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Pledgeability, Industry Liquidity, and Financing Cycles

Douglas W. Diamond[1] Yunzhi Hu and Raghuram G. Rajan

Chicago Booth and NBER University of North Carolina Chicago Booth and NBER

Abstract

Why are downturns following episodes of high valuations of firms so severe and long? Why do firms take on high debt when they anticipate high valuations, and underperform subsequently? In this paper, we propose a theory of financing cycles where the control rights to enforce claims in an asset price boom (rights to sell assets) differ from the control rights used in more normal times (rights over cash flows that we term "pledgeability"). Firm management's limited incentive to enhance pledgeability in an asset price boom can have long-drawn adverse effects in a downturn, which may not be resolved by debt renegotiation. This can also explain why involuntary asset turnover and asset misallocation to outsiders are high in a downturn, as well as why industry productivity falls. The paper highlights an adverse consequence of high anticipated liquidity, working through leverage, on the economy's access to finance and productivity when that liquidity fails to materialize. It also suggests that higher anticipated liquidity can tighten credit constraints, instead of alleviating them.

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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))?[2] 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 when the constraints imposed by debt are already high. Moreover, why would the moral hazard problem be so much more serious in a downturn that follows high valuations?

In this paper, we provide an explanation of the causes of high debt and explain 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 the control rights that are due to high resale prices for assets, which enable external claims to be enforced in a boom, and control rights based on pledging of cash flows, which facilitate the enforcement of external claims at other times, including downturns. The transition between these regimes, in which different types of control rights are operational, 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 managerial knowledge to produce. Within the industry, there are firms run by incumbents. There are also industry insiders (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, which we assume. It has especial value when there are a large number of capable potential buyers willing

[2] Krishnamurthy and Muir (2017) document a positive correlation between pre-crisis credit growth and the severity of the 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.

to pay the full price for the firm's assets. Greater wealth amongst industry insiders (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 or pledgeable over the medium term, for example by improving accounting quality or setting up escrow accounts so that cash flows are hard to divert. From the incumbent manager's perspective, enhancing *cash flow pledgeability* is a double-edged sword. It makes it easier for her to sell the firm when she is no longer capable of running it because new buyers can borrow against future pledgeable cash flows to finance the acquisition. However, it also enables existing creditors to collect more if she stays in control because the creditors' right to seize assets and sell them when not paid in full implies that she has to "buy" the firm from them to stay in control. Increased pledgeability means that creditors can sell the firm for more if they seize it, allowing them to extract more repayment from her, which reduces her incentive to enhance pledgeability. Thus the choice of cash flow pledgeability is subject to additional moral hazard, over and above the intrinsic reluctance of the incumbent to repay outside financiers. This limits the external financing capacity of the firm. The advantages of costly increases in pledgeability for financial capacity have been studied in Dow, Gorton and Krishnamurthy (2005). We examine the advantages and disadvantages of increased pledgeability for the incumbent (even when the direct costs of raising pledgeability are insignificant), and especially how it varies with industry liquidity.

Our goal is to understand how the external obligations built up in a boom affect a firm's pledgeability choice, and its subsequent access to financing. When markets are buoyant and industry insiders have plenty of cash, repayment is enforced by the high resale value of assets. There is no moral hazard discount embedded in the firm price because the most efficient users (industry insiders) have enough wealth to pay the full price of the firm. There is no additional need for them to rely on pledged cash flows in making their bid, hence higher pledgeability is not needed. Industry assets trade at that point for fundamental value (with no underpricing), as in Shleifer and Vishny (1992). The high anticipated resale value increases the amount of debt that a firm can credibly repay and thus the leverage it can raise (see Acharya and Vishwanathan (2011)).

Since pledgeability is not needed to enforce repayment in states with high liquidity, liquidity directly crowds out incentives to raise pledgeability. In addition, though, the higher debt that is taken on, anticipating continued liquidity, diminishes the incumbent's incentive to increase pledgeability, both because the power of the existing creditor to enforce repayment goes up, and the incumbent's residual share after paying off debt in case she is forced to sell the firm goes down. Thus *anticipated liquidity also operates through leverage to crowd out pledgeability*. The adverse effect of anticipated liquidity on pledgeability is a key new focus of this paper. With pledgeability low, an industry downturn that leads to a fall in industry liquidity, even one that is anticipated to occur with significant probability, can then impair firm performance severely. Industry insiders, 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 purchases. Since external claims are high in these episodes, the firm may be sold to outsiders. While industry outsiders have little ability to operate the asset themselves, this may be a virtue – outsiders have a strong incentive to improve cash flow pledgeability because they do not want to own the asset long term, but instead want to sell the asset back to industry insiders 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.

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 insiders, as the higher pledgeability they set increases the insiders' 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 corporations have to restore the pledgeability of their cash flows to cope with a world where liquidity is scarcer. It is the latter, which may make the debt hangover 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! Importantly, these effects also mean that higher anticipated liquidity can reduce the amount of funding that can be raised up front.

The liquidity-leverage overhang on pledgeability choice resembles traditional debt-overhang (Myers (1977)), where firm decisions are distorted whenever the decision causes an increase in the value of outstanding debt. But the decision we model, raising pledgeability, could also benefit the incumbent by raising resale value. This is why there is a trade-off in normal circumstances, which limits the amount of debt the incumbent can issue, and the trade-off 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 stay the course and not tunnel. As our model suggests, this sets a limit on how much debt the buyout can carry.

Our paper 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)).[3] 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.

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 insiders 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. Thus liquidity in our model, unlike in theirs, is not an unmixed blessing.

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.

[3] See Benmelech and Bergman (2011), Coval and Stafford (2007), and Shleifer and Vishny (2011) for comprehensive reviews.

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. Higher anticipated liquidity is therefore not problematic in Shleifer and Vishny (1992) if debt were renegotiable, unlike in our model where its effects can be transmitted through greater anticipatory leverage and lower pledgeability into worse allocations ex post, and lower funding ex ante. Moreover, outsiders in our model are not necessarily more liquid than industry insiders, but still play an important role because they do not suffer from moral hazard over pledgeability. They take over the firm temporarily to raise future pledgeability, even though they cannot generate cash flow. We will address other related papers after presenting our model.

The rest of the paper is as follows. In Section I, we describe the basic benchmark model 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 add an initial period to explain what might drive the pledgeability level we assumed in the two period model and discuss the robustness of the model to alternative assumptions. In Section IV, we discuss empirical implications and the relationship to the literature and 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), and extends over several years. At the beginning of period 1, the state of the industry is realized. The industry either can prosper with probability q^G and its state is good, G, or it can be in state B where it is distressed (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 and not apocalypse).

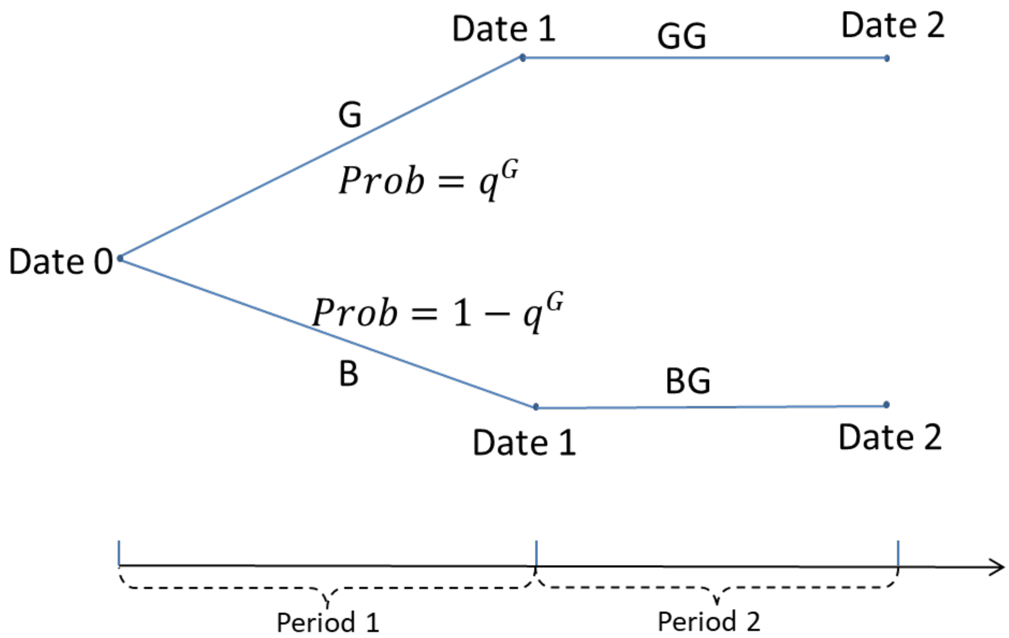

Figure 1: States of Nature

B. Agents and the Asset

There are two types of agents in the economy: *industry insiders* 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. A *low* (L) ability manager cannot produce cash flows regardless of the state. These managers could be *industry outsiders* such as *financiers* who hold the asset for the purpose of reselling, or industry insiders who have lost their ability (see below). Financiers have funds, which they will lend to others managing the firm if they expect to 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 $\theta^H < 1$. Think of this 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 θ^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 insider managers equally able to take her place next period. If a new high ability manager 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 contacts.

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 the right to sell the borrower's assets 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* γ_{t+1} chosen in period *t* is the fraction of period *t+1*'s cash flows that can be automatically paid to outside financiers. $\gamma_{t+1} \in [\underline{\gamma}, \overline{\gamma}]$, where the range of feasible values is determined by the economy's institutions supporting corporate governance (such as regulators and regulations, investigative agencies, laws and the judiciary) and $0 \leq \underline{\gamma} < \overline{\gamma} \leq 1$. To set $\gamma_{t+1} > \underline{\gamma}$, it costs $\varepsilon \geq 0$. Our results will be presented primarily for the case where $\varepsilon \to 0$, and positive ε will only alter the results quantitatively.

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 strict 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 $\overline{\gamma}$. 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, she has general governance capabilities and can set next period's pledgeability. We will see that her inability to generate cash flows can sometimes be a benefit.

E. Control Rights over Assets: Auction and Resale

If the financier has not been paid in full from the pledged cash flow and any additional sum the incumbent voluntarily pays, then the financier gets 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 financier 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 ω_1^{I,s_1} and ω_1^{H,s_1} respectively be the wealth levels of the incumbent and industry insiders. ω_1^{H,s_1} is also termed *industry liquidity*. We assume $\omega_1^{H,G} > \omega_1^{H,B}$ because industry prosperity lifts the private income of industry insiders as they work as contractors, consultants, or employees in the industry. 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 $\omega_1^{I,G} \geq \omega_1^{I,B}$.

There is no pre-existing owner, so the firm is auctioned to the highest bidder at date 0. To simplify notation, we assume that each bidder must always take maximum leverage (the level which raises the largest amount from financiers) to avoid being outbid.

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 with an example in Section 3 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 γ_2, knowing the probability of state G and B. Next, the state s_1 is realized, then her ability in period 2 is known. Subsequently, production takes place and the pledgeable fraction γ_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.

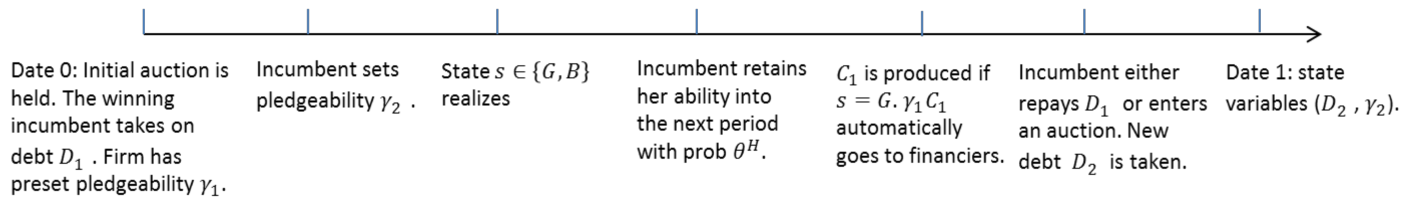

Figure 2: Timing and Decisions in Period 1

II. Solving the Model

We start this section with a simple example with exogenous debt due at date 1 to illustrate the main trade-off in this model, before we embark on the formal analysis. We will show that increased pledgeability is sometimes not needed because of plentiful industry liquidity, but when it is needed, the incumbent has to be appropriately incentivized. We start with three examples where, to keep matters simple, the ex-post aggregate state is certain. They will motivate the tradeoffs present when there is uncertainty about the state.

A. An Illustrative Example

Let the parameters for this subsection be:

$$\theta^H = 0.7,\ \overline{\gamma} = 0.6,\ \underline{\gamma} = 0.3,\ C_1 = C_2 = 1,\ \omega_1^{I,G} = 0.4,\ \omega_1^{I,B} = 0,\ \omega_1^{H,B} = 0.1,\ \varepsilon \to 0,\ \gamma_1 = \overline{\gamma}\ .$$

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

With q^G =1, the good state G will happen for sure. The incumbent will pay the pledged cash flow $\gamma_1 C_1 = 0.6$, leaving 0.9 remaining to be paid. If the incumbent sets date-2 pledgeability γ_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 $\underline{\gamma} C_2$ =0.3 at date 1 (no lender will lend her more since the asset is worthless at the end of that period and the incumbent cannot be forced to repay more than the pledged cash flow). Since this is less than the remaining amount owed, she will precipitate the auction.

In any possible date 1 auction, industry insiders have personal wealth $\omega_1^{H,G}$ =0.8 and can borrow at least $\underline{\gamma}C_2$ =0.3. Therefore, they have funds amounting to $\omega_1^{H,G} + \underline{\gamma}C_2$ =1.1 which exceeds the full date-1 value of the asset C_2 =1. No one will bid more than 1, so higher pledgeability has no effect on the auction price (since industry insiders have enough funding with even low asset pledgeability to pay full price). The period-1 incumbent has no ability to match the auction price if she chooses $\gamma_2 = \underline{\gamma}$. She incurs a cost ε if she sets $\gamma_2 = \overline{\gamma} = 0.6$, after which she will be able to raise enough, which together with her own wealth, will allow her to match auction bid. However, since the industry insider bids the full value of expected cash flows, holding on to the firm does not benefit the incumbent regardless of whether she retains or loses ability. So she chooses low pledgeability, the firm is sold to industry insiders 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 wealth coming in to date 1 of 0.4.

Higher pledgeability is not needed (and has no effect auction bids) because there is ample liquidity. For this reason, the incumbent's wealth doesn't really matter when liquidity is ample. To see this, suppose the incumbent has more wealth than industry insiders (e.g. $\omega_1^{I,G}$ =0.9), she still sets low pledgeability. She can retain control of the firm by paying 0.9 to the lender and receives C_2 =1 in the next period. Selling the firm after setting low pledgeability brings the same payoff to her.

Case 2: $\omega_1^{H,G}$ =0.2, D_1 =1.2, and q^G =1

When industry liquidity in state G is much lower, such that $\omega_1^{H,G}$ =0.2, industry insiders can bid at most 0.2+$\gamma_2 C_2$, whereas the incumbent can always bid more: 0.4+$\gamma_2 C_2$. After paying $\gamma_1 C_1 = 0.6$, the incumbent owes 0.6 more. Assume 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. However, industry insiders will bid only 0.5 for the asset if she chose low pledgeability, in which case she can default strategically and lower the additional repayment to debt from 0.6 to 0.5, even while outbidding others marginally in the auction and retaining control of the asset. If she chose high pledgeability, industry insiders 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 the lender 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 insiders will bid does not cover the outstanding amount owed, and the lender takes 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, would prefer setting pledgeability high given its small cost, ε.

Clearly then, the benefit of setting pledgeability high depends on the probability of her being a buyer (that is, the probability of retaining ability, which is θ^H) as opposed to being a seller (losing ability). It also depends on what she obtains in each case. 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, D_1=0.8, and q^G=0

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 insiders 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 γ_2. In this case, the incumbent 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 insider 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-ε will incentivize the incumbent to choose high pledgeability. Any D_1 above 0.7-ε implies the incumbent will get less from the sale proceeds, after repaying debt, than the cost ε 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, ε.

The points to take away from these examples are (i) High industry liquidity implies the firm is fully valued by bidders, and there is no incentive 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 insiders. (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. Therefore higher debt uniformly reduces the incentive to increase pledgeability.

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 the key results of the paper.

Assumption 1:

a. $\omega_1^{H,G} \geq \left(1-\underline{\gamma}\right)C_2$

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

Assumption 1a ensures that in state G, industry liquidity is high enough that industry insiders can afford to pay the full price of the asset even if pledgeability is set as low as $\underline{\gamma}$. Assumption 1b ensures there is limited industry liquidity in the bad state B, but the incumbent has more wealth than industry insiders so that she can retain control by outbidding industry insiders 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 (as we will make clear in Section III). In state G, prosperity continues into a *boom*, while in state B, prosperity turns to temporary distress. We now solve the model backwards starting from date 2.

B.1 Date 2

Because there is a single state in period 2, and the economy ends after that, both the high type industry insider as well as the incumbent who retains ability can only commit to repay $D_2 = \gamma_2 C_2$ in period 2, where γ_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.

B.2. Date 1

We now turn to payments at date 1 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 $\gamma_1 C_1$ directly goes to the financier (up to the value of the promised claim D_1) where γ_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 $\gamma_1 C_1 < D_1$,[4] 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 industry insiders in the date-1 auction. That is, she pays $\min\left\{\widehat{D}_1^{s_1}, B_1^{H,s_1}(\gamma_2)\right\}$ to retain control. Next, we show that the bids by industry insiders are directly affected by the incumbent through her setting pledgeability γ_2.

Industry Insider Bid

Industry insiders bid using their date 1 wealth, ω_1^{H,s_1}, and any amount that can be borrowed at date 1 against pledged period 2 output ($\gamma_2 C_2$). Therefore, the total amount that they each can pay is $\omega_1^{H,s_1} + \gamma_2 C_2$. Of course, they will not bid more than the total value of cash flow, C_2. So the maximum auction bid at date 1 is $B_1^{H,s_1}(\gamma_2) = Min\left[\omega_1^{H,s_1} + \gamma_2 C_2, C_2\right]$.

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[4] $\widehat{D}_1^G = 0$ 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.

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

Incumbent Bid

The cash that the incumbent has at date 1 is ω_1^{I,s_1} in period 1 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 $B_1^{I,s_1}\left(\gamma_2\right) = \min\left\{\omega_1^{I,s_1} + \gamma_2 C_2, C_2\right\}$ to the financier. Comparing $B_1^{I,s_1}\left(\gamma_2\right)$ and $B_1^{H,s_1}\left(\gamma_2\right)$, we see that the incumbent will outbid industry insiders 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 $B_1^{H,s_1}\left(\gamma_2\right)$. 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 insiders. Regardless of whether she holds on or is outbid, the financier's threat of seizing and auctioning assets allows him to extract a payment of $\min\left\{\widehat{D}_1^{s_1}, B_1^{H,s_1}\left(\gamma_2\right)\right\}$ in addition to the pledgeable portion $\gamma_1 C_1$, which clearly is dependent on the pledgeability set in the past.

Pledgeability Choice

Let us now see how this affects pledgeability choice. Let $V_1^{I,s_1}\left(\widehat{D}_1^{s_1}, \gamma_2\right)$ be the incumbent's payoff when she chooses γ_2, given the remaining required payment $\widehat{D}_1^{s_1}$. The incumbent's benefit from choosing high versus low pledgeability if state s_1 is known to be realized for sure, when the remaining payment owed is $\widehat{D}_1^{s_1}$, is $\Delta_1^{s_1}\left(\widehat{D}_1^{s_1}\right) = V_1^{I,s_1}\left(\widehat{D}_1^{s_1}, \overline{\gamma}\right) - V_1^{I,s_1}\left(\widehat{D}_1^{s_1}, \underline{\gamma}\right)$. 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 $q^G \Delta_1^G\left(D_1 - \gamma_1 C_1\right) + (1-q^G)\Delta_1^B\left(D_1\right) \geq 0$. Below, we solve for $\Delta_1^G\left(\widehat{D}_1^G\right)$ and $\Delta_1^B\left(\widehat{D}_1^B\right)$ separately.

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

Assumption 1a guarantees $B_1^{H,G}(\underline{\gamma})=\min\left\{\omega_1^{H,G}+\underline{\gamma}C_2,C_2\right\}=C_2$. In this case, industry liquidity is sufficiently high that high-ability insiders 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 ε. 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 pledgeability.

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

$V_1^{I,G}(\widehat{D}_1^G,\overline{\gamma})=C_2-\widehat{D}_1^G-\varepsilon$ if $\gamma_2=\overline{\gamma}$, and $V_1^{I,G}(\widehat{D}_1^G,\underline{\gamma})=C_2-\widehat{D}_1^G$ if $\gamma_2=\underline{\gamma}$. Therefore $\Delta_1^G\left(\widehat{D}_1^G\right)\equiv-\varepsilon$ for any $\widehat{D}_1^G$.

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

Assumption 1b suggests industry liquidity in state B is limited so that the firm is *potentially underpriced* and, therefore, there are potential rents to high-ability insiders in the auction. Moreover, since $\omega_1^{I,B}\ge\omega_1^{H,B}$, the incumbent who retains ability can outbid the industry insider regardless of her choice of pledgeability. In this case, she chooses $\gamma_2=\overline{\gamma}$ iff

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

The left hand side is the incumbent's continuation value if she chooses $\gamma_2=\overline{\gamma}$, while the right hand side is if she chooses $\gamma_2=\underline{\gamma}$. The first term on each side of (1) is the residual amount the incumbent expects if she remains a high type in period 2. She gets the output C_2 but repays $\min\left\{\widehat{D}_1^B,B_1^{H,B}(\gamma_2)\right\}=\min\left\{\widehat{D}_1^B,\omega_1^{H,B}+\gamma_2C_2,C_2\right\}$. The second term on each side is the expected residual amount if she loses her ability and has to auction the firm at date 1. In this case, she sells the firm at $B_1^{H,B}(\gamma_2)$ and uses the proceeds from the auction to first pay off the remaining payment. Note that a higher γ_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 γ_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 reduces the incumbent's incentive to choose higher γ_2 because 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. It is easily checked from (1) that the maximum level of promised remaining payment $\widehat{D}_1^{B,Max}$ that still gives her an incentive to choose $\gamma_2 = \overline{\gamma}$ is $D_1^{B,\text{PayIC}} = \theta^H B_1^{H,B}(\underline{\gamma}) + (1-\theta^H) B_1^{H,B}(\overline{\gamma}) - \varepsilon$, where superscript "PayIC" indicates the remaining payment is incentive compatible. Note that it is easier to incentivize the incumbent, and thus support higher remaining payment, when the probability she loses skills $(1-\theta^H)$ is higher, for this enhances the likelihood of sale. It follows from the discussion that

<u>Lemma 2.2:</u> Under Assumption 1b and given the remaining payment $\widehat{D}_1^B \le C_2$, the incumbent expects

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

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

It follows that

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

$\Delta_1^B\left(\widehat{D}_1^B\right) \ge 0$ if and only if $\widehat{D}_1^B \le D_1^{B,\text{PayIC}} = \theta^H B_1^{H,B}(\underline{\gamma}) + (1-\theta^H) B_1^{H,B}(\overline{\gamma}) - \varepsilon$.

In Figure 3, we plot $\Delta_1^B\left(\widehat{D}_1^B\right)$ against $\widehat{D}_1^B$. Note that $\Delta_1^B\left(\widehat{D}_1^B\right)$ is strictly positive for values of $\widehat{D}_1^B$ below $\widehat{D}_1^B = D_1^{B,\text{PayIC}}$, zero at $\widehat{D}_1^B = D_1^{B,\text{PayIC}}$, and negative for higher values of $\widehat{D}_1^B$. Higher committed remaining payments depress the incentive to increase pledgeability.

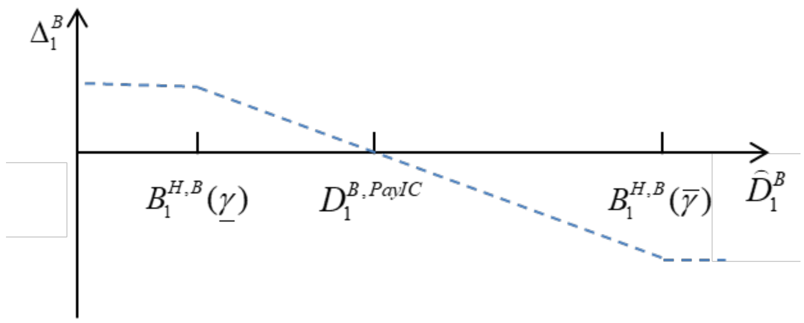

Figure 3 $\Delta_1^B\left(\widehat{D}_1^B\right)$ **as a function of** $\widehat{D}_1^B$

Given $\Delta_1^G\left(\widehat{D}_1^G\right)$ and $\Delta_1^B\left(\widehat{D}_1^B\right)$, 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 $q^G\Delta_1^G\left(D_1-\gamma_1C_1\right)+(1-q^G)\Delta_1^B\left(D_1\right)\geq 0$. Since there is never any incentive to increase pledgeability coming from the future liquid state G, i.e. $\Delta_1^G\left(\widehat{D}_1^G\right)\equiv-\varepsilon\approx 0$ for any $\widehat{D}_1^G$, the constraint really 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 $\varepsilon\to 0$, $D_1^{IC}\to D_1^{B,PayIC}$.

Proof: Directly follows Lemma 2.1 and 2.2.

Note that $D_1^{B,PayIC}$, the maximum remaining payment which still provides incentives for high pledgeability in state B is well below $\gamma_1C_1+C_2$, 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 pay $B_1^{H,G}(\underline{\gamma})+\gamma_1C_1=C_2+\gamma_1C_1$ in state G even if pledgeability is set low. However, to incentivize high pledgeability, the promised payment cannot exceed $D_1^{IC}=D_1^{B,PayIC}$, which falls below $C_2+\gamma_1C_1$. If the difference between $C_2+\gamma_1C_1$ 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 $D_1=C_2+\gamma_1C_1$. The broader point is that the prospect of highly liquid future states not only makes feasible greater promised payments, but these payments also eliminate incentives to enhance pledgeability that might emanate from other states. To restore those incentives, keeping in mind the other states, 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 ε of enhancing pledgeability is infinitesimal. Proposition 2.2 states the results.

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

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

b. If $q^G\left(C_2+\gamma_1 C_1\right)+(1-q^G)B_1^{H,B}(\underline{\gamma}) \le D_1^{B,PayIC}$, then $D_1^{Max}=D_1^{IC}=D_1^{B,PayIC}$. For any promised payment $D_1 \le D_1^{Max}$, $\gamma_2=\overline{\gamma}$.

Interestingly, debt will not be renegotiated before, or after, the state is realized, even if renegotiation is feasible – it will not be renegotiated before because the level of debt is set to raise the maximal amount possible even if it results in low pledgeability, and will not be renegotiated after because relevant parties will not write down their claims given that pledgeability has already been set. 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 almost identical to those in this section.

B.3. Discussion: The Liquidity Leverage Pledgeability Nexus

We have exposited the first important result in the paper. If prosperity is likely to continue, liquidity is high and supports 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 negligible and the probability of a distress 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 bid 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 outcomes in less liquid realized states, as we shall see. Indeed, as we will see later, 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.

B.4. Low-ability Incumbent Manager

The analysis so far has assumed a high-ability incumbent manager was in place at date 0. Now consider a low-ability manager (or equivalently a financier) in place 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 ($\gamma_2 = \overline{\gamma}$) 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 $B_1^{H,B}\left(\overline{\gamma}\right)$ in state B.

<u>Proposition 2.3</u> If a low-ability manager is the incumbent at date 0 and if $\varepsilon \to 0$, then $D_1^{Max} = C_2$. For any $D_1 \le D_1^{Max}$, $\gamma_2 = \overline{\gamma}$.

B.5. 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. Proposition 2.2 shows clearly that a high-ability manager can borrow up to $\max\left\{q^G\left(C_2+\gamma_1 C_1\right)+(1-q^G)B_1^{H,B}(\underline{\gamma}), D_1^{B,PayIC}\right\}$. Together with cash ω_0^H, a high-ability manager bids $B_0^H\left(\gamma_1\right)=\omega_0^H+\max\left\{q^G\left(C_2+\gamma_1 C_1\right)+(1-q^G)B_1^{H,B}(\underline{\gamma}), D_1^{B,PayIC}\right\}$. We assumed that ω_0^H is sufficiently small so that $B_0^H\left(\overline{\gamma}\right)$ is always less than $q^G C_1 + C_2$, the full expected value of the asset. As a result, a high-ability manager always gets rents upon acquiring control. In other words, she is constrained by the amount of liquidity she has and will always fully lever up at date 0.

A low-ability manager can borrow up to $q^G C_2 + \left(1-q^G\right)B_1^{H,B}\left(\overline{\gamma}\right)$. 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 $B_0^H\left(\gamma_1\right)$ and B_0^L shows that a low-ability bidder may win the initial auction when ω_0^H is low, q^G is low, γ_1 is low, and θ^H is high. Intuitively, in these cases, a high-ability manager's moral hazard in setting pledgeability restricts the amount she can borrow at date 0 very much. As a result, she cannot outbid low-ability managers if her own liquidity is low. Note that it is precisely because she has ability 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. We conclude this case with a numerical example.

B.6. Example

q^G =0.9, θ^H =0.7, $\overline{\gamma}$ =0.6, $\underline{\gamma}$ =0.3, $C_1 = C_2$ =1, $\omega_1^{I,G}$ =0.4, $\omega_1^{I,B}$ =0.2, $\omega_1^{H,G}$ =0.8, $\omega_1^{H,B}$ =0.1, ω_0^H =0.1, $\varepsilon \to 0$, $\gamma_1 = \overline{\gamma}$.

Simple calculation shows $B_1^{H,G}\left(\overline{\gamma}\right) = B_1^{H,G}\left(\underline{\gamma}\right) = C_2$ =1. Therefore, there is no potential underpricing in state G. In state B, $B_1^{I,B}\left(\overline{\gamma}\right)$=0.8> $B_1^{H,B}\left(\overline{\gamma}\right)$=0.7 and $B_1^{I,B}\left(\underline{\gamma}\right)$=0.5> $B_1^{H,B}\left(\underline{\gamma}\right)$ =0.4 imply that the incumbent can always retain control. Moreover, $D_1^{B,PayIC} = \theta^H B_1^{H,B}\left(\underline{\gamma}\right) + \left(1-\theta^H\right) B_1^{H,B}\left(\overline{\gamma}\right)$=0.49. At date 0, if the incumbent promises $D_1 = \gamma_1 C_1 + B_1^{H,G}\left(\underline{\gamma}\right)$ =1.6, she can borrow up to $q^G\left(\gamma_1 C_1 + C_2\right) + \left(1-q^G\right) B_1^{H,B}\left(\underline{\gamma}\right)$=1.48. If she promises $D_1^{IC} = D_1^{B,PayIC}$ =0.49, she can only borrow up to 0.49. Obviously, she chooses D_1 =1.6 and subsequently chooses low pledgeability $\gamma_2 = \underline{\gamma}$.

If the incumbent for period 1 has low ability, he can set face value at $D_1 = C_2$ =1, borrow up to $q^G C_2 + \left(1-q^G\right) B_1^{H,B}\left(\overline{\gamma}\right)$=0.97. In this case, a high-ability insider wins the initial auction since she can bid up to 1.58, which is the sum of her personal wealth, ω_0^H =0.1, and the amount she can borrow, 1.48.

Next, we change three parameters to $\gamma_1 = \underline{\gamma}$, q^G =0.2, and ω_0^H =0. In other words, the pledgeability for period 1 is preset as low, the probability of the good state is low, and industry liquidity is also low at date 0. In this case, a low type will win the initial auction and acquire the asset. To see this, if a high-ability promises D_1 =1.6, she can borrow up to $q^G\left(\gamma_1 C_1 + C_2\right) + \left(1-q^G\right) B_1^{H,B}\left(\underline{\gamma}\right)$=0.58, which is still higher than D_1^{IC} =0.49, the amount she can borrow by promising D_1 =0.49. On the other hand, by setting face value at D_1 =1, a low type can borrow up to $q^G C_2 + \left(1-q^G\right) B_1^{H,B}\left(\overline{\gamma}\right)$=0.76. Clearly, a low type wins the initial auction and acquires the firm. The pre-set low pledgeability γ_1, low-probability of expected boom q^G , and low industry liquidity ω_0^H all contribute to this asset misallocation.

C. Case 2: The Industry After a Period of Distress

In this subsection, we analyze the model when Assumption 1 is violated. Instead of assuming state G and B follow a period of prosperity, we assume they follow a period of distress, and there is less liquidity all round. We make the following parametric assumptions.

Assumption 2:

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

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

We assume in 2a that in state G, the incumbent always retains control by outbidding industry insiders. This assumption is identical to Assumption 1b, except that it now applies to the good state G. More generally, the idea is that when good states follow bad ones or bad states follow good ones, industry liquidity is moderate, and the incumbent, with at least one period of strong production, has more liquidity than industry insiders.

We assume in 2b that in the bad state B, the incumbent cannot outbid industry insiders and therefore loses control if she enters the auction. The notion here is a bad state has followed a bad state, and incumbents are in more distress in this bust than are industry insiders.

The analysis for date 2 is unchanged: both high-ability industry insiders and the high ability incumbent can repay up to $D_2 = \gamma_2 C_2$ and thus can borrow $\gamma_2 C_2$ at date 1. Next, we turn to the payments at date 1 and the decisions made over period 1.

Recall that $\Delta_1^{s_1}\left(\widehat{D}_1^{s_1}\right)$ is the net benefit from choosing high versus low pledgeability when the remaining payment is $\widehat{D}_1^{s_1}$, if state s_1 is known to be realized for sure (q^G =1 or 0). Since the incumbent retains control under Assumption 2a, $\Delta_1^{G}\left(\widehat{D}_1^{G}\right)$ is identical to that described in Lemma 2.2 except that the B superscripts there should be changed to G. Next, we describe $\Delta_1^{B}\left(\widehat{D}_1^{B}\right)$. Under Assumption 2b, $B_1^{H,B}(\underline{\gamma}) > B_1^{I,B}(\underline{\gamma})$, and the industry insider can always outbid the incumbent no matter what level the pledgeability is set at.[5] By setting remaining payments at or below $\widehat{D}_1^{B,Max} = B_1^{H,B}(\overline{\gamma}) - \varepsilon$, the incumbent

[5] Strictly speaking, there is one more case because we break ties in favor of the incumbent. If $C_2 = B_1^{H,B}(\overline{\gamma}) = B_1^{I,B}(\overline{\gamma})$ and $B_1^{H,B}(\underline{\gamma}) > B_1^{I,B}(\underline{\gamma})$, the incumbent retains control if she chooses high

is incentivized to set next period's pledgeability at $\bar{\gamma}$. She recoups the cost ε of setting pledgeability high because the promised payment is at least ε below the auction bid. It is easy to check that the incumbent's payoff would not increase if she set pledgeability lower. Lemma 2.3 formalizes the results.

<u>Lemma 2.3:</u> Under Assumption 2b, $\Delta^B\left(\hat{D}_1^B\right)=0$ if $\hat{D}_1^B = B_1^{H,B}(\bar{\gamma})-\varepsilon$. Moreover, $\Delta^B\left(\hat{D}_1^B\right)\geq -\varepsilon$

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

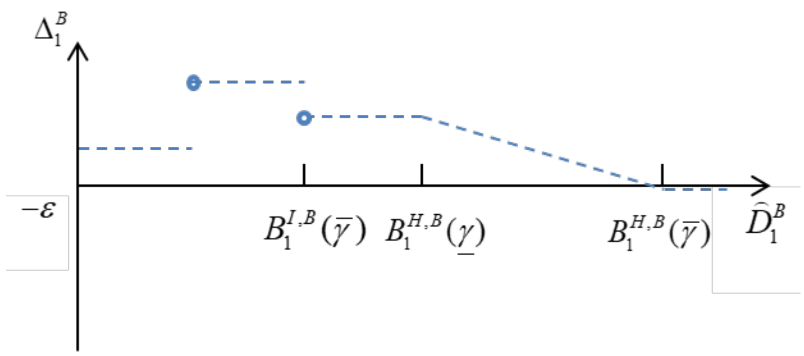

Figure 4 $\Delta_1^B\left(\hat{D}_1^B\right)$ **as a function of** $\hat{D}_1^B$

In Figure 4, we plot the function $\Delta_1^B\left(\hat{D}_1^B\right)$ against $\hat{D}_1^B$ if $B_1^{H,B}\left(\underline{\gamma}\right)\geq B_1^{I,B}\left(\bar{\gamma}\right)$. Importantly, $\Delta_1^B\left(\hat{D}_1^B\right)>0$ for all levels of debt below $B_1^{H,B}\left(\bar{\gamma}\right)-\varepsilon$, and even if debt is higher, $\Delta_1^B\left(\hat{D}_1^B\right)\geq -\varepsilon$, 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 $\hat{D}_1^B$—above the most the asset could be sold for, the only disadvantage of choosing high pledgeability is its cost, ε. The more general point is lower incumbent liquidity relative to

pledgeability and continues to be a high type, because she is able to pay the full value of the asset C_2, and insiders 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.

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 $q^G \Delta_1^G\left(D_1 - \gamma_1 C_1\right) + (1-q^G)\Delta_1^B\left(D_1\right) \geq 0$. In state B, as we see above, $\Delta_1^B\left(\widehat{D}_1^B\right) \geq -\varepsilon$ for any $\widehat{D}_1^B$. Therefore, the incentive constraint really depends only on the incumbent's incentive stemming from state G (provided she recovers cost $\varepsilon \to 0$). The incumbent has ex-ante incentives to increase pledgeability whenever there are incentives in state G (i.e., whenever $\Delta_1^G\left(\widehat{D}_1\right) \geq 0$).[6] We have

Proposition 2.4: Under Assumption 2 and with $\varepsilon \to 0$, 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 $D_1^{IC} \to \gamma_1 C_1 + D_1^{G,PayIC}$.

Finally, in contrast to the case in subsection 2B, D_1^{IC} is indeed the face value that enables the incumbent to raise the most at date 0. Any D_1 above D_1^{IC} will induce low pledgeability, and the incumbent can commit to pay strictly less in both state G and 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 2.5: Under Assumption 2, the face value that enables the incumbent to raise the maximal amount at date 0 is $D_1^{Max} = D_1^{IC} = \gamma_1 C_1 + D_1^{G,PayIC}$. For any promised payment $D_1 \leq D_1^{Max}$, $\gamma_2 = \overline{\gamma}$.

C.1. Example

q^G =0.1, θ^H =0.7, $\overline{\gamma}$ =0.6, $\underline{\gamma}$ =0.3, $C_1 = C_2$ =1, $\omega_1^{I,G}$ =0.4, $\omega_1^{I,B}$ =0, $\omega_1^{H,G}$ =0.3, $\omega_1^{H,B}$ =0.1, ω_0^H =0.1, $\varepsilon \to 0$, $\gamma_1 = \overline{\gamma}$.

Simple calculation shows $B_1^{I,G}\left(\overline{\gamma}\right)$=1>0.9=$B_1^{H,G}\left(\overline{\gamma}\right)$ and $B_1^{I,G}\left(\underline{\gamma}\right)$=0.7>0.6=$B_1^{H,G}\left(\underline{\gamma}\right)$. Therefore, the incumbent can always retain control in state G. Moreover, $D_1^{G,PayIC} = \theta^H B_1^{H,G}\left(\underline{\gamma}\right) + \left(1-\theta^H\right) B_1^{H,G}\left(\overline{\gamma}\right)$ =0.69. In state B, $B_1^{I,B}\left(\overline{\gamma}\right)$ =0.6< $B_1^{H,B}\left(\overline{\gamma}\right)$ =0.7 and

[6] We implicitly assume that $\gamma_1 C_1 + D_1^{G,PayIC} > B_1^{H,B}\left(\overline{\gamma}\right)$. Since $\omega_1^{H,G} > \omega_1^{H,B}$, this condition is automatically satisfied if $\gamma_1 = \overline{\gamma}$ and $C_1 = C_2$.

$B_1^{I,B}\left(\underline{\gamma}\right)$=0.3< $B_1^{H,B}\left(\underline{\gamma}\right)$ =0.4 imply that the incumbent loses control for sure once she enters an auction, no matter what pledgeability she chooses. Thus, $D_1^{IC} = \gamma_1 C_1 + D_1^{G,PayIC}$ =1.29. At date 0, if the incumbent promises $D_1 = D_1^{IC}$ =1.29, she can borrow up to $q^G\left(\gamma_1 C_1 + D_1^{G,PayIC}\right) + \left(1-q^G\right)B_1^{H,B}\left(\overline{\gamma}\right)$=0.759. Any $D_1 > D_1^{IC}$ will induce the incumbent to choose $\gamma_2 = \underline{\gamma}$ in which case she can borrow less since she can commit to repay less in both G and B.

If the incumbent for period 1 is low-ability and $\varepsilon \to 0$, he can set face value at $D_1 = B_1^{H,G}\left(\overline{\gamma}\right)$ =0.9, borrow up to $q^G B_1^{H,G}\left(\overline{\gamma}\right) + \left(1-q^G\right)B_1^{H,B}\left(\overline{\gamma}\right)$=0.1*0.9+0.9*0.7=0.72. In this case, a high-ability industry insider wins the initial auction since she can bid up to 0.859, which is the sum of her personal wealth ω_0^H =0.1 and the amount she can borrow 0.759.

C.2. Discussion

Subsection 2B (Case 1) and 2C (Case 2) have covered all the possible state-specific situations that could arise. In Case 1, the winning date-0 bidder anticipates plentiful industry liquidity ($\omega_1^{H,G}$ high) and chooses high leverage. In Case 2, the winning bidder anticipates lower liquidity. A choice of low pledgeability would significantly reduce the amount financiers expect to recover. Therefore, the competitive financial market will prevent "excessive" leverage (in terms of its effect on pledgeability) in times of lower liquidity because it wants incumbents to retain incentives to set high pledgeability.

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 insiders will outbid her using the firm's enhanced borrowing capacity). In state B of this case, the incumbent has lower personal liquidity, so she knows she cannot outbid industry insiders, 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. As we will make clear in Section III.C where the ex-post state is certain, maximum payment consistent with an incentive to raise pledgeability is monotonically increasing in industry liquidity, until underpricing is eliminated in that state (or is reduced below the cost, ε), removing any incentive to raise pledgeability. The maximum incentive-compatible leverage is not, however, increasing in incumbent liquidity.

III. Dynamics and Robustness

In subsection 3A, we add one more period before date 0, both to show how we arrived at the initial states in Case 1 and Case 2 described in the previous section, and to describe some interesting dynamic effects. In particular, we will show how high industry liquidity leads to low pledgeability choice γ_1 and results in the asset being acquired by a low-ability manager on date 0. In subsection 3B, we discuss the robustness of the basic model. In subsection 3C, we analyze the results when the aggregate state is also contractible.

A. Dynamic Effects

In subsection 2B, we showed how a low-ability manager may win the auction on date 1 when γ_1 is low. In this subsection, we endogenize the choice of initial pledgeability, γ_1, and also show how the asset can be acquired at date 0 by low ability managers if the state in period 0 is B. State $s_0 \in \{G, B\}$ is realized at the beginning of this period. For consistency, the firm is now assumed to be auctioned to the highest bidder at date -1, with the rest of the time line similar to that in period 1. Figure 5 below shows the states of nature with this additional period, with Case 1 in section 2B reflecting developments from the upper date-0 node, and Case 2 in section 2C reflecting developments from the lower date-0 node.

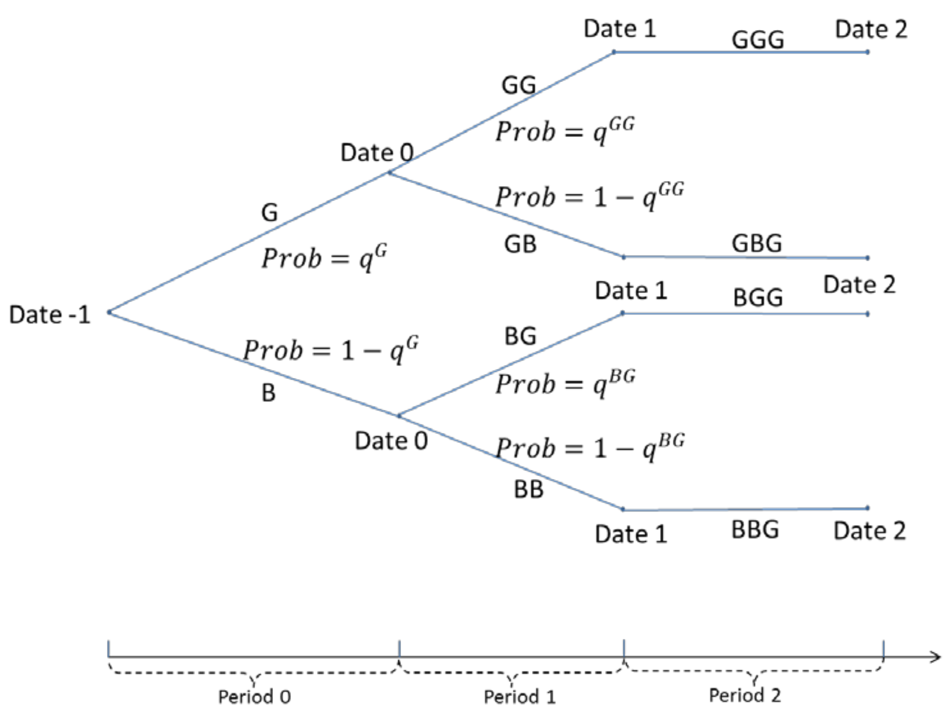

Figure 5 States of Nature in the Dynamic Model

Let $B_0^{H,s_0}(\gamma_1)$ and $B_0^{I,s_0}(\gamma_1)$ respectively be the bids by industry insiders and the period-0 incumbent at date 0,[7] and let B_0^{L,s_0} be the bids by low-ability managers at date 0. In addition, we define $B_0^{s_0,\min} = \max\{B_0^{L,s_0}, B_0^{H,s_0}(\underline{\gamma})\}$ be the minimum bid the incumbent will face in the date-0 auction, and $B_0^{s_0,\max} = \max\{B_0^{L,s_0}, B_0^{H,s_0}(\overline{\gamma})\}$ be the maximum bid the incumbent will face. Similar to date 1, we can define D_0^{IC} such that $q^G\Delta^G\left(D_0^{IC} - \gamma_0 C_0\right) + \left(1 - q^G\right)\Delta^B\left(D_0^{IC}\right) = 0$. We proceed with the following parametric assumptions:

Assumption 3:

- **a.** $B_0^{G,\max} = B_0^{G,\min} = q^{GG}C_1 + C_2$
- **b.** $B_0^{B,\max} > B_0^{B,\min}$ and $B_0^{I,B}(\underline{\gamma}) < B_0^{B,\min}(\underline{\gamma})$
- **c.** $B_0^{H,B}(\overline{\gamma}) > B_0^{L,B} > B_0^{H,B}(\underline{\gamma})$

Assumption 3a is the date 0 counterpart to Assumption 1a, which says industry liquidity at date 0 is sufficiently high in state G such that the asset is sold at full price $q^{GG}C_1 + C_2$. Assumption 3b corresponds to Assumption 2b: the incumbent cannot outbid in the B state and therefore loses control if she enters the auction.

We assume in 3c that in state B, high-ability types can outbid low-ability types only if high pledgeability is set for period 1. If low pledgeability is set, however, they lose the auction, and an incumbent who has lost her ability has to sell the firm to a low type.

Under Assumption 3a, pledgeability γ_1 is not needed so that $\Delta^G\left(D_0\right) \equiv -\varepsilon$ for any D_0. Under Assumption 3b, the downside of increasing pledgeability for an incumbent is, at worst, its cost ε so that $\Delta^B\left(D_0\right) \geq -\varepsilon$. Therefore,

Proposition 3.1

Under Assumption 3, $D_0^{IC} \to B_0^{H,B}\left(\overline{\gamma}\right)$ as $\varepsilon \to 0$.

The three-period model allows us to explain the rationales for the earlier two cases, which followed different branches of the tree after the initial period 0, which we now examine.

Proposition 3.2

[7] Detailed expressions for these bids can be found in Appendix B.

Under Assumption 3, let D_0^{Max} be the face value of the debt that enables the incumbent to raise the most at date -1.

a. If $q^G\left(q^{GG}C_1+C_2+\gamma_0 C_0\right)+(1-q^G)B_0^{L,B}\geq B_0^{H,B}\left(\overline{\gamma}\right)$, then $D_0^{Max}=q^{GG}C_1+C_2+\gamma_0 C_0$. For any promised payment $B_0^{H,B}\left(\overline{\gamma}\right)<D_0\leq D_0^{Max}$, $\gamma_1=\underline{\gamma}$.

b. If $q^G\left(q^{GG}C_1+C_2+\gamma_0 C_0\right)+(1-q^G)B_0^{L,B}<B_0^{H,B}\left(\overline{\gamma}\right)$, then $D_0^{Max}=D_0^{IC}=B_0^{H,B}\left(\overline{\gamma}\right)$. For any promised payment $D_0\leq D_0^{Max}$, $\gamma_1=\overline{\gamma}$.

For sufficiently high probability of state G in period 0, and sufficiently high liquidity in state G, the incumbent will set date-0 debt high enough that she chooses low pledgeability for period 1. If the realized state is G, she repays everything. If the state turns out to be B, she is forced to sell the asset and the preset low pledgeability, $\gamma_1=\underline{\gamma}$, restricts the amount at which she can sell to industry insiders. This forces a sale to financiers for $B_0^{L,B}$. If she had set pledgeability γ_1 higher, she would have sold to an industry insider. Typically, this sale in adverse circumstances will also mean that outstanding debt is not fully honored and has to be written down.

Since high-ability insiders could outbid low-ability outsiders if γ_1 were set high, a natural question is whether policymakers can improve the outcome by imposing limits on the amount of leverage that the firm is allowed to take. Suppose they require that D_0 cannot exceed $D_0^{IC}=D_0^{B,PayIC}$, in which case the incumbent will voluntarily set γ_1 to be high. While this avoids asset misallocation when state B is realized in period 0 and the period-0 incumbent has lost her ability, it also reduces the amount that the bidder can borrow upfront at date -1. In the current setup when the asset is already in place, such a policy only reduces the proceeds that can be collected from the date -1 auction (though it could also potentially allow industry outsiders to win). If instead we put a minimum amount of investment required to be assembled into the firm, then the restriction on leverage can lead to ex-ante underinvestment. Thus, in this altered set up, policymakers would face a trade-off between ex-ante versus ex-post efficiency.

A.1. Discussion

The additional misallocation in industry distress stems wholly from the anticipated high liquidity in prosperity and the high probability of that state, which causes the incumbent to both promise high debt payments for date 0, and induces her to choose low pledgeability in period 0. When the expected prosperity fails to materialize, the asset may go to outsiders who can enhance pledgeability even in the face of high debt, since their primary intention is to sell. The production of cash flows is delayed (that is, even if the state in period 1 improves to G, cash flows are not produced) because financial rehabilitation necessarily takes precedence over real rehabilitation.

The preference for leverage in times of high liquidity is particularly high in sectors that have high stability θ^H , where the moral hazard over pledgeability is very high, and the levels of debt that would induce higher pledgeability are very low. In such mature sectors (an alternative interpretation is that these are sectors that require little new financing, as we will see in subsection 3B), the preference in times of high anticipated liquidity is to forego maintaining pledgeability altogether. When liquidity does dry up, these firms find it much harder to finance investment or change, which is why they need to improve governance even as they delever – delevering alone is insufficient.

Outsider control may also be necessary when because of high stability, high-ability incumbents would set period-2 pledgeability low in period 1, even at very low levels of date-1 debt. Outsiders, by contrast, set pledgeability high regardless of the level of debt they face, and therefore can borrow full value against the assets. Such a situation 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.

A.2. Example

In this example, we show that higher anticipated liquidity can induce more misallocation via the increase in debt. In particular, for given parameters, the asset would not be misallocated even with debt contracts *if liquidity in the good state were lower*.

Consider the following parameter values:

$\overline{\gamma}$ =0.6, $\underline{\gamma}$ =0.1, C_0 =0, $C_1 = C_2$ =1, $\omega_0^{H,G}$ =0.6, $\omega_0^{H,B}$ =0.01, $\omega_1^{H,GG}$ =0.9, $\omega_1^{H,GB}$ =0.6, $\omega_1^{H,BG}$ =0.3, $\omega_1^{H,BB}$ =0.1, $\omega_0^{I,G}$ =0.7, $\omega_0^{I,B}$ =0, $\omega_1^{I,GG}$ =0.9, $\omega_1^{I,GB}$ =0.6, $\omega_1^{I,BG}$ =0.6, $\omega_1^{I,BB}$ =0, θ^H =0.7, ε =0, q^G =0.2, q^{GG} =0.5, q^{BG} =0.2, $\gamma_0 = \overline{\gamma}$ =0.6

It is easily checked there is no potential underpricing in state GG. In state GB and BG, a high-type incumbent can retain control of the firm. In state BB, a high-type incumbent cannot outbid industry insiders. These cases are consistent with case 1 in section 2B and case 2 in section 2C. In state G, both $B_0^{H,G}\left(\overline{\gamma}\right)$ and $B_0^{H,G}\left(\underline{\gamma}\right)$ equal $q^{GG}C_1 + C_2$ =1.5 so there is no potential underpricing as well. In state B, $B_0^{H,B}\left(\overline{\gamma}\right)$ =0.8> $B_0^{L,B}$ =0.74> $B_0^{H,B}\left(\underline{\gamma}\right)$ =0.7. Therefore, a low-ability manager can outbid industry insiders if low pledgeability is chosen, i.e., $\gamma_1 = \underline{\gamma}$. Since $q^G\left(\gamma_0 C_0 + q^{GG}C_1 + C_2\right) + \left(1 - q^G\right)B_0^{L,B}$ =0.892> $B_0^{H,B}\left(\overline{\gamma}\right)$ =0.8, date-0 debt is set as high as $\gamma_0 C_0 + q^{GG}C_1 + C_2$ =1.5, and the incumbent sets $\gamma_1 = \underline{\gamma}$ in period 0. If the state B is realized, the asset is sold to an industry outsider who bids $B_0^{L,B}$ =0.74, above what industry insiders can pay $B_0^{H,B}\left(\underline{\gamma}\right)$ =0.7. Such a reallocation could have been avoided if γ_1 had been set at $\overline{\gamma}$ in which case industry insiders can pay $B_0^{H,B}\left(\overline{\gamma}\right)$ =0.8, but that would have required issuing less debt. So debt leads to low pledgeability and greater misallocation.

Suppose now that date-0 industry liquidity in the G state were lower, so $\omega_0^{H,G}$ =0.5. There exists potential underpricing in state G since $B_0^{H,G}\left(\overline{\gamma}\right)$ =1.5> $B_0^{H,G}\left(\underline{\gamma}\right)$ =1.4. Therefore, the incumbent is on Pay IC constraint in state G and cannot retain control in state B. As a result, high pledgeability $\gamma_1 = \overline{\gamma}$ would have be chosen. In this case, the optimal debt is $D_0 = D_0^{IC} = D_0^{G,PayIC}$ =1.43. As a result, the asset is "correctly" allocated to an industry insider if state B is realized. So lower liquidity leads to debt with a lower face value, which in turn leads to higher pledgeability and thus a more productive allocation of control in downturns. More generally, anticipated liquidity operating through greater leverage causes the adverse spillover between states which pushes down pledgeability and causes misallocation.

It is worth noting that the maximum amount of funding that can be raised by the initial winning bidder at date -1 is higher in the second case when the date-0 industry liquidity in the G state is lower. To see this, note when $\omega_0^{H,G}$ =0.6, the initial winning bidder sets debt at $\gamma_0 C_0 + q^{GG} C_1 + C_2$ =1.5 and borrows $q^G\left(\gamma_0 C_0 + q^{GG} C_1 + C_2\right) + \left(1 - q^G\right) B_0^{L,B}$ =0.892. When $\omega_0^{H,G}$ =0.5, however, the initial winning bidder sets debt at $D_0 = D_0^{IC} = D_0^{G,PayIC}$ =1.43 and borrows $q^G\left(\gamma_0 C_0 + D_0^{G,PayIC}\right) + \left(1 - q^G\right) B_0^{H,B}\left(\overline{\gamma}\right)$ =0.926. This comparison shows clearly the tradeoff between ex-ante and ex-post liquidity. When liquidity in one of the future states (state G in this case) is *higher*, the increasing disincentive for the incumbent to choose high pledgeability leads to *lower* funding being raised ex-ante! Importantly, setting debt just slightly lower (say at 1.43, down from 1.5) when liquidity is high will not enhance incentives to raise pledgeability because high liquidity in state G ensures no incentive to enhance pledgeability can emanate from that state, no matter the level of debt. Leverage has to be reduced low enough so that incentives from state B come into play for high pledgeability to be chosen. In sum, high anticipated liquidity can directly and adversely affect pledgeability, and reduce access to current fund raising!

B. Robustness of the basic model

B.1. 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 insiders. 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.

B.2. 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, $[\underline{\gamma}, \overline{\gamma}]$, is computed as the pledgeability she sets for the future, net of the maximum amount the future incumbent can push inherited pledgeability down by.

B.3. 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 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 injection 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. 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 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. [8]

[8] Interestingly, a greater share of the pie is more attractive when increasing the pie through new investment is difficult, so moral hazard over pledgeability increases still further in a downturn. That is, if $(1-\theta^H)$ falls in states of industry distress, we would get some interesting new effects. This is left for future research.

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.

B.4. Long Term Debt Contracts

We have assumed short term debt contracts, which give the lender the maximum ability to embed contingencies, and allow the borrower to raise the maximum. Long term debt (all payments due only at date 2) would not completely undo the need for pledgeability, since the incumbent may have some need to sell at date 1, but would eliminate the need to do so when the incumbent retains ability. This would increase moral hazard over pledgeability. Ex ante competition would then prevent borrowers from issuing long-term claims.

B.5. 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 (whenever there is potential underpricing so that bids would not be for the full value of the firm). 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 overhang effect through excessive fixed payments will not carry over to equity contracts; instead, the disincentive to raise pledgeability will occur if the incumbent retains too small a stake in the firm.

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.

C. 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 insiders 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 ω_1^{I,s_1}, because higher ω_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, θ^H, reduces the maximum feasible payment for similar reasons. Finally, an increase in *industry liquidity* ω_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 insiders 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 is an adverse effect of both liquidity and leverage 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 keeping in mind the high liquidity, 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 releveraging 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 to prevent fire sale prices for assets, but to restore pledgeability. Firms might need to be managed at such times, not to maximize value alone, but also to improve governability, and 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 (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 compensating for low realized cash flows by adjusting discretionary accruals). Of course, 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 which accurately reflect future cash flows. Choice of a high quality auditor is thus a way to increase future pledgeability, because analysts will then not need to adjust down reported earnings. Our model then predicts a cyclical demand for high reliability accounting: in booms that are likely to continue (our state G), market forces will not provide incentives for highly reliable accounting. In normal times with limited industry liquidity (our state B), market forces will provide such incentives.

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 (forthcoming, 2017) finds that bank borrowers are less likely to be required to deliver unqualified financial statements during industry booms in the construction industry. This allows future cash flow pledgeability to be lower. At the end of the industry boom, lenders increase their demand for unqualified audited financial statements.

Consider another suggestive bit of evidence. If the firm chooses a low quality audit, this choice of low reliability accounting could eventually be detected. Our model predicts that more such low reliability accounting will be chosen (and subsequently unearthed) when liquidity was 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 after the onset of the crisis, and started to increase again as central banks around the world maintained extremely liquid conditions in financial markets.

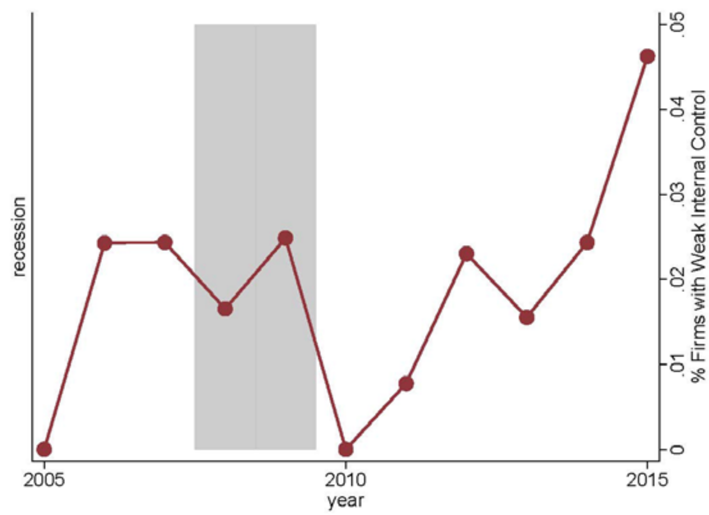

Figure 6 Weakness of Internal Control

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 lack of need for all forms of cash flow pledgeability, given that abundant liquidity makes it easy to raise money.

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.

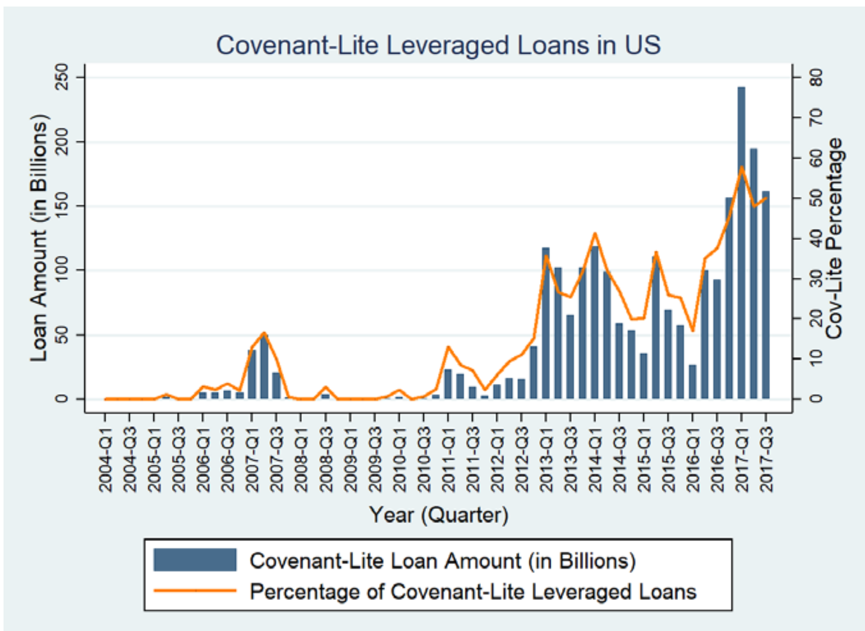

Figure 7 Covenant Lite Loans and as Fraction of Leveraged Loans

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 strong through the cycle, they may prevent large fluctuations in asset pledgeability. By allowing only moderate room to alter pledgeability, a strong institutional environment could lead to more stable credit. However, to the extent that the institutional environment is weak or responds to the cycle (regulators get complacent in good times), asset pledgeability is more endogenous, and credit may vary more over the cycle. Credit booms and busts will be more pronounced in such cases, as will asset price booms and busts.

C. Related Literature

Dow, Gorton, Krishnamurthy (2005), henceforth DGK, present a model where management overinvests cash flow, so good times lead to low productivity investments by incumbent firms. They analyze a model where investors hire costly accountants/monitors 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, ε, 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. [9]

Unlike Holmstrom and Tirole (1997, 1998), pledgeability in our paper is a direct choice variable, referring to instruments 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. If the anticipated boom does not materialize, the entry by lower quality borrowers will lead to larger losses to creditors (and

[9] 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.

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 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.

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* 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 heterogeneous agents. The specific mechanisms are different though. In our setup, pledgeability is essentially a choice by asset holders (incumbent), whereas in his model, pledgeability is always fixed at one. The beliefs of pessimists determine their willingness to lend, for a given amount of collateral. 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, or just increased anticipation of one, optimists lose wealth as well as their ability to borrow. Consequently, the asset migrates to more pessimistic hands and is valued less. Excessive leverage taken in booms, if followed by bad news, leads to excessive deleveraging in bad times, even before/without an actual crash in fundamentals. This constitutes the leverage cycle. The asset price is very high in the initial or overleveraged normal economy, and after deleveraging, the price is even lower than it would have been had there never been the overleveraging 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 rationally accepting the adverse 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

We have focused on two kinds of moral hazard in this paper – moral hazard over appropriation of cash flows and moral hazard over pledgeability choice. In good times, the threat of ownership change is the means of enforcing debt contracts, and plentiful liquidity makes the threat credible. The seeds of distress are sown at such times, because incumbents have no incentive to maintain 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. As bad times hit, financing capacity plunges, and outsiders who have a better ability to take on leverage may outbid insiders. 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 insiders can once again bid large amounts and return to controlling firms. As liquidity among industry insiders increases further, the threat of asset sales once again becomes the source of debt enforcement. The incentive to maintain cash flow pledgeability wanes once again, and the cycle resumes.

Importantly, the change in effective creditor control rights, from cash-flow-based to asset-sale-based, occurs smoothly when economic conditions continue to improve. Incumbents simply neglect to maintain pledgeability since it is not needed to raise financing. However, when boom turns to bust, past neglect of pledgeability and the distortion to incentives caused by debt overhang ensure the transition from asset-sale-based to cash-flow-based enforcement is not smooth. Economic activity can be disrupted until outside capacity to control (and thus finance) is restored. Real investment, which we do not model, could fall significantly under these circumstances, even when it is positive net present value.

Our model suggests why assets that require management (such as mortgages or bank loans, or the securitized claims on such assets) may have different collateral haircuts associated with them over the cycle, unlike passively held assets such as equities. While asset values fall uniformly with the fall in liquidity, the fraction of asset values lenders are willing to lend rises in proportion to both the liquidity of industry insiders (in the upturn) and the restoration of pledgeability (in the downturn), with a possible steep fall as the state of the economy switches from upturn to downturn.

Also, this paper has focused on the choice of pledgeability, assuming that both incumbent and industry insider have access to the same sources of pledgeability. Incumbent pledgeability could be different from the pledgeability industry insiders could utilize – the incumbent may be able to borrow more from relationship banks than can an industry insider who does not know the bankers. The gap between incumbent pledgeability and industry pledgeability may have independent importance over the cycle, and understanding this may be fruitful. Moreover, we can delve deeper into the sources of pledgeability and its dynamics. Institutions that were designed to raise pledgeability 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, $V_1^{I,B}\left(\widehat{D}_1^B,\overline{\gamma}\right)$ and $V_1^{I,B}\left(\widehat{D}_1^B,\underline{\gamma}\right)$ are respectively as follows:

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

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

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

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

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

b. If $B_1^{H,B}\left(\underline{\gamma}\right)\ge B_1^{I,B}\left(\overline{\gamma}\right)$,

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

B. Detailed Expressions for $B_0^{H,s_0}(\gamma_1)$ and $B_0^{I,s_0}(\gamma_1)$

The detailed expressions are:

$$B_0^{H,s_0}(\gamma_1) = \underset{D_1 \le D_1^{s_0,Max}}{Max} \; Min\left[\omega_0^{H,s_0} + q^{s_0 G}\tilde{D}_1^G\left(D_1,\gamma_1\right) + (1-q^{s_0 G})\tilde{D}_1^B\left(D_1,\gamma_1\right), \tilde{C}_1^{H,s_0}(D_1,\gamma_1)\right]$$

$$B_0^{I,s_0}(\gamma_1) = \underset{D_1 \le D_1^{s_0,Max}}{Max} \; Min\left[\omega_0^{I,s_0} + q^{s_0 G}\tilde{D}_1^G\left(D_1,\gamma_1\right) + (1-q^{s_0 G})\tilde{D}_1^B\left(D_1,\gamma_1\right), \tilde{C}_1^{I,s_0}(D_1,\gamma_1)\right].$$ Specifically,

the period-1 incumbent and industry insiders choose a face value $D_1 \le D_1^{s_0,Max}$ to maximize their bid, which is the minimum of the amount of liquidity they can raise and the continuation value of the firm.

Below, we illustrate the expression for $B_0^{H,s_0}(\gamma_1)$ in details. $B_0^{I,s_0}(\gamma_1)$ can be analyzed similarly. The first term within the brackets $\omega_0^{H,s_0} + q^{s_0 G}\tilde{D}_1^G\left(D_1,\gamma_1\right) + (1-q^{s_0 G})\tilde{D}_1^B\left(D_1,\gamma_1\right)$ is the amount of liquidity an industry insider can raise on date 0 by choosing the debt face value as D_1. $\tilde{D}_1^G\left(D_1,\gamma_1\right)$ and $\tilde{D}_1^B\left(D_1,\gamma_1\right)$ are the amount that financiers can recoup from the incumbent on date 1 when the face value is D_1. In particular, for $D_1 > \gamma_1 C_1$, $\tilde{D}_1^G\left(D_1,\gamma_1\right) = \begin{cases} \gamma_1 C_1 + \min\left\{D_1 - \gamma_1 C_1, B_1^{H,G}\left(\bar{\gamma}\right)\right\} & \text{if } D_1 \le D_1^{IC} \\ \gamma_1 C_1 + \min\left\{D_1 - \gamma_1 C_1, B_1^{H,G}\left(\underline{\gamma}\right)\right\} & \text{if } D_1 > D_1^{IC} \end{cases}$

and $\tilde{D}_1^B\left(D_1,\gamma_1\right) = \begin{cases} \min\left\{D_1, B_1^{H,B}\left(\bar{\gamma}\right)\right\} & \text{if } D_1 \le D_1^{IC} \\ \min\left\{D_1, B_1^{H,B}\left(\underline{\gamma}\right)\right\} & \text{if } D_1 > D_1^{IC}. \end{cases}$

The second term $\tilde{C}_1^{H,s_0}(D_1,\gamma_1)$ is the continuation value of the firm if an industry insider acquires it on date 0. It equals $q^{s_0 G}\left[C_1 + \left(D_1 - \gamma_1 C_1\right) + V_1^{I,G}(D_1 - \gamma_1 C_1)\right] + (1-q^{s_0 G})\left[D_1 + V_1^{I,B}(D_1)\right]$, where $V_1^{I,G}$ and $V_1^{I,B}$ are defined in Lemma 2.1, 2.2, and 2.3 in different cases. Note that the superscripts of these value functions are I, since an industry insider who acquires the firm becomes the incumbent in period 1.