability is restored. Leverage will tend to have more amplified cycles than liquidity.

Finally, outsiders, including financiers and government entities (like the Reconstruction Finance Corporation during the Depression) play useful roles after episodes of high liquidity and associated leverage, not just in preventing fire sale prices for assets, but in restoring pledgeability. Firms might need to be managed at such times, not to maximize value alone, but also to improve governability. There may be a trade-off between the two in that those best positioned to maximize value may not have the incentives to improve governance. Commitments to sell eventually (as with bankruptcy administrators or leveraged buyout teams) may be important to improve incentives for management to improve governability.

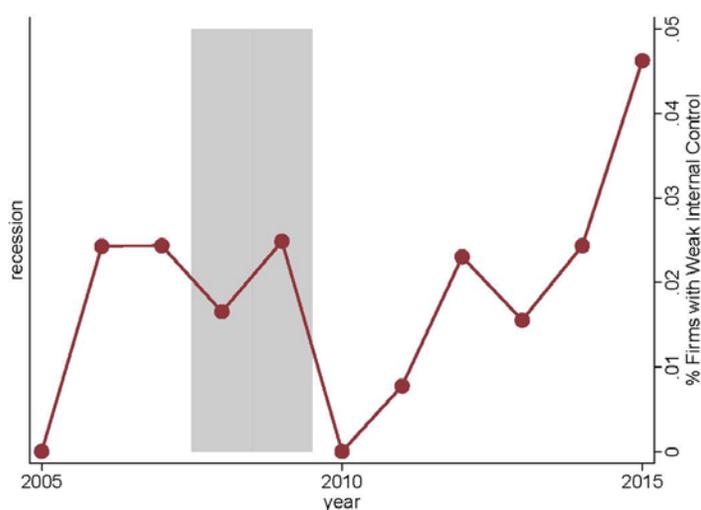
### *B. Proxies for pledgeability and evidence*

When a firm wants to raise more by issuing securities to the market, it will have a relatively strong incentive to overstate earnings (for example by adjusting discretionary accruals to hide low realized cash flows). Of course, anticipating such behavior, analysts may adjust for possible overstatement, preventing the firm from fooling them on average, but outside investors will rely less on reported earnings. Consequently, when a firm anticipates that it will need to raise financing, it will want to have in place high quality auditors who report accounting earnings accurately. Choosing a high quality auditor or audit is thus a way to increase future pledgeability. Our model then predicts that in booms that are likely to continue (our state G), the firm will not have incentives for highly reliable accounting. In normal times with limited industry liquidity (our state B), it will.

We are not aware of many studies explicitly testing for a cyclical demand for ex-ante auditor quality, but there is evidence of cyclical audit quality where quality is lower in industry booms. Lisowsky, Minnis and Sutherland (2017) examine the booming construction sector over the financing cycle. Specifically, they study the most recent housing boom-bust cycle in 2002-2011 and find banks required, on average, fewer high-quality, audited financial statements from construction firms (relative to other firms) before lending to them during the housing boom before 2008. Moreover, the trend was reversed during the subsequent downturn between 2008 and 2011. Interestingly, in the downturn, banks that collected fewer high-quality financial reports also experienced larger loan losses. This pattern is consistent with our theory of the financing cycle that that high industry liquidity induces low pledgeability, which leads to a larger loss-given-default if a downturn is realized.

Consider another suggestive bit of evidence. Our model predicts that low reliability accounting will be chosen (and subsequently unearthed) when liquidity is anticipated to be plentiful at the time of choice. Compustat reports the auditor's opinion of the effectiveness of the company's internal control over financial reporting while auditing a company's financial statements, an opinion which is mandated by

section 404 of the 2002 Sarbanes-Oxley Act. A material weakness is a deficiency, or a combination of deficiencies, in internal control over financial reporting, such that there is a reasonable possibility that a material misstatement of the company's annual or interim financial statements will not be prevented or detected on a timely basis. When an auditor indicates a material weakness, it signifies a previously undetected choice to degrade accounting reliability, and can thus serve as a measure of the previous choice of low pledgeability. Figure 6 below indicates that the percentage of Compustat firms with material weakness of internal control started to increase in the extremely liquid period before the financial crisis, fell during the crisis, and started to increase again as central banks around the world maintained extremely liquid conditions in financial markets.



**Figure 6 Weakness of Internal Control**

**Note:** this figure plots the series of percentage of firms that were reported as with weak internal control. The data are obtained as the variable AUOPIC from the Compustat Annual database. This dummy variable is set to 1 for firms reporting an internal control deficiency, i.e. a material weakness in the client's internal control system, in the restatement year and/or the two subsequent years, otherwise the variable is set to zero

Loan contracts with few covenants could also be a proxy for the choice of low pledgeability. While such a loan contract does not prevent subsequent potential acquirers from issuing debt with strong covenants, it does allow the firm to violate the conditions that would typically be written into strong covenants – such as capital ratios or minimum liquidity and quick asset ratios. As a result, a subsequent would-be acquirer may find the firm simply cannot issue debt with strong and detailed covenants – it would be in violation immediately. More generally, covenant lite loans may reflect a general disdain for cash flow pledgeability, given that abundant liquidity makes it easy to raise loans.

If so, in bad to normal times we should see many covenants and relatively low levels of leverage when fresh capital structures are chosen (such as when the firm comes out of bankruptcy). In contrast, during booms we will see higher leverage and covenant lite loans (defined as loans without maintenance covenants such as maximum payout ratios or minimum liquid asset ratios). Boom periods could also see an increase in the fraction of unmonitored market finance (bonds or covenant lite loans) as opposed to intermediated finance (covenant-intensive bank debt). Indeed, this is what we see, interestingly, with the pattern in the usage of covenant lite loans in Figure 7 mirroring the weakness of internal controls in Figure 6 – more covenant lite loans in the 2006-7 period of extremely high liquidity, followed by a fall, then a rise again as central banks instituted extremely accommodative conditions. Before 2004, Becker and Ivashina (2016) show that covenant-lite leveraged loans were extremely rare, except for higher levels between 1% and 5% during the period 1997 to 1999, once again the liquid period of the Dot Com boom.

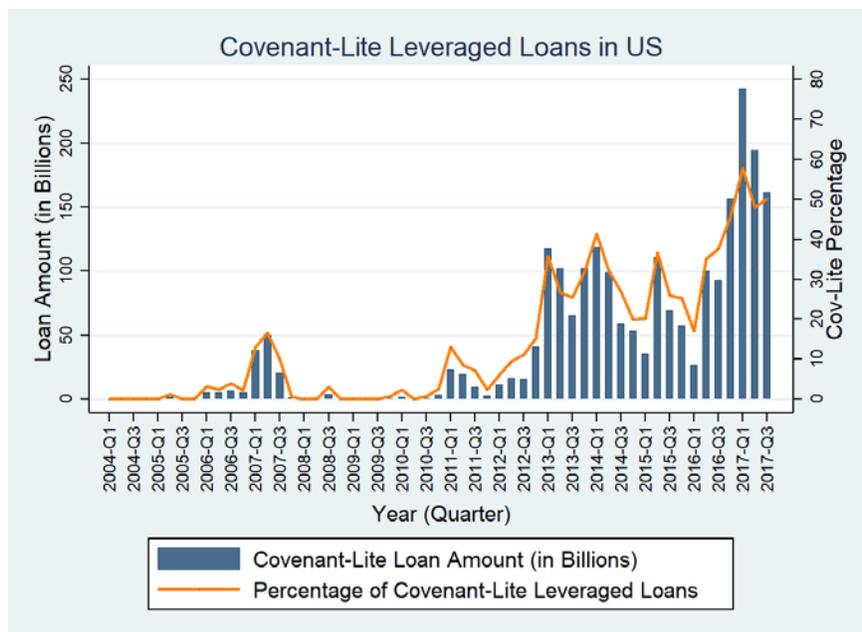


Figure 7 Covenant Lite Loans and as Fraction of Leveraged Loans

Finally, the fluctuation in debt capacity over the cycle may be larger if the range of possible pledgeability values is larger. To the extent that financial infrastructure such as accounting standards or collateral registries as well as contract enforcement are at levels high enough to ensure high minimum pledgeability through the cycle, they prevent large fluctuations in asset pledgeability, and hence credit.

### C. Related Literature

Our paper builds on Shleifer and Vishny (1992), where the high net worth of industry participants allows assets to sell for their fundamental value because the best user of an asset can outbid less efficient users. This leads to efficient reallocation in good times. Shleifer and Vishny argue that debt set to curb

overinvestment in the boom can prove problematic in a downturn. Reallocation to inefficient users takes place then because industry experts are less liquid than outsiders. The key difference in our paper is the source of managerial moral hazard -- not over-investment but pledgeability. The interesting results in our model emerge because even though like Shleifer and Vishny (1992), liquidity enhances leverage, it also depresses pledgeability. Higher anticipated liquidity is not problematic in Shleifer and Vishny (1992) if debt were renegotiable ex post, unlike in our model where its effects can be transmitted through greater anticipatory leverage and lower pledgeability into worse allocations, and lower funding ex ante.

Eisfeldt and Rampini (2008) develop a theory where capital reallocation is more efficient in good times, with key ingredients being private information about managerial ability and cyclical effects of labor market competition for managers. Good times increase required cash compensation to managers because reservation managerial wages become elevated. As a result, high ability managers can accept lower wages in return for the benefits of managing more assets. They use the differential compensation to bribe low ability managers to give up their assets. In bad times, managerial compensation is lower and even if high ability managers accepted zero cash compensation, it would not be sufficient to bribe low ability managers to give up their assets. This leads to a more efficient reallocation of capital in good (high compensation and therefore high manager liquidity) times and less in bad.

In both Shleifer and Vishny (1992) and Eisfeldt and Rampini (2008), adjusting for current conditions (such as industry net worth or compensation), past actions do not affect financial capacity or the efficiency of reallocation of assets today. This is unlike our model, where history matters over and above the effects of leverage because of pledgeability, allowing us to explain prolonged downturns following booms, and to sketch the possibility of financing cycles.

Dow, Gorton, Krishnamurthy (2005), henceforth DGK, present a model where management overinvests cash flow. To curb this, investors hire accountants who force firm managers to pay out in the next period. Accountants are costly and absorb a fixed fraction of the payout they enforce. Money that is not forced to be paid out is reinvested by the incumbent manager, although it provides investors a negative net present value. As a result, when cash flows are unexpectedly high (in an unanticipated boom) and exceed the capacity of accountants to force payout, there will be too much investment and low returns will follow. If high debt is another proxy for what DGK imply by many accountants (as they suggest), there is overinvestment in a boom because there is too little debt to force payout.

We distinguish between debt and pledgeability, unlike DGK, and pledgeability in our model is chosen by management, not investors (but, of course, management is aware it needs lenders to finance future bids). Moreover, unlike DGK, we assume the direct cost of pledging such as hiring reputable accountants,

$\varepsilon$ , is small relative to cash flows, while it is key to the trade-off in DGK. As in DGK, good times do cause problems in ours. But in their model, high payout via leverage/pledgeability is part of the solution. In our model, high liquidity and leverage cause low pledgeability, which is the source of difficulties in the bust. An important difference in the empirical implications of the models is that DGK would predict high pledgeability in booms, while our model would predict low pledgeability.<sup>8</sup>

Unlike Holmstrom and Tirole (1997, 1998), pledgeability in our paper is a direct choice variable, referring to structures for pledging cash flow. Their notion of pledgeability differs in that it is how much can be paid to outsiders taking into account moral hazard stemming from outside claims (similar to Diamond (1991, section IX)). Pledgeability is therefore an outcome of capital structure choices and the environment, and not a direct choice variable.

Acharya and Viswanathan (2011) present a model where a boom which increases the liquidity of other firms in the industry raises the resale value of the industry's assets (similar to the underlying mechanism in this paper). This allows lower quality firms to be able to attract financing and enter the market, because the increased value makes it more profitable to lend to them.<sup>9</sup> If the anticipated boom does not materialize, the previous entry by lower quality borrowers will lead to larger losses to creditors (and increased liquidation of assets) than if they had been unable to enter. So like our model, an anticipated boom that does not materialize can lead to a more severe downturn than conditions would otherwise warrant. Their mechanism is from a factor external to the firm, i.e., entry heterogeneity, however, ours is a change in incentives to maintain pledgeability within a given firm. Deleveraging would restore a sense of comfort amongst lenders in their model, full recovery in ours would also require an enhancement of pledgeability. Finally, an increase in liquidity would always increase ex ante financing in Acharya and Vishwanathan, but not in our model, as we illustrate.

Rampini and Viswanathan (2010) presents a dynamic model which explains the correlation between firm net worth and risk management. In their paper, debt capacity is derived from a limited enforcement problem and as a result, the firm is subject to state-contingent collateral constraints. They focus on the tradeoff between risk management (which itself requires collateral to be credible) and

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<sup>8</sup> Phillipon (2006) presents a model where firms vary in the quality of their corporate governance and will overinvest in the absence of good governance. In a boom that raises the productivity of all firms, the firms with poor governance face less outside restriction on investment and are able to raise more funding. This leads to greater fluctuations in productivity and investment than in an economy with good corporate governance in all firms. Our paper focuses more on changes in governance over the cycle but is similar to Phillipon in that effective governance is lower in the boom.

<sup>9</sup> This is also related to Dell'Arriccia and Marquez (2006), high credit demand reduces the degree of adverse selection in the market, and thus causes banks to suspend screening. See Hu (2018) for a dynamic extension with borrowers' endogenous entry.

forgone current investment opportunities. They predict a less efficient allocation of capital in bad times because more productive firms will use their net worth to invest and will hedge less giving them less future net worth in future recessions. This occurs because the opportunity cost of hedging is high for constrained but productive firms. Our paper assumes away contingent contracting (when we study debt contracts) but endogenizes the pledgeability choice ( $\theta$  in their paper for example). By doing so, we are able to discuss the implications of high industry liquidity (as opposed to firm net worth) on pledgeability, leverage and alternative financing methods.

Our paper also bears some resemblance to papers where a small probability of a regime change is irrationally (Gennaioli, Shleifer, and Vishny (2015)) or rationally neglected (Dang, Gorton, and Holmstrom (2012)), though our results on the effect of anticipated liquidity on leverage and pledgeability hold even if the probability of the seemingly neglected state is not small. Our point is that the low pledgeability set in good times cannot be reversed immediately in bad times, unlike expectations of outcomes or information acquisition or even leverage, because pledgeability takes time to reset. Therefore, not only is there a collapse in access to finance, but also a restoration of access takes time.

Brunnermeier and Sannikov (2014) present a model that also explains slow recoveries. In their model, slow recoveries follow if productive agents, constrained by low wealth (industry liquidity) are forced to misallocate assets to less productive agents. In their case, increasing the wealth level of productive agents always accelerates recovery. In our model, however, we show the downside of increasing *ex-post* or anticipated liquidity when debt leverage is allowed to respond to liquidity: productive agents can get further financially constrained, and asset misallocation can be more severe.

Our paper shares similar insights with a sequence of papers by Geanakoplos (for instance, Geanakoplos 2010) on leverage cycles—which are analogous to our financing cycles. Like us, Geanakoplos endogenizes the borrowing constraint, though through a different approach. He sets up a general equilibrium model in which agents have heterogeneous beliefs. Therefore, optimists—those who assign a high probability on good states—naturally take on leverage and borrow from pessimists. Since all borrowing is collateralized, the borrowing constraint is endogenously determined by the beliefs of pessimistic agents, but under a given agent's beliefs, assets are fully pledgeable. This, together with the beliefs of optimists which determine their willingness to borrow, pins down the loan-to-value ratio in equilibrium. After a bad shock, optimists lose wealth. Consequently, the asset migrates to more pessimistic hands and is valued less. Extreme leverage taken in booms, if followed by bad news, leads to deleveraging in bad times, even without an actual crash in fundamentals. This constitutes the leverage

cycle. The asset price is very high in the initial highly leveraged economy. After deleveraging, the price is even lower than it would have been had there never been the extreme leveraging in the first place.

A crucial difference between the two models is that in ours all participants have the same beliefs about the future. If debt contracts are the best way to raise finance, high anticipated liquidity in some future states will prompt the issuance of a lot of debt today, with both the borrower and the lender agreeing about the consequences of debt spilling over into the future low-liquidity states. In hindsight, from the vantage point of the low liquidity state, it might appear that participants neglected the possibility that it would occur, or were overly optimistic. As our model suggests, they may rationally neglect to prepare (by neglecting pledgeability) for such states.

## V. Conclusion

In good times, bidders have plentiful liquidity and do not need cash flow pledgeability to make high bids. Firms can issue enforceable debt contracts without maintaining cash flow pledgeability – this alternative source of commitment seems unnecessary when times largely promise to be good, and the incentive to maintain high levels is further suppressed by the high leverage that is induced by liquidity. In such times, increases in industry liquidity can decrease the amount of debt consistent with incentives for increased pledgeability. Financiers can lend more at very high leverage levels which induce incumbents to neglect to maintain pledgeability.

As bad times hit, financing capacity plunges, and outsiders who have a better ability to take on leverage may outbid experts. Cash flow pledgeability now becomes key to debt capacity, and industry outsiders have the incentive to increase it even in the face of high debt – it is precisely their ineffectiveness in managing the asset that makes them immune from moral hazard over pledgeability. As cash flow pledgeability increases and industry cash flows recover somewhat, industry experts can once again bid large amounts and return to controlling firms. As liquidity among industry experts increases further, the incentive to maintain cash flow pledgeability wanes once again, and the cycle resumes.

This paper has focused on the choice of pledgeability, assuming that both incumbent and industry expert have access to the same sources of pledgeability. Incumbent pledgeability could be different from the pledgeability industry experts could utilize – the incumbent may be able to borrow more from relationship banks than can an industry expert who does not know the bankers. The gap between incumbent pledgeability and industry pledgeability, especially over the cycle, deserves study.

The existence of institutions that support pledgeability may also change over the financing cycle. When there is a prolonged aggregate boom (with a good probability of continuing), there will be little

demand for increased pledgeability. The institutions and professions which reinforce pledgeability will atrophy, and those with such specific skills (such as forensic accountants) will depart these professions. If we were to introduce more heterogeneity of borrowers, this would make it more difficult to increase pledgeability when other firms do not value such an increase. We plan to explore more of these implications in future work.

Finally, in ongoing work, we recognize pledgeability could be jointly determined by firm managers and a lender, say by the latter monitoring more closely and insisting on a variety of conditional control rights through covenants. Since such lenders, typically financial intermediaries, will need to raise money themselves, and will have to bind themselves to do the right thing by preserving sufficient “skin in the game” through capital, we can get implications for the effects of liquidity on intermediary capital ratios. The model offers rich prospects for future work.

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## Appendix

### A. Proof of Lemma 2.3

Under Assumption 2b,  $V_1^{I,B}(\widehat{D}_1^B, \bar{\gamma})$  and  $V_1^{I,B}(\widehat{D}_1^B, \underline{\gamma})$  are respectively as follows:

$$V_1^{I,B}(\widehat{D}_1^B, \bar{\gamma}) = \begin{cases} -\varepsilon & \text{if } \widehat{D}_1^B > B_1^{H,B}(\bar{\gamma}) \\ B_1^{H,B}(\bar{\gamma}) - \widehat{D}_1^B - \varepsilon & \text{if } B_1^{I,B}(\bar{\gamma}) < \widehat{D}_1^B \leq B_1^{H,B}(\bar{\gamma}) \\ \theta^H C_2 + (1 - \theta^H) B_1^{H,B}(\bar{\gamma}) - \widehat{D}_1^B - \varepsilon & \text{if } \widehat{D}_1^B \leq B_1^{I,B}(\bar{\gamma}) \end{cases}$$

$$V_1^{I,B}(\widehat{D}_1^B, \underline{\gamma}) = \begin{cases} -\varepsilon & \text{if } \widehat{D}_1^B > B_1^{H,B}(\underline{\gamma}) \\ B_1^{H,B}(\underline{\gamma}) - \widehat{D}_1^B - \varepsilon & \text{if } B_1^{I,B}(\underline{\gamma}) < \widehat{D}_1^B \leq B_1^{H,B}(\underline{\gamma}) \\ \theta^H C_2 + (1 - \theta^H) B_1^{H,B}(\underline{\gamma}) - \widehat{D}_1^B - \varepsilon & \text{if } \widehat{D}_1^B \leq B_1^{I,B}(\underline{\gamma}) \end{cases}$$

The first and second case in both value functions have been explained in the main body of the paper. In the third case, the promised payment levels are below the incumbent's bid  $B_1^{I,B}(\gamma_2)$  so that she is able to stay in control by repaying  $\widehat{D}_1^B$ . Therefore, she chooses so if she keeps her ability but sells the firm if she loses ability. The continuation value in this case is thus

$$\theta^H C_2 + (1 - \theta^H) B_1^{H,B}(\gamma_2) - \widehat{D}_1^B - \varepsilon \cdot 1_{\{\gamma_2 \geq \underline{\gamma}\}}.$$

Take the difference, the results on  $\Delta^B(\widehat{D}_1^B) = V_1^{I,B}(\widehat{D}_1^B, \bar{\gamma}) - V_1^{I,B}(\widehat{D}_1^B, \underline{\gamma})$  naturally follows as below.

a. If  $B_1^{H,B}(\underline{\gamma}) < B_1^{I,B}(\bar{\gamma})$ ,

$$\Delta^B(\widehat{D}_1^B) = \begin{cases} -\varepsilon & \text{if } \widehat{D}_1^B > B_1^{H,B}(\bar{\gamma}) \\ B_1^{H,B}(\bar{\gamma}) - \widehat{D}_1^B - \varepsilon & \text{if } B_1^{I,B}(\bar{\gamma}) < \widehat{D}_1^B \leq B_1^{H,B}(\bar{\gamma}) \\ \theta^H C_2 + (1 - \theta^H) B_1^{H,B}(\bar{\gamma}) - \widehat{D}_1^B - \varepsilon & \text{if } B_1^{H,B}(\underline{\gamma}) < \widehat{D}_1^B \leq B_1^{I,B}(\bar{\gamma}) \\ \theta^H C_2 + (1 - \theta^H) B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma}) - \varepsilon & \text{if } B_1^{I,B}(\underline{\gamma}) < \widehat{D}_1^B \leq B_1^{H,B}(\underline{\gamma}) \\ (1 - \theta^H) [B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma})] - \varepsilon & \text{if } \widehat{D}_1^B \leq B_1^{I,B}(\underline{\gamma}). \end{cases}$$

b. If  $B_1^{H,B}(\underline{\gamma}) \geq B_1^{I,B}(\bar{\gamma})$ ,

$$\Delta^B(\widehat{D}_1^B) = \begin{cases} -\varepsilon & \text{if } \widehat{D}_1^B > B_1^{H,B}(\bar{\gamma}) \\ B_1^{H,B}(\bar{\gamma}) - \widehat{D}_1^B - \varepsilon & \text{if } B_1^{H,B}(\underline{\gamma}) < \widehat{D}_1^B \leq B_1^{H,B}(\bar{\gamma}) \\ [B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma})] - \varepsilon & \text{if } B_1^{I,B}(\bar{\gamma}) < \widehat{D}_1^B \leq B_1^{H,B}(\underline{\gamma}) \\ \theta^H C_2 + (1 - \theta^H) B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma}) - \varepsilon & \text{if } B_1^{I,B}(\underline{\gamma}) < \widehat{D}_1^B \leq B_1^{I,B}(\bar{\gamma}) \\ (1 - \theta^H) [B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma})] - \varepsilon & \text{if } \widehat{D}_1^B \leq B_1^{I,B}(\underline{\gamma}). \end{cases}$$

### B. Proof of Proposition 2.4

We can define  $D_1^{G,PayIC} = \theta^H B_1^{H,G}(\underline{\gamma}) + (1 - \theta^H) B_1^{H,G}(\bar{\gamma}) - \varepsilon$  and

$D_1^{B,PayIC} = \theta^H B_1^{H,B}(\underline{\gamma}) + (1 - \theta^H) B_1^{H,B}(\bar{\gamma}) - \varepsilon$  such that the benefits from choosing high versus low

pledgeability satisfy  $\Delta_1^G(\gamma_1 C_1 + D_1^{G,PayIC}) = \Delta_1^B(D_1^{B,PayIC}) = 0$ . Since  $\Delta_1^s(D_1)$  decreases (weakly)

monotonically in  $D_1$ , there exists a  $D_1 \in [D_1^{B,PayIC}, \gamma_1 C_1 + D_1^{G,PayIC}]$  that satisfies

$q^G \Delta_1^G(D_1 - \gamma_1 C_1) + (1 - q^G) \Delta_1^B(D_1) = 0$ . Let  $D_1^{IC}$  be that  $D_1$ , or the maximum such  $D_1$  if not

unique.<sup>10</sup>  $D_1^{IC}$  will be such that the incumbent sees an expected positive benefit from the G state of

raising pledgeability (because  $D_1^{IC} < \gamma_1 C_1 + D_1^{G,PayIC}$ ) and an equal expected negative benefit (or cost) in

the B state from doing so (because  $D_1^{IC} > D_1^{B,PayIC}$ ). The net benefit of setting high pledgeability in either

<sup>10</sup>  $D_1^{IC}$  is not unique only if  $q^G (1 - \theta^H) [B_1^{H,G}(\bar{\gamma}) - B_1^{H,G}(\underline{\gamma})] = (1 - q^G) \theta^H [B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma})]$ . If

so, we can pick the highest  $D_1^{IC}$  which is  $\gamma_1 C_1 + B_1^{H,G}(\underline{\gamma})$ .

state is summarized by Lemma 2.2. Note that the (expected) benefit in state G is capped at  $q^G (1 - \theta^H) [B_1^{H,G}(\bar{\gamma}) - B_1^{H,G}(\underline{\gamma})]$ , whereas the (expected) cost in state B is also capped at  $-(1 - q^G) \theta^H [B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma})]$ .

By setting the face value of the debt at  $D_1^{IC}$ , the incumbent is able to raise  $q^G D_1^{IC} + (1 - q^G) \min \{D_1^{IC}, B_1^{H,B}(\bar{\gamma})\}$  at date 0. If  $D_1^{IC} \geq \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma})$ , the incentive compatible level of debt is also what enables the incumbent to raise the most up front. Else if  $\gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) > D_1^{IC}$ , we have to check if the incumbent can borrow more by setting  $D_1 = \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma})$ , and raising  $q^G (\gamma_1 C_1 + B_1^{H,G}(\underline{\gamma})) + (1 - q^G) B_1^{H,B}(\underline{\gamma})$  up front. Let  $D_1^{Max}$  be the face value of the debt that raises the maximum amount at date 0.

We derive the sufficient and necessary conditions for high pledgeability choices.

1. If  $\gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) \leq B_1^{H,B}(\bar{\gamma})$  so that the liquidity in each state is not far from each other:
  - a. If  $q^G (1 - \theta^H) \geq (1 - q^G) \theta^H$  or equivalently  $q^G \geq \theta^H$ , then  $\gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) < D_1^{IC}$ .

Therefore, high pledgeability is always guaranteed.

Note that the face value, if set at  $\gamma_1 C_1 + B_1^{H,G}(\underline{\gamma})$  is strictly below  $\gamma_1 C_1 + D_1^{G,PayIC}$  so that in state G, the incumbent would always prefer high pledgeability. The size of the gain from choosing high pledgeability is  $\Delta_1^G = (1 - \theta^H) [B_1^{H,G}(\bar{\gamma}) - B_1^{H,G}(\underline{\gamma})] - \varepsilon$ . Intuitively, if the incumbent keeps her ability, she needs to repay  $D_1 = \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma})$  no matter what pledgeability choice she makes. If she loses her ability, which occurs with probability  $1 - \theta^H$ , the incumbent can sell the asset for additional value of  $[B_1^{H,G}(\bar{\gamma}) - B_1^{H,G}(\underline{\gamma})]$  with high pledgeability. Therefore, the overall benefit is  $(1 - \theta^H) [B_1^{H,G}(\bar{\gamma}) - B_1^{H,G}(\underline{\gamma})] - \varepsilon$ . Now we examine the net loss of high pledgeability in state B when  $D_1 = \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma})$ . Note that the net loss  $-\Delta_1^B$  is at most  $-\theta^H [B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma})] - \varepsilon$ . This maximum net loss is attained if and only if  $D_1 = \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) \geq B_1^{H,B}(\bar{\gamma})$ . Intuitively, if the incumbent loses ability, she does not receive additional residual proceeds with debt so high, whatever the pledgeability she chooses. If she keeps her ability, which occurs with probability  $\theta^H$ , she needs to make additional payments if she chooses high pledgeability, which amounts to  $B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma})$ . Hence the net loss from choosing high pledgeability.

A sufficient condition for  $D_1^{IC} > \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma})$  is

$q^G \left\{ (1-\theta^H) \left[ B_1^{H,G}(\bar{\gamma}) - B_1^{H,G}(\underline{\gamma}) \right] - \varepsilon \right\} \geq (1-q^G) \left\{ -\theta^H \left[ B_1^{H,B}(\bar{\gamma}) - B_1^{H,B}(\underline{\gamma}) \right] - \varepsilon \right\}$ . Given the assumption that there are rents even with high pledgeability, a sufficient condition for this to hold when  $\varepsilon \rightarrow 0$  is  $q^G (1-\theta^H) \geq (1-q^G) \theta^H$  or equivalently  $q^G \geq \theta^H$ .

b. If  $q^G < \theta^H$

i. Comparing the incremental expected benefit from raising pledgeability when  $D_1 = \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma})$ , it is easy to see that

$$q^G \Delta_1^G(\gamma_1 C_1 + B_1^{H,G}(\underline{\gamma})) > (1-q^G) \Delta_1^B(\gamma_1 C_1 + B_1^{H,G}(\underline{\gamma})) \text{ if}$$

$$q^G (1-\theta^H) (\bar{\gamma} - \underline{\gamma}) C_2 \geq (1-q^G) \left\{ \left[ \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) \right] - D_1^{B,PayIC} \right\}. \text{ Then}$$

$$\gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) < D_1^{IC} \text{ and high pledgeability is always guaranteed. The}$$

$$\text{condition } q^G (1-\theta^H) (\bar{\gamma} - \underline{\gamma}) C_2 \geq (1-q^G) \left\{ \left[ \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) \right] - D_1^{B,PayIC} \right\} \text{ can}$$

$$\text{be expressed in terms of primitives: } (\gamma_1 C_1 + \omega_1^{H,G}) - \omega_1^{H,B} \leq \frac{1-\theta^H}{1-q^G} (\bar{\gamma} - \underline{\gamma}) C_2.$$

ii. If  $q^G (1-\theta^H) (\bar{\gamma} - \underline{\gamma}) C_2 < (1-q^G) \left\{ \left[ \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) \right] - D_1^{B,PayIC} \right\}$ , then

$$D_1^{IC} < \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) < B_1^{H,B}(\bar{\gamma}). \text{ In this case, we can derive the explicit}$$

$$\text{expression } D_1^{IC} \rightarrow D_1^{B,PayIC} + \frac{q^G (1-\theta^H)}{1-q^G} (\bar{\gamma} - \underline{\gamma}) C_2 \text{ as } \varepsilon \rightarrow 0. \text{ In this case,}$$

high pledgeability is chosen if and only if

$$D_1^{IC} > q^G \left[ \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) \right] + (1-q^G) B_1^{H,B}(\underline{\gamma}).$$

2. If  $\gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) > B_1^{H,B}(\bar{\gamma})$

a. If  $q^G \geq \theta^H$ , then  $D_1^{IC} > \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) \geq B_1^{H,B}(\bar{\gamma})$  and high pledgeability is always guaranteed.

b. If  $q^G < \theta^H$ , then  $\gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) \geq B_1^{H,B}(\bar{\gamma}) > D_1^{IC}$ . In fact, we can derive the explicit

$$\text{expression } D_1^{IC} \rightarrow D_1^{B,PayIC} + \frac{q^G (1-\theta^H)}{1-q^G} (\bar{\gamma} - \underline{\gamma}) C_2 \text{ as } \varepsilon \rightarrow 0. \text{ In this case, high}$$

$$\text{pledgeability is chosen if and only if } D_1^{IC} > q^G \left[ \gamma_1 C_1 + B_1^{H,G}(\underline{\gamma}) \right] + (1-q^G) B_1^{H,B}(\underline{\gamma}).$$

To summarize, a set of sufficient conditions for high pledgeability is i)  $q^G \geq \theta^H$ ; or ii)  $q^G < \theta^H$

$$\text{and } (\gamma_1 C_1 + \omega_1^{H,G}) - \omega_1^{H,B} \leq \frac{1-\theta^H}{1-q^G} (\bar{\gamma} - \underline{\gamma}) C_2.$$

### C. Long-term contracts

Suppose an initial bidder borrows a long term debt with  $D_2$  due at date 2 and nothing due at date 1. During period 1, she knows if she keeps ability, she receives  $C_2 - D_2$ . If she loses ability, however, she needs to sell the firm. Industry experts will bid

$B_1^{H,s_1}(\gamma_2, D_2) = \min \left\{ \omega_1^{H,s_1} + \max(\gamma_2 C_2 - D_2, 0), C_2 - D_2 \right\}$ , assuming all new debt they issue is junior to the original long-term debt (if it were senior, then they would fully dilute it and the incumbent could borrow nothing at date 0). The first term  $\omega_1^{H,s_1} + \max(\gamma_2 C_2 - D_2, 0)$  is industry liquidity and the amount that can still be borrowed with junior debt after  $D_2$  gets repaid. The second term  $C_2 - D_2$  is the value of the firm to acquirers because they need to pay off the debt  $D_2$  at date 2. Therefore, the incumbent's expected payoff after acquiring control of the firm is

$\theta^H (C_2 - D_2) + (1 - \theta^H) \left[ q^G B_1^{H,G}(\gamma_2, D_2) + (1 - q^G) B_1^{H,B}(\gamma_2, D_2) \right]$ . Clearly, the payoff increases

weakly with  $\gamma_2$  and high pledgeability  $\gamma_2 = \bar{\gamma}$  is chosen if  $D_2 \leq \bar{\gamma} C_2$ . Therefore, the maximum date 2 payment from debt is  $D_2 = \bar{\gamma} C_2$ . However in this case, low types can borrow

$q^G B_1^{H,G}(\bar{\gamma}) + (1 - q^G) B_1^{H,B}(\bar{\gamma})$ , which clearly dominates  $\bar{\gamma} C_2$ . Therefore, long-term debt without any

date 1 payment never raises the largest amount upfront. Such debt may raise more than an industry experts (high type), as we show next. Consider the parameters in subsection IIB and further assume the borrower has no initial liquidity and in state B:  $\omega_0^H = \omega_1^{H,B} = 0$ . In this case, a bidder who borrows one-period short-term debt borrows up to  $B_0^H(\gamma_1) = D_1^{B,PayIC}$  as  $q^G \rightarrow 0$ . Since  $\omega_1^{H,B} = 0$ ,

$B_0^H(\gamma_1) = D_1^{B,PayIC} = \left[ \theta^H \underline{\gamma} + (1 - \theta^H) \bar{\gamma} \right] C_2 < \bar{\gamma} C_2$ . Note long-term debt with positive payments on

both dates 1 and 2 could possibly raise more for industry experts (high types) than short-term debt as well as low types' bids. One such example is in the case  $q^G \rightarrow 1$ , the initial bidder sets  $D_1 = \omega_1^{H,G} + \gamma_1 C_1$

(assuming  $\omega_1^{H,G} < (1 - \bar{\gamma}) C_2$ ) and  $D_2 = \bar{\gamma} C_2$ . This debt structure, if not renegotiated (accelerated),

circumvents the moral hazard issues in pledgeability choices (by locking up all future value and preventing increased pledgeability from increasing bids on date 1) and therefore raises

$\omega_1^{H,G} + \gamma_1 C_1 + \bar{\gamma} C_2$ , exceeding both low types bids  $\omega_1^{H,G} + \gamma_1 C_1 + \bar{\gamma} C_2$  and high types' using short-term debt only ( $\gamma_1 C_1 + D_1^{G,PayIC}$  in the case  $\omega_1^{I,G} \geq \omega_1^{H,G}$  and  $\omega_1^{H,G} + \gamma_1 C_1 + \bar{\gamma} C_2$  in the case  $\omega_1^{I,G} < \omega_1^{H,G}$ ).

Next, we show that whenever the incumbent could raise more by using long-term debt with payments on both dates, she has incentive to default strategically and accelerate all the claims to date 1. To proceed, we assume  $D_2 \leq \bar{\gamma} C_2$  without loss of generality. We will show that the incumbent always prefers to strategically default on any contract that raises more than short-term debt, accelerating all claims to date 1, no matter she has retained her ability or not. Let us first examine the incumbent's payoff when she retains her ability. If she doesn't default strategically, her payoff is

$C_2 - \min \left\{ \hat{D}_1^{s_1}, B_1^{H,s_1}(\gamma_2, D_2) \right\} - D_2$ : she needs to pay  $\min \left\{ \hat{D}_1^{s_1}, B_1^{H,s_1}(\gamma_2, D_2) \right\}$  to retain control of the firm and pay  $D_2$  at date 2 in exchange for the asset's continuation cash flow  $C_2$ . If she defaults

strategically, she receives  $C_2 - \min \{ \widehat{D}_1^{s_1} + D_2, B_1^{H,s_1}(\gamma_2, 0) \}$ . Clearly,

$C_2 - \min \{ \widehat{D}_1^{s_1} + D_2, B_1^{H,s_1}(\gamma_2, 0) \} \geq C_2 - \min \{ \widehat{D}_1^{s_1}, B_1^{H,s_1}(\gamma_2, D_2) \} - D_2$  so that the incumbent would always accelerate the payment and pay (weakly) less overall. This inequality is strict if  $D_2 > \gamma_2 C_2$  and  $\omega_1^{H,s_1} < \min \{ C_2 - D_2, \widehat{D}_1^{s_1} \}$ . Intuitively, if the incumbent accelerates the payments, the total amount that she can repay at date 1 is capped by the bids from industry experts.

Next, we examine the incumbent's payoff if she loses ability. This payoff is also equivalent to one that she cannot outbid industry experts even if she keeps her ability. If she doesn't accelerate the payments, her payoff is  $\max \{ B_1^{H,s_1}(\gamma_2, D_2) - \widehat{D}_1^{s_1}, 0 \}$ . If she accelerates, the payoff is

$\max \{ B_1^{H,s_1}(\gamma_2, 0) - \widehat{D}_1^{s_1} - D_2, 0 \}$ . For the remainder, we will show that these two payoffs are always identical to each other in the relevant cases. Note that

$$\max \{ B_1^{H,s_1}(\gamma_2, D_2) - \widehat{D}_1^{s_1}, 0 \} = \max \left\{ \min \left\{ \omega_1^{H,s_1} + \max(\gamma_2 C_2 - D_2, 0) - \widehat{D}_1^{s_1}, C_2 - D_2 - \widehat{D}_1^{s_1} \right\}, 0 \right\} \text{ and}$$

$$\max \{ B_1^{H,s_1}(\gamma_2, 0) - \widehat{D}_1^{s_1} - D_2, 0 \} = \max \left\{ \min \left\{ \omega_1^{H,s_1} + \gamma_2 C_2 - D_2 - \widehat{D}_1^{s_1}, C_2 - D_2 - \widehat{D}_1^{s_1} \right\}, 0 \right\}.$$

If  $D_2 < \gamma_2 C_2$ , these two payoffs are clearly identical. This is the case if  $\gamma_2 = \bar{\gamma}$  has been chosen.

Therefore, the only case that the incumbent might not accelerate debt payments is  $\underline{\gamma} C_2 < D_2 < \bar{\gamma} C_2$  and low pledgeability  $\gamma_2 = \underline{\gamma}$  has been chosen.<sup>11</sup> In general, the incumbent could over-promise the payments at date 2 to commit to not accelerate the debt ( $D_2 > \underline{\gamma} C_2$ ). But if this is the case, neither the incumbent nor industry experts can borrow against the output in period 2. The maximal amount that can be raised ex-ante is  $q^G (\gamma_1 C_1 + \omega_1^{H,G}) + (1 - q^G) \omega_1^{H,B} + \underline{\gamma} C_2$ , which is dominated by the amount that can be raised by only using short-term debt alone (see subsection IIB, IIC, IID). Therefore, it can never be optimal to set up such a debt structure in the first place.

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<sup>11</sup> In general, the initial incumbent could over promise payments at date 2  $D_2 > \bar{\gamma} C_2$  which helps her commit to not to accelerate the payments if she loses her ability and needs to sell the firm. We exclude this possibility as it is public information that the payments due at date 2 can never exceed  $\bar{\gamma} C_2$ .