Pledgeability, Industry Liquidity, and Financing Cycles

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August 2014

Revised February 11, 2015

Preliminary

Abstract

Why are downturns following episodes of high asset values so detrimental to growth? A traditional explanation is “debt overhang” – the debt built up during the boom serves to restrict borrowing and investment during the bust. But why is the debt not renegotiated? In this paper, we attempt a different explanation of the causes and consequences of debt overhang. In doing so, we also differentiate between the control rights over assets, which are sufficient to enforce external claims only in a boom, and control rights over cash flows that enable the enforcement of external claims in a downturn. It is the change in the relevant control rights that makes it so hard to renegotiate debt efficiently, and causes the debt build up to have long-drawn adverse effects in the downturn.

¹ Diamond and Rajan thank the Center for Research in Security Prices at Chicago Booth and the National Science Foundation for research support. Rajan also thanks the Stigler Center. We are grateful for helpful comments from Alan Morrison and workshop participants at the OXFIT 2014 conference and the Federal Reserve Bank of Richmond.
How do previous market conditions influence a firm’s access to capital today? Why are downturns following episodes of high valuations of firms and their assets so detrimental to growth? One traditional rationale when these prior episodes are periods of high leverage is based on the idea of “debt overhang” – the debt built up during the boom serves to restrict borrowing and investment during the bust. The obvious argument against the debt overhang explanation is that if everyone, including the debt holders, knows that debt is holding back investment, they 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.

One explanation for the optimality of debt overhang is to say that the firm cannot be trusted to take only value enhancing investments, even in a downturn. So debt overhang is needed to constrain the firm’s investment – overhang is a second best solution to a fundamental moral hazard problem (see Hart and Moore (1995)). The immediate question raised by such an analysis is why do we want to constrain firms more in bad times? Why is the moral hazard problem so much more serious in a downturn than in an upturn? Why isn’t debt overhang the tool of choice to constrain corporate mal-investment all the time (and casual empiricism suggests it is not)?

In this paper, we attempt a different explanation of the causes and consequences of debt overhang and its link to high prior values of firms. In doing so, we also 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 that facilitate the enforcement of external claims at other times, including downturns. It is the change in the nature of the control rights that makes it so hard to renegotiate debt efficiently, and causes the debt build up to have long-drawn adverse effects in the downturn.
Let us be more specific. Consider an industry that requires special managerial knowledge. Within the industry, there are incumbents (those who are running firms) and industry insiders (those who know the industry well enough to be able to run firms as efficiently as the incumbents). Industry outsiders (those who don’t really know how to run industry firms but have general managerial/financial skills) are the other agents in the model.

We first examine the effects of financing with fully state-contingent financial contracts, then we turn to standard debt with a constant payment in a given period. Financiers have two sorts of control rights; first, control through the right to repossess and sell the underlying asset being financed if payments are not made 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 to pay a full price for the asset. Greater wealth amongst industry insiders (which we term industry liquidity) increases the availability of this asset-based financing.

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 – for example, by improving accounting standards and transparency, by setting up escrow accounts and monitoring arrangements, by including debt covenants and conditions on dividend payments, or even by standardizing managerial procedures so as to make herself more replaceable as a manager. From the incumbent manager’s perspective, enhancing cash flow pledgeability is a double-edged sword; while it makes it easier for the incumbent to sell the firm when she is no longer fit to run it (because new buyers can borrow against future pledgeable cash flows to finance the acquisition) it makes it easier for existing creditors to collect more when the incumbent stays in control. Low pledgeability also serves to entrench the incumbent, by reducing the ability of outsiders to outbid the incumbent. Thus cash flow pledgeability is subject to moral hazard, which as we shall see, limits the fund raising capacity of the firm. The advantages of high pledgeability for financial capacity have been studied by Holmström and Tirole.
(1998). We examine the tradeoff between the advantages and disadvantages of increased pledgeability for the incumbent.

When markets are buoyant and industry insiders have plenty of cash, repayment is enforced by the high resale value of assets and not by any pledging of cash flows by the incumbent. Industry assets trade for fundamental value (leaving no rents to asset acquirers), as in Shleifer and Vishny (1992). The most efficient users hold the assets because they have enough cash and borrowing capacity up front to buy. This has an important implication: In such an environment of easy sales, incumbents have little reason to maintain cash flow pledgeability.

The high resale value of assets increases the amount of financing that a firm can credibly repay, increasing the potential leverage of the firm. If the firm uses this financing capacity by issuing standard debt, high debt built up during the asset price boom and the neglect of cash flow pledgeability can be counterproductive in a downturn. Industry insiders, also hit by the downturn, no longer have personal wealth to buy assets, nor does the low cash flow pledgeability allow them to borrow against future cash flows to pay for purchases. Asset prices plummet. Faced with large debt claims, incumbents see more value to reducing future pledgeability (so as to further reduce the payout to outside claim holders) than maintaining it.

With debt high, creditors will either agree to renegotiate debt down significantly, or seize assets and sell to industry outsiders. While industry outsiders have little ability to run the asset themselves, this may be a virtue – they have a strong incentive to improve pledgeability while the asset is under their control, because they want to sell the asset back to industry insiders at a high price. Outsiders play an important role, therefore, not because they are flush with funds but because they are not subject to moral hazard over pledgeability.

Interestingly, anticipating such sales to outsiders as the industry turns down, current debt holders have little incentive to renegotiate down debt levels, even if it causes incumbent moral hazard over
pledgeability; Short term improvements in pledgeability contribute little immediately to repayments, given the weak state of the economy, but improvements in long-term pledgeability after an asset sale will enhance the recovery of long term payments significantly. Consequently, in the downturn 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 increases the insiders’ ability to raise money against cash flows. Recoveries following periods of asset price inflation 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 financing is more difficult. It is the latter which may make the debt hangover more prolonged.

The interplay between industry liquidity and internal incentives to enhance pledgeability are also interesting. Very high liquidity will imply that assets are fully priced, and the incumbent has no incentive to enhance pledgeability. Very low liquidity will mean that the incumbent prefers to sell to an industry outsider, which reduces the need to increase pledgeability. It is only at intermediate levels of liquidity that the incumbent has the incentive to increase pledgeability, and the ability to increase borrowing capacity. An interesting relationship also emerges between debt and efficiency. High promised payments are usually thought of as forcing assets into more efficient hands. But because moral hazard over pledgeability may be more acute for more efficient producers, they may be able to borrow less when pledgeability matters. So the need to make high promised payments may force the firm out of their hands into the hands of the less efficient. Productive efficiency may suffer ex post, but this may be necessary to raise more money up front. More generally, high debt may not lead to more efficient ownership.
Our paper explains why asset price booms based on a combination of liquidity and credit can be fragile (see, for example, Borio and Lowe (2002), Adrian and Shin (2010), and Rajan and Ramcharan (forthcoming)). 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)).

The model can, with some tweaking, be applied to areas where assets are not actively managed. For instance, an analogous argument to the one above can be made for real estate cycles. In the boom, the reliance on home repossession and resale as the basis for lending (and refinance) implies the lender reduces emphasis on undertaking due diligence on buyers, their income prospects, and their repayment capacity. New potential buyers are liquid because of home equity. In a downturn, repayment capacity becomes important, and the past lack of due diligence comes to haunt lenders. At such times, high debt overhang leads owners to neglect maintenance as there is little chance they will have any equity left in a sale. It may even make sense for a lender to repossess and leave the house vacant (or use the time to fix up the house) so as to get a better price when the recovery starts. The recovery starts as lenders restructure their lending procedures to focus on buyer income and repayment prospects until, as house prices boom, the threat of repossession becomes once again the basis of repayment.

In Shleifer and Vishny (1992), 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, which leads to efficient reallocation. Eisfeldt and Rampini (2008) develops a theory of more efficient capital reallocation in good times based on private information about managerial ability and cyclical effects of labor market competition for managers. Good times lead to high required cash compensation to managers because reservation managerial wages become elevated. As a result, high ability managers can accept

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2 See Benmelech and Bergman (2011), Coval and Stafford (2007), and Shleifer and Vishny (2011) for comprehensive reviews.
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 capital. This leads to a more efficient reallocation of capital in good (high compensation) times and less in bad. Both Shleifer and Vishny (1992) and Eisfeldt and Rampini (2008) study the effects of current conditions (such as industry net worth or compensation) for the efficiency of current reallocation of capital. Our analysis of pledgeability choice shows how previous, current, and anticipated conditions determine current financial capacity and the efficiency of capital reallocation.

The rest of the paper is as follows. In Section I, we describe the basic model of pledgeability choice and the timing of decisions. In Section II, we analyze the implications of pledgeability choice when financial contracts are fully state contingent. The maximum amount that can be pledged to outside investors is characterized. In Section III, we examine two extensions, one with standard debt contracts rather than fully state contingent payments and the other where the incumbent can become disabled rather than fully incapacitated. In Section IV, we discuss the implications of the model and conclude.

I. The Model: Framework

1.1. The Industry

We consider the simplest multi-period model that allows us to explore the issues we want to focus on. Consider an industry in a world with 4 dates – 0, 1, 2, 3 – and three periods. G is the normal state of the industry and we assume the industry is in that state before date 0. The new state is realized at the beginning of every period. In period 3, 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). In between, however, the industry can move between the two states (see Figure 1). At date 0, the probability of being in state G in period 1 is \( q^G \). At date 1, the probability of being in state G in period 2, conditional
on being in state \( s \) at date 1, \( s \in \{G,B\} \), is \( q^G \). We assume some serial correlation in states over this period so \( q^{GG} > q^{BG} \). Note that a full description of the state in periods 2 and 3 includes the states that were realized in previous periods, but where a reference to past realized states is unnecessary we will skip it for convenience.

**Production Technology and Agents**

There are two types of agents in the economy: Some have high ability to manage an asset, which we will call the firm. Think of them as industry insiders. When the state is G, only a high (H) ability manager in place at the beginning of a period \( t \) can produce cash flows \( C_t \) with the asset over the period – there is some mutual specialization established over the period between the manager and the firm (or more broadly, between the CEO and the un-modeled organization that is needed to operate the firm). In the B state, however, even a high ability manager cannot produce cash flows. There are also industry outsiders, or equivalently, insiders who have lost their ability (see below). These low (L) ability outsiders can produce nothing with the asset regardless of the state. Some of these outsiders have funds which they...
can lend if they expect to break even – they are financiers. All agents are risk neutral. We ignore time
discounting, which is just a matter of rescaling the units of cash flows.

An incumbent high ability manager retains her ability into the next period only with probability
$\Theta^H$. Think of this as the degree of stability of the industry. Intuitively, the critical capabilities for success
are likely to be stable in a mature industry or in an industry with little technological innovation.
However, in an industry which is young and unsettled, 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, effectively
becoming an outsider, and this occurs with higher probability in an unstable industry.

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. A new high ability manager can take over at the end of the
current period and shape the firm towards her idiosyncratic management style, so she can indeed produce
cash flows with the firm’s assets next period in good states.

Pledgeability

Having acquired control of the firm, a manager would like to keep the realized cash flow for
herself rather than share it with financiers. However, the manager’s share in period $t$ is constrained by the
pledgeability $\gamma$ put in place the previous period, $t-1$. Pledgeability is the fraction of realized cash flows
that are automatically directed to an outside financier. In practice, it is determined by a variety of factors
such as the information possessed by financiers and hence the nature of financiers (arm’s length or
relationship), the nature of financing (for example, concentrated or dispersed), the quality of the
accounting systems that are in place, the transparency of the organizational structure and the system of
contracting (e.g., the absence of pyramids, the rules governing related party transactions, etc.), and the
checks and balances that are imposed on the manager by the organization (the quality and independence of the board, the replaceability of the CEO, the independence of the auditor and the audit committee, etc.).

After seeing the state but before learning her type next period, the incumbent manager can set the pledgeability of the firm’s assets in period \( t+1 \) (which does not influence how much she can appropriate in period \( t \), but could influence her ability to borrow against next period’s output). The incumbent sets two kinds of pledgeability. *Incumbent pledgeability* \( \gamma^i \) is the fraction of next period’s cash flows this period’s incumbent can commit to pay out if she is still in control next period. *General pledgeability* \( \gamma^g \) is the fraction of next period’s cash flows another industry insider can commit to pay out if she takes over control at the end of this period. An industry outsider cannot generate cash flows, but he can set next period’s general pledgeability if he is the incumbent this period – he does not have industry-specific managerial capabilities but has governance capabilities.

Incumbent pledgeability can differ from general pledgeability because some aspects of pledgeability are specific to the incumbent. For instance, stronger relationships with specific lenders would enhance incumbent pledgeability (see, for instance, Diamond and Rajan (2001)) but not general pledgeability. We assume \( \gamma^g_t \in \left[ \underline{\gamma}^g, \bar{\gamma}^g \right] \) where \( 0 \leq \underline{\gamma}^g < \bar{\gamma}^g \leq 1 \), and there is a small fixed cost \( \varepsilon \) of setting \( \gamma^g_t > \underline{\gamma}^g \). This is the cost of taking actions like setting up a bond trustee and writing in detailed covenants that will ensure higher cash flow pledgeability. For simplicity, we will assume the incumbent can set \( \gamma^i_t \) at any desired level below \( \bar{\gamma}^i \) without incurring any cost and that \( \bar{\gamma}^i \geq \bar{\gamma}^g \).

**Contracts**

Any manager can raise money against the asset by writing one period state-contingent financing contracts specifying a state contingent repayment – later, in section III, we will explore the consequences if contracts are non-state-contingent debt. Over the period, the financier gets the pledgeable portion of
generated cash flows, and just before the end of the period, the right to auction the firm to the highest bidder if he has not been paid in full. One can think of some forms of bankruptcy as a way of implementing such an auction. 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 outsiders in the competitive auction.

**Bidding and wealth**

At date 0, there is no prior incumbent, and the firm is sold in a competitive auction to the highest bidder. The firm’s general pledgeability in period 1 is preset as $\gamma_1^g = \gamma^g$. In any auction, bidders can pay cash from their wealth and any money they can raise from financiers against future cash flows conditional on being successful in the bid.

We assume that high ability insiders start out with wealth $\omega_0^H \geq 0$. If the industry is good at date $t$, the wealth of industry insiders goes up over the period by $\rho C_t$ to $\omega_t^H$. Intuitively, a string of good (G) states for the industry will mean that insiders – working as sub-contractors or employees -- will grow more wealthy, even if they do not own the firm.

The incumbent’s wealth at the end of the period depends on the cash flows she generates within the firm, what she has promised financiers, and what is pledgeable. Unlike other industry insiders, she does not get $\rho C_t$ since she is occupied full time running the firm.

Industry outsiders can also bid for the firm. Their wealth will turn out not to matter since they do not generate cash flow themselves and they will pay only what they can sell the asset for. This is why industry outsiders and financiers are interchangeable in the model. The timing of choices by an incumbent in the basic model with state contingent financial contracts is described in more detail in Figure 2.
Notions of Efficiency

We do not model investment, instead assuming that the asset exists at date 0. If we put a floor on the value of asset which must be bid at date 0 (the value of real inputs to be assembled into the firm), real investment would be possible at that date only if enough funding were available. Sufficiently weak incentives to make cash flows pledgeable or to transfer the firm to more efficient producers would reduce bids at date 0 below this floor, and this would result in underinvestment. The measure of economic efficiency we use through the rest of this paper, however, is the ability to keep the asset in the hands of the most productive owner, assuming the initial investment need is met.
II. Solving the Basic Model With State Contingent Financial Contracts

We will characterize the maximum state contingent payments to lenders. There are two forms of moral hazard at work. First, incumbents can withhold cash flows from financiers unless forced to pay by pre-set pledgeability or the financier’s threat to seize and auction assets. Second, the incumbent can alter future pledgeability. We analyze the choice of pledgeability, the conditions under which the assets change ownership, and whom the assets go to if payments are not fully made by incumbents. The analysis with state contingent contracts will provide a useful benchmark when we consider standard debt contracts (with the same promised payment in all states of nature).

Other than when liquidity is plentiful, or asset sales are certain, we will see that repayment in each state cannot be set too high, else the industry insider incumbent has an incentive to reduce future pledgeability. Thus payment capacity for the industry insider is limited by moral hazard. Interestingly, payment capacity is not similarly limited for the industry outsider – because he generates no cash, he has no incentive to lower pledgeability or to hold on to the asset longer than he needs to, therefore his focus is on increasing pledgeability to make the asset more saleable. This difference will explain why assets sometimes migrate to less-able industry outsiders for a while when potential moral hazard (the incentive to reduce general pledgeability) is high, even when industry insiders have some liquidity.

2.1. Date 2 Payments to Financier

Let the promised payment to the financier at date 2 in state $s$ be $D_2^s$. If the incumbent in period 2 is a high type H (an industry insider) and the state is G, she will generate pledgeable cash of $\gamma_2 C_2$ which goes directly to the period-2 financier (up to the value of his promised claim), where $\gamma_2 = \gamma_2^i$ if the incumbent in period 2 is the same as that in period 1, else $\gamma_2 = \gamma_2^g$, the general pledgeability level chosen
by the previous incumbent. So the remaining debt to be paid voluntarily is 
\[ \tilde{D}_2^s = D_2^s - \text{Min}[\gamma_2 C_2, D_2^s] \]
if the state is good. Otherwise, 
\[ \tilde{D}_2^s = D_2^s. \]

In any date 2 auction for the firm, industry outsiders will not bid since the firm is worthless in their hands in the last period. Industry insiders can raise \( \gamma_3^H C_3 \). Together with their pre-existing wealth, they can pay up to \( \omega_2^{H,s} + \gamma_3^g C_3 \). Of course, they will not bid more than the fundamental value \( C_3 \) less the opportunity return of \( \rho C_3 \) (that all industry insiders get over the period if they work outside the firm). So the maximum auction bid at date 2 is 
\[ B_2^{H,s}(\gamma_3^g) = \text{Min}[\omega_2^{H,s} + \gamma_3^g C_3, (1 - \rho)C_3]. \] If she can win by bidding below \( (1 - \rho)C_3 \), the industry insider earns rents from acquiring the asset.

The incumbent will have to pay the financier \( \text{Min}[\tilde{D}_2^s, B_2^{H,s}] \) if she wants to retain control into period 3. We will begin by assuming that there is no way for the incumbent to carry cash into a future period. It turns out that with state contingent contracts, there is no reason to carry cash forward: instead the incumbent will reduce the amount she raises externally. Therefore, the only cash she has at the end of the period is the non-pledgeable portion of cash flows generated during that period. So at date 2, the incumbent has cash \( (1 - \gamma_2)C_2 \) if she is an H type and the period-2 state is G. She can also raise \( \gamma_3^i C_3 \) against the firm’s period-3 cash flows. This means that if she will continue to be H in period 3, the incumbent can pay as much as 
\[ B_2^{i,G}(\bar{\gamma}^i) = (1 - \gamma_2)C_2 + \bar{\gamma}^i C_3 \] to the financier at the end of period 2 in state G. If the period-2 state is B, she generates no cash during the period and can pay only what she can raise at the end, 
\[ B_2^{i,B} = \bar{\gamma}^i C_3. \] The incumbent will retain control if the amount she can pay is greater than \( \text{Min}[\tilde{D}_2^s, B_2^{H,s}] \). Of course, if the incumbent realizes she has lost her ability, or she is a low type to begin with, she will want to sell out since she cannot generate cash flow next period and the firm is worthless in her hands.
The incumbent will set \( \gamma^i \) sufficiently high to just win the auction (if winning is feasible) if she continues to be a high type in period 3. Regardless of who wins, the financier recoups \( \min[\gamma^2 C, D^i] + \min[\tilde{D}^i, B^{H,s}_2] \) if the incumbent in period 2 is a high type and the state is G, and \( \min[D^i, B^{H,s}_2] \) otherwise. The financier’s threat of seizing and selling assets is therefore a powerful instrument for him to extract repayment. The value of that threat depends on the bid \( B^{H,s}_2 \) by industry insiders, which depends in turn on the wealth of industry insiders and the future pledgeability of the asset.

Below we study the pledgeability choice and the maximal promised payment in different scenarios.

2.1.1 When pledgeability does not affect payouts.

The amount any industry insider will pay for the asset is limited by \( (1 - \rho)C_3 \), the cash flow it generates in excess of the industry insiders’ outside option. So if industry bidders have high enough internal wealth, they can pay full value for the asset even if it has low future pledgeability, that is, if \( B^{H,s}_2(\gamma^s) = (1 - \rho)C_3 \), they will pay \( (1 - \rho)C_3 \). When industry liquidity is this high, there are no remaining potential rents to acquirers of assets that can be pushed into higher bids by increasing pledgeability. So at very high levels of industry liquidity, future pledgeability is inconsequential to payout, because payout is extracted entirely by the threat to seize and sell the asset, supported by plentiful liquidity. As a result, we will see that promised payments do not affect the incentive to pledge. We will refer to these cases as “not on IC” for short.

2.1.2 When pledgeability affects payouts

Suppose now that industry wealth is lower, so pledgeability affects how much can be extracted from the incumbent, that is, suppose \( B^{H,s}_2(\gamma^s) < (1 - \rho)C_3 \). Consider the incumbent’s incentive to set
period-3 general pledgeability after seeing the period-2 state. By increasing general pledgeability, $\gamma^g_3$, the incumbent potentially increases the amount other industry insiders can bid for the firm (by raising the amount they can finance against the asset). The incumbent can therefore sell the firm for more, which she likes, if she turns out to be an L type at the end of the period. However the higher outside bid gives the current financier a more powerful threat – to go to an outside auction if the incumbent retains ability but does not pay. This potentially increases the amount the financier can extract in repayment from the H-type incumbent. Indeed, a high enough outside bid might also make it impossible for the incumbent to retain control and enjoy any rents from controlling the firm. The incumbent dislikes this.

In trading off these effects, three broad situations are relevant for determining the incumbent’s incentives to set pledgeability. The first is where she loses control for sure, the second where she does not lose control independent of how she sets pledgeability (provided she retains her ability), and the third is where depending on the level of general pledgeability, she may or may not lose control.

2.1.2.1. Incumbent always loses control

If the incumbent knows that she has to sell at the end of the period for sure and there are potential rents to acquirers ($B_2^{H,s}(\gamma^g_3) < (1 - \rho)C_3$), she has an incentive to set general pledgeability at its highest value, provided she gets something after paying off claimants. This is the case if the incumbent is an industry outsider, an incumbent with a high probability of loss of ability ($\theta^H \rightarrow 0$), or if the incumbent does not have enough cash to make either the promised payments or to win the subsequent auction even after having set general pledgeability to its lowest level and incumbent pledgeability to its highest level ($\min\{\tilde{D}_2^s, B_2^{H,s}(\gamma^g_3)\} > B_2^{i,s}$). The promised payment does affect incentives in these

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3 “Being a L type” could instead be the need to finance additional investment, where there is value to keeping pledgeability high.
situations but only through the need to make sure that the incumbent receives at least \( \varepsilon \), the cost of increasing general pledgeability. In this case, the maximal promised payout is thus \( B_2^{H,s}(\bar{\gamma}^g) - \varepsilon \).

We now examine how the promised payment affects the incumbent’s incentives when the incumbent has the possibility of retaining control. The range of potential date-2 bids for the firm the incumbent can generate through his choice of \( \gamma_3^g \) is \( [B_2^{H,s}(\underline{\gamma}^g), B_2^{H,s}(\bar{\gamma}^g)] \).

2.1.2.2. Incumbent always retains control conditional on retaining ability

Consider \( B_2^{s}(\bar{\gamma}^g) \geq \text{Min}[\tilde{D}_2^{s}, B_2^{H,s}(\bar{\gamma}^g)] \), so that the incumbent can retain control by increasing incumbent pledgeability sufficiently, even if general pledgeability is at its maximum. She will choose \( \gamma_3^g = \bar{\gamma}^g \) iff

\[
\theta^H (C_3 - \text{Min} [\tilde{D}_2^{s}, B_2^{H,s}(\bar{\gamma}^g)]) + (1 - \theta^H) (B_2^{H,s}(\bar{\gamma}^g) - \text{Min} [\tilde{D}_2^{s}, B_2^{H,s}(\bar{\gamma}^g)]) - \varepsilon \\
\geq \theta^H (C_3 - \text{Min} [\tilde{D}_2^{s}, B_2^{H,s}(\underline{\gamma}^g)]) + (1 - \theta^H) (B_2^{H,s}(\underline{\gamma}^g) - \text{Min} [\tilde{D}_2^{s}, B_2^{H,s}(\underline{\gamma}^g)])
\]

(1)

The left hand side is the incumbent’s rents if she chooses \( \gamma_3^g = \bar{\gamma}^g \), while the right hand side is the incumbent’s rents if she chooses \( \gamma_3^g = \underline{\gamma}^g \). The first term on each side of (1) is the residual amount the incumbent expects if she remains a high type in period 3. The second term on each side is the expected residual amount if she loses her ability and becomes a low type, and has to auction the firm at date 2.

Note that a higher \( \gamma_3^g \) (weakly) increases the amount the financier gets and (weakly) decreases the first term, while it (weakly) increases the amount the incumbent gets in the auction and (weakly) increases the second term. The incumbent has the incentive to set \( \gamma_3^g = \bar{\gamma}^g \) if by doing so she gets more, net of the cost \( \varepsilon \), than by setting \( \gamma_3^g = \underline{\gamma}^g \), and obtaining the expected amount on the right hand side.
Now consider the effects of promised payment, $\tilde{D}_2^s$. When it is zero, the incumbent who can retain control sees only upside to increasing general pledgeability – she gets a higher value from the auction if she turns out to be a low type and is forced to sell – and no downside since she does not have to pay out any more. Indeed, so long as $\tilde{D}_2^s \leq B_2^{H,s}(\gamma^g)$, a higher $\tilde{D}_2^s$ does not change the relative magnitudes of the two sides of inequality.

Matters are different when $\tilde{D}_2^s > B_2^{H,s}(\gamma^g)$. Increasing general pledgeability will increase the amount the incumbent must pay even though she can always keep control. As a result, the incumbent can lower the industry insider’s bid and thus her own payments by setting general pledgeability low. The maximum level of promised payment $\tilde{D}_2^s$ that still gives her an incentive to choose $\gamma^g = \gamma^g$ is easily checked to be $D_2^{\text{PayIC}} = \theta^H B_2^{H,s}(\gamma^g) + (1 - \theta^H)B_2^{H,s}(\gamma^g) - \varepsilon$. If the promised payment $\tilde{D}_2^s > D_2^{\text{PayIC}}$, the incumbent sets $\gamma^g = \gamma^g$.  

Intuitively, higher is the probability of a sale $(1 - \theta^H)$, higher the value from a high bid in the auction, and greater the benefit of high general pledgeability – so higher the payment that can be committed to. Conversely, higher is stability $\theta^H$, lower the likelihood of a forced sale, greater the attractiveness of choosing low pledgeability and reducing the enforceable payment, so lower the payment that can be sustained. Greater stability in an industry reduces the likelihood that different management capabilities will be needed, and reduces management’s incentive to maintain high pledgeability for any debt level.\footnote{The incumbent’s objective function is increasing in $\gamma^g$ when $B_2^{H,s}(\gamma^g) > \bar{D}_2^s$ and decreasing otherwise. So it is easy to see that we only need compare the value she gets at $\gamma^g$ and $\gamma^g$. This is exactly what (1) does.} \footnote{There is a parallel here to Jensen (1986)’s argument that free cash flows increase in mature industries. In his view, the paucity of investment needs in mature industries results in firms generating substantial free cash flows (and}
2.1.2.3. Incumbent turnover depends on the level of general pledgeability

Now consider what happens when \( B_2^{H,s}(\gamma^g) \leq B_2^{i,s}(\tilde{\gamma}) < \text{Min}[\tilde{D}_2^{s}, B_2^{H,s}(\gamma^g)] \) so that the incumbent retains control if she chooses low general pledgeability and continues to be a high type, because she lowers to \( B_2^{H,s}(\gamma^g) \) the payment she has to make to retain control. By contrast, if she chooses high pledgeability, she loses control no matter what type she is because the high promised payment is enforceable and higher than what she can pay. So she chooses high pledgeability if

\[
(B_2^{H,s}(\gamma^g) - \text{Min}[\tilde{D}_2^{s}, B_2^{H,s}(\gamma^g)]) - \varepsilon \geq \theta^H((1-\rho)C_3 - \text{Min}[\tilde{D}_2^{s}, B_2^{H,s}(\gamma^g)])
\]  

(2)

This requires \( \tilde{D}_2^s \) to not exceed \( D_2^{Control IC} = B_2^{H,s}(\gamma^g) - \theta^H((1-\rho)C_3 - B_2^{H,s}(\gamma^g)) - \varepsilon \).

Intuitively, promised payments cannot be too high if the choice of high pledgeability means a certain loss of control – the incumbent needs to obtain adequate rents from sale to choose high pledgeability. It is easily checked that \( D_2^{Pay IC} \geq D_2^{Control IC} \).

2.1.2.4 Maximum promised payment and the value of being an incumbent

We are interested in the maximal possible promised payment \( \tilde{D}_2^{s,Max} \) which is the upper bound on what can be pledged by an industry insider incumbent, taking account of incentive compatibility and hence needing governance. In our model, the lower probability of the need to sell the firm to managers with different capabilities (or equivalently, the lower need to issue financial claims to raise finance for unmodeled investment) in a mature or stable industry reduces the need to maintain better outside pledgeability.

6 This case requires \( B_2^{i,s}(\tilde{\gamma}) \geq \text{Min}[\tilde{D}_2^{s}, B_2^{H,s}(\gamma^g)] \). It may turn out that \( D_2^{Pay IC} > B_2^{i,s}(\tilde{\gamma}) \). If so the maximal promised payout is \( B_2^{i,s}(\tilde{\gamma}) \), as indicated in case (3)(ii) in Lemma 1 below.

7 Would the incumbent want to choose an interior level of general pledgeability, so that she can maintain control if she retains her ability? The answer is no. Consider a \( \gamma^g \) such that \( \tilde{D}_2^{s} \geq B_2^{H,s}(\gamma^g) \). Because debt is higher than the outside bid, the outside bid has to be paid, and the incumbent will get nothing if she loses her ability. But conditional on retaining her ability, she is better off having set \( \gamma^g = \tilde{\gamma}^g \). And condition (2) says that she is still better off having set \( \gamma^g = \tilde{\gamma}^g \).
feasibility, as well as the associated payoff the incumbent gets $V_{2i,s}^{H,J} (\hat{D}_2^s)$ (including any payoffs she gets as an industry insider if she loses control) beyond date 2 for any $\hat{D}_2^s \leq \hat{D}_2^{s,Max}$. We have

**Lemma 1**

(1) If $B_2^{H,s} (\gamma^g) \geq (1-\rho)C_3$ ,

$$\hat{D}_2^{s,Max} = (1-\rho)C_3 \text{ and } \gamma_3^s = \gamma^g.$$ For any promised payment $\hat{D}_2^s \leq \hat{D}_2^{s,Max}$, incumbent expects :

$$V_{2i,s}^{H,J} (\hat{D}_2^s) = \theta^H C_3 + (1-\theta^H)(1-\rho)C_3 - \hat{D}_2^s$$

(2) else if $(1-\rho)C_3 > B_2^{H,s} (\gamma^g) > B_2^{i,s} (\overline{\gamma}^i)$

then $\hat{D}_2^{s,Max} = B_2^{H,s} (\overline{\gamma}^g) - \epsilon$. For any promised payment $\hat{D}_2^s \leq \hat{D}_2^{s,Max}$, the incumbent chooses $\gamma_3^g = \overline{\gamma}^g$ and expects $V_{2i,s}^{H,J} (\hat{D}_2^s) = B_2^{H,s} (\overline{\gamma}^g) + \theta^H \rho C_3 - \hat{D}_2^s - \epsilon$ if $\hat{D}_2^s > B_2^{i,s} (\overline{\gamma}^i)$ and

$$V_{2i,s}^{H,J} (\hat{D}_2^s) = \theta^H C_3 + (1-\theta^H)B_2^{H,s} (\overline{\gamma}^g) - \hat{D}_2^s - \epsilon \text{ if } \hat{D}_2^s \leq B_2^{i,s} (\overline{\gamma}^i) .$$

(3) else if $(1-\rho)C_3 > B_2^{H,s} (\gamma^g)$ and

(i) $B_2^{i,s} (\overline{\gamma}^i) \geq D_2^{s,PayIC}$, then $\hat{D}_2^{s,Max} = D_2^{s,PayIC}$. For any promised payment $\hat{D}_2^s \leq \hat{D}_2^{s,Max}$, incumbent chooses $\gamma_3^g = \overline{\gamma}^g$ and expects

$$V_{2i,s}^{H,J} (\hat{D}_2^s) = \theta^H C_3 + (1-\theta^H)B_2^{H,s} (\overline{\gamma}^g) - \hat{D}_2^s - \epsilon.$$
(ii) $D_{2i}^{\text{Pay IC}} > B_{2i}^{s}(\bar{\gamma}^i) \geq D_{2i}^{\text{Control IC}}$, then $\tilde{D}_{2i}^{s,\text{Max}} = B_{2i}^{i,s}(\bar{\gamma}^i)$. For any promised payment $\tilde{D}_{2i}^{s} \leq \tilde{D}_{2i}^{s,\text{Max}}$, incumbent chooses $\gamma_3^\gamma = \bar{\gamma}^s$ and expects

$$V_{2i}^{s}(\tilde{D}_{2i}^{s}) = \theta^H C_3 + (1 - \theta^H)B_{2i}^{H,s}(\bar{\gamma}^s) - \tilde{D}_{2i}^{s} - \epsilon^s.$$  

(iii) $D_{2i}^{\text{Control IC}} > B_{2i}^{i,s}(\bar{\gamma}^i) \geq B_{2i}^{H,s}(\bar{\gamma}^s)$ then $\tilde{D}_{2i}^{s,\text{Max}} = D_{2i}^{\text{Control IC}}$. For any promised payment $\tilde{D}_{2i}^{s} \leq \tilde{D}_{2i}^{s,\text{Max}}$, incumbent chooses $\gamma_3^\gamma = \bar{\gamma}^s$ and expects:

$$V_{2i}^{i,s}(\tilde{D}_{2i}^{s}) = B_{2i}^{H,s}(\bar{\gamma}^s) + \theta^H \rho C_3 - \tilde{D}_{2i}^{s} - \epsilon$$  if $\tilde{D}_{2i}^{s} > B_{2i}^{i,s}(\bar{\gamma}^i)$ and

$$V_{2i}^{i,s}(\tilde{D}_{2i}^{s}) = \theta^H C_3 + (1 - \theta^H)B_{2i}^{H,s}(\bar{\gamma}^s) - \tilde{D}_{2i}^{s} - \epsilon$$  if $\tilde{D}_{2i}^{s} \leq B_{2i}^{i,s}(\bar{\gamma}^i)$.

Proof: Sketched in text.

Note that, ceteris paribus, the maximum credible promised claim $\tilde{D}_{2i}^{s,\text{Max}}$ does not increase monotonically with the amount the incumbent can raise, $B_{2i}^{i,s}(\bar{\gamma}^i)$, or in the maximum level of incumbent pledgeability, $\bar{\gamma}^i$. When $B_{2i}^{i,s}(\bar{\gamma}^i)$ is low in case (2), the incumbent cannot retain control when debt levels exceed what she can pay. Since she always gets more by selling, she has the incentive to set general pledgeability high, and hence promised payments can be set very high. By contrast, as maximum incumbent pledgeability $\bar{\gamma}^i$ increases so that case (3) applies and she has some chance of retaining control if she sets general pledgeability low, her incentives start mattering at lower promised payments. The maximum credible promised claim now falls as $\bar{\gamma}^i$ falls (from case 3(i) to 3(iii)) because of moral hazard.

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8 The intuition here is that when payment is set at $B_{2i}^{i,s}(\bar{\gamma}^i)$, the incumbent can just retain control if she chooses high pledgeability and remains able, and also when she chooses low pledgeability. Since payment is below $D_{2i}^{\text{Pay IC}}$, she has the incentive to choose high pledgeability. So the maximum payment is $B_{2i}^{i,s}(\bar{\gamma}^i)$. 

20
Figure 3 below illustrates this non-monotonicity by plotting $\bar{D}_2^{BB,\text{max}}$ as a function of $\bar{y}$. $\bar{D}_2^{BB,\text{max}}$ is the highest when $\bar{y} < 0.34$. After a dramatic drop, $\bar{D}_2^{BB,\text{max}}$ starts to increase when $\bar{y}$ increases from 0.34 to 0.4.

![Figure 3: $\bar{D}_2^{BB,\text{max}}$ as a function of $\bar{y}$](image)

Note: this figure plots $\bar{D}_2^{BB,\text{max}}$ against $\bar{y}$. Other parameters are given as follows:

$\bar{y} = 0.45, y_H = 0.27, q^H = 0.7, q^{M^H} = 0.8, q^{M^R} = 0.1, e_0^H = 0.1, \rho = 0.3, \alpha_g = 1, C = 1.5, \theta^R = 0.7, e = \text{small}$

Matters are different with increases in the maximum general pledgeability. As long as $\theta^H < 1$, both $D_2^s \text{Control IC}$ and $D_2^s \text{Pay IC}$ increase in $B_2^{H,s} (\bar{y}_g)$, which in turn increases in $\bar{y}$. Intuitively, greater maximum general pledgeability increases the attractiveness of setting high pledgeability (relative to setting low pledgeability), reduces the extent of moral hazard, and increases the maximum credible promised claim.

Figure 4 below illustrates this monotonicity by plotting $\bar{D}_2^{BB,\text{max}}$ as a function of $\bar{y}$. $\bar{D}_2^{BB,\text{max}}$ is strictly increasing when $\bar{y}$ is less than 0.64.
Note: this figure plots $\hat{D}_{2}^{BB,\text{max}}$ against $\gamma^{g}$. Other parameters are given as follows:

$\gamma = 0.85, q^{r} = 0.27, q^{r} = 0.7, q^{r} = 0.8, q^{r} = 0.1, a_{0} = 0.1, \gamma = 0.3, C_{1} = 1, C_{1} = 1.5, \theta^{p} = 0.7, \epsilon \text{ small}$

What about the effects of industry liquidity, that is, the wealth of industry insiders, $\omega_{2}^{H,s}$? An increase in industry liquidity will push up the amount industry insiders can pay, $B_{2}^{H,s}(\gamma_{3}^{g})$, for any level of general pledgeability. This will increase the maximum pledgeable payment whenever there are rents to acquirers (and not decrease it when there are no such rents).

**Corollary 1:** $\hat{D}_{2}^{x,\text{Max}}$ is weakly increasing in industry liquidity $\omega_{2}^{H,s}$, and strictly increasing if and only if there are potential rents to acquirers if $\gamma_{3}^{g} = \gamma^{g}$.

Proof: See appendix I.

In sum, the incumbent in period 2 selects low general pledgeability when the date 2 market will be very liquid (and assets are fully priced and potential acquirer rents are zero). The maximum state contingent payment always incentivizes the choice of high general pledgeability in all other cases. When liquidity is high so that potential acquirers pay full value, the incumbent cannot commit to pay more by setting pledgeability high. Moral hazard over pledgeability is irrelevant. When potential acquirers pay less
than full value, the choice of pledgeability matters to financing capacity, and payouts are set so as to preserve the incumbent’s incentives.

2.2 Choices on Date 1

We have just determined the maximum credible payment a bidder can make in each state at date 2. This then allows us to determine who wins the auction in each state at date 1. The bid by industry insiders is easily arrived at. Each insider has the resources to bid up to

\[
\omega_1^{H,s} + q^G \left( \gamma_2^s C_2 + \tilde{D}_2^s \right) + (1 - q^G) \tilde{D}_2^B
\]

where \( \omega_1^{H,s} \) is the cash she has at period 1 and \( \gamma_2^s C_2 + \tilde{D}_2^s \) (less than \( \gamma_2^i C_2 + \tilde{D}_2^{i,Max} \) and \( \tilde{D}_2^B \) (less than \( \tilde{D}_2^{i,B,Max} \)) are the state contingent date-2 payments contracted at date 1. The additional surplus (before debt repayments) she hopes to get by acquiring the firm at date 1 (relative to staying an industry insider and collecting \( \rho C_i \) in good states if she retains capability) is

\[
q^G \left( (1 - \rho)C_2 + \tilde{D}_2^g + V_2^{i,g} (\tilde{D}_2^g) - \theta^H \rho C_3 \right) + (1 - q^G)(\tilde{D}_2^B + V_2^{i,B} (\tilde{D}_2^B) - \theta^H \rho C_3). \]

So the industry insider’s maximum bid with promised payments \( \tilde{D}_2^g, \tilde{D}_2^B \) and pre-set pledgeability \( \gamma_2^s \) is

\[
B_1^{H,s}(\gamma_2^s) = \max_{\tilde{D}_2^g \leq \tilde{D}_2^{g,Max}, \tilde{D}_2^B \leq \tilde{D}_2^{B,Max}} \min \left[ \omega_1^{H,s} + q^G \left( \gamma_2^s C_2 + \tilde{D}_2^g \right) + (1 - q^G) \tilde{D}_2^B, q^G \left( (1 - \rho)C_2 + \tilde{D}_2^g + V_2^{i,g} (\tilde{D}_2^g) - \theta^H \rho C_3 \right) + (1 - q^G)(\tilde{D}_2^B + V_2^{i,B} (\tilde{D}_2^B) - \theta^H \rho C_3) \right]
\]

The intuition behind this expression is simple -- the insider will not pay more from his wealth than the incremental rents he expects to get. The winning insider at date 1 becomes the incumbent in period 2.

When \( B_2^{i,s}(\tilde{D}_2^g) \) is relatively high for incentive compatible levels of debt, so the period-2 incumbent expects to retain control in period 3 (see Lemma 1) and when period-3 cash flows are high, the incumbent will be willing to raise debt up to the highest incentive compatible level, \( \tilde{D}_2^{i,Max} \). When \( B_2^{i,s}(\tilde{D}_2^g) \) or period-3 cash flows are relatively low, while a higher promised payment can raise more
financing and thus allow the incumbent to bid more, it may also reduce the rents from owning the firm (since the period-2 incumbent may lose control at the end of the period, as suggested by case (2) and (3)(iii) in Lemma 1). The amount the industry insider raises from financiers at date 1, given preset pledgeability \( \gamma_2^F \), trades off these two effects.

An industry outsider can also bid at date 1, with the objective of holding on to the firm over the period if he can get it cheaply, and selling at date 2. Given that the industry outsider does not suffer from moral hazard (he has no desire to set \( \gamma_2^F \) low because he wants to sell for certain), he can pay up to

\[
B_{1,s}^L = q^{sG} B_{2}^{H,sG} (\gamma_2^F) + (1 - q^{sG}) B_{2}^{H,sB} (\gamma_2^F) - \epsilon.
\]

Note that the wealth of the industry outsider coming into date 1 does not matter. Because he does not suffer from moral hazard, he can borrow the entire amount he realizes from the verifiable future sale (though he must keep a small rent to compensate himself for the cost of enhancing pledgeability).

Consider now the high type incumbent at date 1. She can afford to pay up to

\[
(1 - \gamma_1^F) C_1 i_{s=G} + q^{sG} (\overline{\gamma}_2^C C_2 + \overline{D}_2^{sG,Max}) + (1 - q^{sG}) \overline{D}_2^{sB,Max} \]

where \( i_s \) is an indicator variable for the period 1 state, \( \gamma_1^F \) is the date-1 pledgeability set before date 0, and \( \overline{D}_2^{sG,Max} \) and \( \overline{D}_2^{sB,Max} \) are the maximum state contingent date-2 payments indicated by Lemma 1 contracted at date 1. The incumbent’s rents from winning could be less than the industry insider\(^9\). Therefore, the incumbent will bid the minimum of her available liquidity and the continuation value of the firm in her hands.\(^{10}\)

\(^9\) Because \( \overline{\gamma}^i > \overline{\gamma}^g \), the incumbent’s bid at date 2 if she was also the period 1 incumbent is less than her bid if she was an industry insider during period 1. This can result in different cases in Lemma 1 and thus lower continuation value if \( \gamma_2^i = \overline{\gamma}^i \).

\(^{10}\) Note here \( \overline{D}_2^{sG,Max} \), \( \overline{D}_2^{sB,Max} \), \( V_2^{i,sG} \) and \( V_2^{i,sB} \) below could differ from those in \( B_2^{H,s} (\gamma_2^F) \), despite the same notation. This is because the incumbent’s bid at date 2 depends on whether \( \gamma_2 = \overline{\gamma}^i \), \( \gamma_2 = \overline{\gamma}^g \) or \( \gamma_2 = \gamma_2^F \).
$$B_1^{I,s} = \max_{\tilde{D}_1^{i,s}, \tilde{D}_2^{i,s}, \tilde{D}_2^{i,B}} \min\left[ (1 - \gamma_i^s)C_1 + q_i^{G}\left(\tilde{D}_2 + \tilde{D}_2^{G}\right) + (1 - q_i^{G})\tilde{D}_2^{B}, q_i^{G}\left((1 - \rho)C_2 + \tilde{D}_2^{G} + q_i^{i,s}(\tilde{D}_2^{B}) - \theta^H \rho C_3\right) + (1 - q_i^{G})(\tilde{D}_2^{B} + q_i^{i,s}(\tilde{D}_2^{B}) - \theta^H \rho C_3) \right]$$

Finally, consider the period 1 incentive problem for the incumbent in setting $\gamma_i^s$. Suppose $B_1^{H,s}(\tilde{\gamma}^i) \geq B_1^{I,s}(\tilde{\gamma}^i)$, so that outsiders can always pay more than industry insiders. Then having promised high payments, the incumbent has no incentive to set general pledgeability high since she knows that no matter what she sets it at, the maximum outside bid in the auction at the end of the period will be by an industry outsider. She will set general pledgeability low, but will set incumbent pledgeability high if that makes it possible for her to beat the outsider.

Suppose instead that $B_1^{H,s}(\tilde{\gamma}^i) > B_1^{I,s}(\tilde{\gamma}^i)$. Let $B_1^{min,s} = \max\{B_1^{L,s}, B_1^{H,s}(\gamma_i^s)\}$. This is the minimum bid the incumbent will face. Once again, we are interested in the maximal possible promised payment $\tilde{D}_1^{s, Max}$ which is enforceable given the incumbent’s incentives. Along the lines of the analysis in period 2, when the incumbent’s choice does not lead to a change in control so long as she remains capable, the maximal promised payout $\tilde{D}_1^{s, Pay IC}$ solves equation

$$\theta^H V_{1+}^{i,s}(\tilde{\gamma}^i, \tilde{D}_1^{s, Pay IC}) + (1 - \theta^H)\left( B_1^{H,s}(\tilde{\gamma}^i, \tilde{D}_1^{s, Pay IC}) - \tilde{D}_1^{s, Pay IC}\right) - \varepsilon = \theta^H V_{1+}^{i,s}(\tilde{\gamma}^i, B_1^{min,s}),$$

where $V_{1+}^{i,s}(\tilde{\gamma}^i, d)$ is the maximum expected rent a high type incumbent can get if she wins the auction at date 1 after setting incumbent pledgeability at its maximum $\tilde{\gamma}^i$ and promised repayments enough to repay $d$.

Specifically, $V_{1+}^{i,s}(\tilde{\gamma}^i, d) = \max_{\tilde{D}_1^{i,s} \leq \tilde{D}_1^{G}, \tilde{D}_2^{i,B} \leq \tilde{D}_2^{B, Max}} q_i^{G}\left((1 - \tilde{\gamma}^i)C_2 + V_{1+}^{i,s}(\tilde{D}_2^{G})\right) + (1 - q_i^{G})V_{2+}^{i,s}(\tilde{D}_2^{B})$ such
\[ (1 - \gamma_1^g)C_1^i + sG + q^{sG}(\overline{\gamma}^i C_2 + \overline{D}_2^{sG}) + (1 - q^{sG})\overline{D}_2^{sB} \geq d. \]  

If the payment to retain control does not dynamically affect future control, this reduces to \( D_1^s\text{Pay}_{IC} = \theta^H B_1^{\text{min},s} + (1 - \theta^H) B_1^{H,s}(\overline{\gamma}^g) - \epsilon \) which is analogous to the date 2 expression \( D_2^s\text{Pay}_{IC} \). Similarly, when the choice of pledgeability leads to a change in control, we have:

\[
D_1^{s_{\text{Control}_{IC}}} = B_1^{H,s}(\overline{\gamma}^g) + \theta^H(q^{sG} \rho C_2 + \theta^H \rho C_3) - \theta^H V_{1+}^{i,s}(\overline{\gamma}^i, B_1^{\text{Min},s}) - \epsilon.
\]

It follows along the lines shown at date 2 that the promised state-contingent payment which pledges a maximum amount to a lender at date 1 is:

**Lemma 2** \(^{12}\)

1. If \( B_1^{\text{min},s} \geq (1 - \rho)(q^{sG} C_2 + C_3), \overline{D}_1^{s,\text{Max}} = (1 - \rho)(q^{sG} C_2 + C_3), \) and \( \gamma_2^g = \gamma_2^g \)

For any promised payment \( D_1^s \leq \overline{D}_1^{s,\text{Max}} \), the incumbent expects

\[
V_{1+}^{i,s}(\overline{D}_1^i) = (1 - \rho)(q^{sG} C_2 + C_3) + \theta^H \rho(q^{sG} C_2 + \theta^H C_3) - \overline{D}_1^s.
\]

2. else if \( (1 - \rho)(q^{sG} C_2 + C_3) > B_1^{\text{min},s} \geq B_1^{H,s}(\overline{\gamma}^g), \overline{D}_1^{s,\text{Max}} = B_1^{\text{min},s} \text{ and } \gamma_2^g = \gamma_2^g \)

---

\(^{11}\) Since all contingent payments are risk free, the \( \gamma_2^f \) that maximizes the high ability incumbent’s rents, \( V_{1+}^{i,s}(\gamma_2^f, \overline{D}_1^i), \) is \( \overline{\gamma}^i \). Intuitively, the incumbent prefers to remain in control, so he prefers increasing \( \gamma_2^f \) and lowering contingent payments \( \{D_2^{sG}, D_2^{sB}\} \) to enable himself to match the outside bid. We assume in the way expressions are written that \( (1 - \gamma_1^g)C_1^i + sG + q^{sG}(\overline{\gamma}^i C_2) \leq \overline{D}_1^s \). The alternative cases are equally straightforward.

\(^{12}\) Case 2 below includes two situations. First, \( (1 - \rho)(q^{sG} C_2 + C_3) > B_1^{I,s} > B_1^{H,s}(\overline{\gamma}^g) \) so that the low types bid the highest. Second, \( (1 - \rho)(q^{sG} C_2 + C_3) > B_1^{H,s}(\overline{\gamma}^g) = B_1^{H,s}(\gamma_2^g) > B_1^{I,s} \) so that industry insiders bid the highest (but not as much as the full expected future cash flow).
For any promised payment $\hat{D}_1^s \leq \hat{D}_1^{s,\text{Max}}$, the incumbent gets $V_{1,i,s}^i(\hat{D}_1^s) = B_{1,i,s}^\text{Min} + \theta^H \rho(q^sG_2 + \theta^H C_3) - \hat{D}_1^s$ if $B_{1,i,s}(\overline{\gamma}_i) < \hat{D}_1^s$. If $B_{1,i,s}(\overline{\gamma}_i) \geq \hat{D}_1^s$ then the incumbent gets $V_{1,i,s}^i(\hat{D}_1^s) = \theta^H V_{1,i,s}^i(\overline{\gamma}_i, \hat{D}_1^s) + (1 - \theta^H)(B_{1,i,s}^\text{Min} - \hat{D}_1^s)$.

3. else if $B_{1,i,s}^\text{Min} > B_{1,i,s}(\overline{\gamma}_i)$ then $\hat{D}_1^{i,\text{Max}} = B_{1,i,s}(\overline{\gamma}_i) - \varepsilon$. For any promised payment $\hat{D}_1^s \leq \hat{D}_1^{i,\text{Max}}$, the incumbent chooses $\gamma_2^g = \overline{\gamma}_g$ and gets $V_{1,i,s}^i(\hat{D}_1^s) = B_{1,i,s}^H(\overline{\gamma}_g) + \theta^H \rho(q^sG_2 + \theta^H C_3) - \hat{D}_1^s - \varepsilon$ if $\hat{D}_1^s > B_{1,i,s}(\overline{\gamma}_i)$, otherwise $V_{1,i,s}^i(\hat{D}_1^s) = \theta^H V_{1,i,s}^i(\overline{\gamma}_i, \hat{D}_1^s) + (1 - \theta^H)(B_{1,i,s}^H(\overline{\gamma}_g) - \hat{D}_1^s) - \varepsilon$.

4. else if $B_{1,i,s}^H(\overline{\gamma}_g) > B_{1,i,s}^\text{Min}$ and if

(i) $B_{1,i,s}(\overline{\gamma}_i) \geq D_{1,i}^s\text{ Pay IC}$, then $\hat{D}_1^{s,\text{Max}} = D_{1,i}^s\text{ Pay IC}$. For any promised payment $\hat{D}_1^s \leq \hat{D}_1^{s,\text{Max}}$, the incumbent chooses $\gamma_2^g = \overline{\gamma}_g$ and gets $V_{1,i,s}^i(\hat{D}_1^s) = \theta^H V_{1,i,s}^i(\overline{\gamma}_i, \hat{D}_1^s) + (1 - \theta^H)(B_{1,i,s}^H(\overline{\gamma}_g) - \hat{D}_1^s) - \varepsilon$.

(ii) $D_{1,i}^s\text{ Pay IC} > B_{1,i,s}(\overline{\gamma}_i) \geq D_{1,i}^s\text{ Control IC}$, then $\hat{D}_1^{s,\text{Max}} = B_{1,i,s}(\overline{\gamma}_i)$. For any promised payment $\hat{D}_1^s \leq \hat{D}_1^{s,\text{Max}}$, the incumbent chooses $\gamma_2^g = \overline{\gamma}_g$ and gets $V_{1,i,s}^i(\hat{D}_1^s) = \theta^H V_{1,i,s}^i(\overline{\gamma}_i, \hat{D}_1^s) + (1 - \theta^H)(B_{1,i,s}^H(\overline{\gamma}_g) - \hat{D}_1^s) - \varepsilon$.

(iii) $D_{1,i}^s\text{ Control IC} > B_{1,i,s}(\overline{\gamma}_i) \geq B_{1,i,s}^\text{Min}$ then $\hat{D}_1^{s,\text{Max}} = D_{1,i}^s\text{ Control IC}$. For any promised payment $\hat{D}_1^s \leq \hat{D}_1^{s,\text{Max}}$, the incumbent chooses $\gamma_2^g = \overline{\gamma}_g$ and gets $V_{1,i,s}^i(\hat{D}_1^s) = B_{1,i,s}^H(\overline{\gamma}_g) + \theta^H \rho(q^sG_2 + \theta^H C_3) - \hat{D}_1^s - \varepsilon$ if $\hat{D}_1^s > B_{1,i,s}(\overline{\gamma}_i)$. Otherwise if $\hat{D}_1^s \leq B_{1,i,s}(\overline{\gamma}_i)$ the incumbent chooses $\gamma_3^g = \overline{\gamma}_g$ and gets $V_{1,i,s}^i(\hat{D}_1^s) = \theta^H V_{1,i,s}^i(\overline{\gamma}_i, \hat{D}_1^s) + (1 - \theta^H)(B_{1,i,s}^H(\overline{\gamma}_g) - \hat{D}_1^s) - \varepsilon$.

Proof: Follows along the lines of lemma 1.

2.2. Choices at date 0

We now know the amount of financing each type of bidder can raise at date 0 against the assets.
Following the earlier logic, an industry insider can bid the minimum of what she can raise plus her initial wealth, and the surplus she expects:

\[
B_0^H(\gamma_1^H) = \max_{D_1^H \leq D_{1,\text{Max}}^H} \min\{\omega_0^H + q^G[\gamma_1^H C_1 + \hat{D}_1^G] + (1 - q^G)\hat{D}_1^B, \\
q^G \left[ (1 - \rho)C_1 + \hat{D}_1^G + V_1^{i,G}(\hat{D}_1^G) - \theta^H(q^G \rho C_2 + \theta^H \rho C_3) \right] + (1 - q^G) \left[ \hat{D}_1^H + V_1^{i,B}(\hat{D}_1^B) - \theta^H(q^B \rho C_2 + \theta^H \rho C_3) \right]\}
\]

An industry outsider will bid

\[
B_0^L = q^G \max\{B_1^{H,G}(\bar{\gamma}) - \varepsilon, B_1^{L,G}\} + (1 - q^G) \max\{B_1^{H,B}(\bar{\gamma}) - \varepsilon, B_1^{L,B}\}.
\]

An example can help fix ideas.

**Example.**

Consider a situation where there is substantial serial correlation in states, so a good state at date 1 is followed by a very high probability of a good state at date 2, while a bad state is followed by a very high probability of a bad state. We assume that there is sufficiently low wealth of industry insiders such that there are rents to initial industry insider acquirers at date 0.

\[
\bar{\gamma'} = 0.85, \bar{\gamma}^g = 0.45 = \gamma_1^g, \gamma^g = 0.27, q^G = 0.7, q^{GG} = 0.8, q^{BG} = 0.1, \omega_0^H = 0.1, \rho = 0.3 \\
C_1 = C_2 = 1, C_3 = 1.5, \theta^H = 0.7, \varepsilon \text{ small}
\]

The full marginal value of the firm = \((1 - \rho)\left[ q^G(C_1 + q^{GG} C_2) + (1 - q^G)q^{BG} C_2 + C_3 \right] = 1.953
\]

Full marginal value of the project at date 1 in state G = \((1 - \rho)\left[ q^{GG} C_2 + C_3 \right] = 1.61
\]

Full marginal value of the project at date 1 in state B = \((1 - \rho)\left[ q^{BG} C_2 + C_3 \right] = 1.12
\]

At date 0, the high type industry insider bids \(B_0^H(\gamma_1^H) = 1.78\), which is greater than the outsider bid, \(B_0^L = 1.37\). So an industry insider buys control at date 0. The state contingent voluntary payments committed
at date 0 by the successful industry insider are \( \hat{D}_{1}^{G} = 1.61 \) in the good state (in addition to the interim pledged payment \( \gamma_{1}^{C} C_{1} = 0.45 \)) at date 1 and \( \hat{D}_{1}^{B} = 0.80 \) in the bad state at date 1. Note that \( \hat{D}_{1}^{G} = \hat{D}_{1}^{G,\text{max}} \) and \( \hat{D}_{1}^{B} = \hat{D}_{1}^{B,\text{max}} \) so that the initial high type borrows up to her financial capacity. This is because there are initial rents to the winner, who pays 1.78 at date 0 for cash flows which turn out to be worth 1.858 to her (her value is less than the full value of 1.953 because, as we show shortly, she loses control in state B at date 1, and thus does not capture all the rents).

The winner at date 0 chooses low pledgeability \( \gamma_{1}^{G} = \gamma^{G} \) in both states in period 1. There are no potential rents to bidding insiders in the Good state (at date 1, a high type industry insider will bid \( \hat{D}_{1}^{H,s} (\gamma^{G}) = 1.61 \) even with low general pledgeability). In the Bad state, a low type industry outsider can bid 0.8, which is more than the maximum incentive compatible date-1 payment of 0.7 that the high type incumbent can make. The insider can borrow enough to preserve control at date 1 if the economy continues in the Good state. However, she loses control to an industry outsider if the economy turns Bad. Even though the insider could be induced to choose high pledgeability if the promised payment were renegotiated down immediately to 0.7 after the bad state is realized, creditors will not agree since they will get more by holding out and selling to an outsider. Intuitively, the maximum moral-hazard avoiding payments insiders can promise in the low state are so low that the outsider, who is not subject to moral hazard, gains control easily by raising more financing. Moreover, because the state has a high probability of continuing to be bad, there is little cost to giving the firm over to an outsider to set right.

Interestingly, therefore, even with state-contingent payments, debt overhang will be a feature of the downturn (the incumbent who expects to lose control at date 1 in the downturn does not bother to increase either general or incumbent pledgeability), and the asset goes to outside hands at date 1. This means it generates no cash in period 2 even though it could if it were in the “right” hands. Productivity
falls simply because the asset is in the “wrong” hands. At date 2, the asset is sold back to an industry insider, and productivity goes back up.

High pledgeability $\gamma_3^g = \gamma_3^g$ is chosen in states GB, BG and BB in period 2 (in each case, there are potential period 3 rents to industry insider acquirers). In contrast, general pledgeability will be low in state GG because there is so much liquidity then that there are no potential rents to acquirers and no need for high pledgeability. The period 2 insider incumbent retains control in states GG and GB if she remains a high type. In states BG and BB, the unproductive outsiders sell the firm back to high type insiders.

Note that if an industry insider could buy the firm at date 0 without promising large payments in the downturn, the asset could continue to stay in their hands if they continued to be capable at date 1. So limited initial wealth results in inefficiency. Greater industry wealth will help assets stay in insider hands. Indeed, as long as $w_0^H > 0.14$, it is the industry insider who gains control at date 1 if the economy turns bad. As a result, high general pledgeability is chosen. When $w_0^H$ gets sufficiently large such that assets are fully priced in state B, however, low general pledgeability is again chosen by the incumbent. Therefore, it is only at intermediate levels of liquidity that the incumbent has the incentive to increase pledgeability.

What if the bad state is less persistent? If $q_{BG}=0.2$ (up from 0.1), it turns out that the initial insider winner choses high pledgeability in the bad state in period 1, but loses control to an industry insider (not an industry outsider as earlier). If $q_{BG}=0.5$, the initial insider winner again chooses high pledgeability in the bad state in period 1 but retains control if she retains her ability. Thus a higher probability of a good state conditional on being in the bad state leads to contracts being structured such that industry insiders stay in control.
If the industry turns less stable (lower $\theta'$), efficiency is improved as the industry insiders' moral hazard costs are reduced. Indeed, if $\theta' < 0.55$, industry insiders outbid outsiders at date 1 if the economy turns to state B.

III. Extensions

We now turn to two simple but important extensions. The first is to consider simple debt contracts where payments are not state contingent but fixed across states. The second is to consider the possibility that the incumbent may become inefficient relative to an industry insider, but can still produce some cash flows when she loses capability.

3.1 Simple Debt Contracts

Simple debt contracts specify a constant promised payment on a given date in all states, that is, $D_s t DD = D_t$ for all $s$, with the possibility that a lower actual payment triggers a possible auction (which can be interpreted as a bankruptcy or a renegotiation after the default). We do not add explicit frictions to make debt the optimal contract, such as costs of verifying the state at the relevant time, or explicit impediments to renegotiation before pledgeability choices are made.

Because there is a single state in period 3, the promised payment when contracts are restricted to simple debt contracts will be identical to that for state contingent contracts. Turning to period 2, there are only two possible candidates for the promised payment that would realize the maximum pledgeable expected payment across the two states; the maximum payment in each state if contracts were state contingent. From our analysis of state contingent payments, these candidates are
\[ \tilde{D}_{2, \text{Max}}^G + \gamma_2 C_2 \text{ and } \tilde{D}_{2, \text{Max}}^B. \] 13 We assume \( \tilde{D}_{2, \text{Max}}^B < \tilde{D}_{2, \text{Max}}^G + \gamma_2 C_2 \) so that the larger payment is that made in the good state. 14

If there are no potential rents to acquirers at date 2 in state B even if \( \gamma^B_2 = \gamma^G_2 \) (as in case 1 of Lemma 1) then exceeding the maximum pledgeable amount does not distort borrower behavior in that state. As a result, the higher promised payment, \( \tilde{D}_{2, \text{Max}}^G + \gamma_2 C_2 \) is the maximum pledgeable amount, implying risky debt with full payment in state G only. The pledgeability choices in this case are identical to those where financial contracts are state contingent.

When there are potential rents to acquirers in state \( B \), the incumbent’s incentive to choose high general pledgeability depends on the face value \( \tilde{D}_{2, \text{Max}}^B \). A debt contract with face value \( \tilde{D}_{2, \text{Max}}^G + \gamma_2 C_2 \) in both states will make her choose low general pledgeability in state B. The maximum amount which will be paid in state B is then \( B_{2, \text{Max}}^{H,B} (\gamma^G_2) \). At the lower face value \( \tilde{D}_{2, \text{Max}}^B \), high pledgeability will be selected and \( \tilde{D}_{2, \text{Max}}^B \) will be paid in both states. Therefore, if

\[ q^G [\tilde{D}_{2, \text{Max}}^G + \gamma_2 C_2] + (1 - q^G) [B_{2, \text{Max}}^{H,B} (\gamma^G_2)] > \tilde{D}_{2, \text{Max}}^B, \]

the higher face value will maximize expected repayment. Debt will be risky and in state B, low pledgeability is chosen. This is true when the probability of the good state \( q^G \) is sufficiently high. As the bad state becomes sufficiently likely, the low payment \( \tilde{D}_{2, \text{Max}}^B \) will be set, pledgeability will be set high in state B, and debt is safe. Somewhat interestingly, therefore, simple debt gets riskier over a range as the probability of the good state increases.

---

13 Recall that the promised payment \( \tilde{D}_{2, \text{Max}}^G \) was defined as net of the pledgeable amount \( \gamma_2 C_2 \) received in the Good state, so we must add it back to represent standard debt. This formulation assumes that the face value of contingent debt in state G exceeds \( \gamma_2 C_2 \) and thus that \( \tilde{D}_{2, \text{Max}}^G > 0 \).

14 This is by far the most plausible case. All the following analysis assumes this is true. The analysis where this assumption is violated is almost symmetric.
In all the above cases, the pledgeability choice in state G is identical to the case where contracts are state contingent.

Note that any face value $\tilde{D}_2 \in (\tilde{D}_2^{B, Max}, \tilde{D}_2^{G, Max} + \gamma_2 C_2)$ always delivers less than $\tilde{D}_2 = \tilde{D}_2^{G, Max} + \gamma_2 C_2$ as it distorts pledgeability choice in the bad state but pays less in the good state.

We obtain Lemmas similar to Lemma 1 and 2 and state the details and all of the value functions in Appendix II in Lemma 3 and Lemma 4.

Compared to state-contingent contracts, standard debt contracts will typically result in the industry insider being able to raise less (because of fear of the moral hazard consequences of debt overhang), and losing out more to industry outsiders, who do not suffer from the moral hazard caused by debt overhang. It is useful to see how simple debt contracts differ from state contingent contracts for our previous example.

**Example contd.**

First consider $q^{BG} = 0.1$. The allocation of the firm is identical to the state contingent case: a high type wins initially, retaining control if she stays a high type in state G but losing to an industry outsider in state B. In period 2, the pledgeability choices with state-contingent contracts are $\gamma_3^G = \gamma_3^G$ in state GG and $\gamma_3^G = \gamma_3^G$ in other states. With simple debt contracts, in state G at date 1, the incumbent will choose to promise a high level of debt at date 2. There are no potential rents to acquirers in state GG so the incumbent prefers $\gamma_3^G = \gamma_3^G$ for any level of debt in that state. But in state GB, the incumbent reduces pledgeability again to the minimum, because of the high payment induced by state GG. So simple debt creates an underincentive to pledge (a form of standard debt overhang). This increases upfront rents to the initial incumbent, who has a lower ability to commit to pay financiers with simple debt contracts relative to state contingent contracts.
Next consider \( q^{BG} = 0.2 \). With state contingent contracts, the incumbent chose high pledgeability in state B in period 1, and industry insiders acquired the firm at date 1. With simple debt contracts, the incumbent chooses low pledgeability in state B in period 1, and industry outsiders acquire the firm at date 1 (similar to when \( q^{BG} = 0.1 \)). Once again, simple debt leads to lower pledgeability, and induces a different ownership pattern than financing with state contingent contracts. Finally, with \( q^{BG} = 0.5 \), it is again easy to show that pledgeability in period 1 in state B and in period 2 in state BG and BB are all set low, even while the incumbent always retains control if capable. The rents to the initially successful bidder commensurately increase, while the payout that can be committed to financiers also decreases. The point in all these cases is that the highly liquid G state induces high debt to be taken, which exacerbates moral hazard over pledgeability.

So far we have assumed that renegotiation never occurs. If debt is allowed to be renegotiated after the state is known but before the incumbent chooses pledgeability, and if all the surplus from renegotiation goes to the lender, the outcomes (pledgeability choice and cash flows produced) at date 2 are identical to those where state contingent payments are allowed, as formalized in Lemma 1. This is because reducing the promised payment to the maximum pledgeable amount in a given state is in the interest of both lender and incumbent (and further reductions would benefit the incumbent). At date 1, however, it is easy to see cases once again where the debt in the bad state remains too high for high pledgeability to be chosen but the lender will not negotiate it down because he plans to sell to an industry outsider.\(^{15}\) This could explain why the debt does not get renegotiated down, and why productivity turns down in a downturn.

\(^{15}\) For instance, if \( B_{1}^{H,B} (\gamma^{B}) > B_{1}^{L,B} > D_{1}^{B,Max} \), the lender could renegotiate down the face value to \( D_{1}^{B,Max} \) to provide incentives for choice of high general pledgeability. If this was done, insiders could always outbid the outsiders. However, the lender has no interest in this debt reduction and will keep the debt level high to get the benefit of selling to an industry outsider, rather than negotiate down in period 1.
3.2 Pledgeability choice before the current state is known

For robustness, we have also solved the model if the incumbent issues uncontingent debt and chooses general pledgeability before the period’s state is revealed. This could represent pledgeability choice when pledgeability is more durable. When pledgeability is selected before the state is revealed, the incentive constraint for setting pledgeability is different: it considers the tradeoff given the probability distribution of state realizations. High liquidity in a high probability state enhances the maximum payable amount conditional on that state occurring, which then induces low pledgeability across states. Therefore, for both assumptions on timing of pledgeability, simple debt leads to increased incentives for low pledgeability in a boom (where the probability of the good state is high).

3.3. Inefficient Incumbency

Let us now turn to a different possibility than inflexible debt contracts. What if the incumbent loses ability with probability \( (1 - \theta^H) \) as before, but can still produce \( \alpha C_i \) in the firm when the state is good, where \( \alpha \in (0,1) \), instead of \( \alpha = 0 \) as previously assumed? The disabled incumbent’s productivity now lies between that of the able industry insider, who can produce \( C_i \) when the state is good, and the industry outsider, who can produce nothing. A new source of moral hazard emerges: the incumbent may want to retain the firm even when she loses ability. This may necessitate still lower maximum debt so as to restore incentives.

An incumbent who is able at date 1 will remain high ability (H) at date 2 with probability \( \theta^H \) and be able to bid up to \( B_{2}^{iH,s}(\gamma^i) = (1 - \gamma^i)j_{[s=G]}C + \gamma^iC \) if the period 2 state is \( s \), where \( i \) is the indicator variable. The incumbent is disabled (L) with probability \( (1 - \theta^H) \) and can bid up to

\[
B_{2}^{iL,s}(\gamma^i) = (1 - \gamma^i)j_{[s=G]}C + \gamma^i\alpha C.
\]

To simplify notation, let us assume that, as before, the disabled incumbent can produce nothing if she leaves the firm.
Note that if $\alpha C_3 \leq B^{H,s}_2(\gamma^g)$ or $B^{L,s}_2(\gamma^i) < B^{H,s}_2(\gamma^g)$, the maximum debt capacity derived in Lemma 1 remains unchanged. Intuitively, the first inequality indicates that the disabled incumbent can get more by selling than by holding on, even after setting pledgeability low, so she will always sell when she loses ability. The second inequality indicates that the disabled incumbent cannot match the lowest possible outside offer, so once again she will have to sell even at the lowest level of debt capacity. Given that she sells when she loses ability, the analysis is then identical to that leading to Lemma 1.

Matters are different when $\alpha C_3 > B^{H,s}_2(\gamma^g)$ and $B^{L,s}_2(\gamma^i) \geq B^{H,s}_2(\gamma^g)$. First consider $\alpha C_3 \geq B^{H,s}_2(\gamma^g)$. Now it is impossible to incentivize the incumbent to choose high pledgeability. By retaining control, not only does she generate more cash flow than the highest possible outside bid, she can (weakly) reduce payout for any level of debt by choosing low pledgeability. She also retains control under all circumstances after choosing low pledgeability (because $B^{L,s}_2(\gamma^i) \geq B^{H,s}_2(\gamma^g)$). So low pledgeability is what she will always choose, and she will always retain control. This outcome is efficient if and only if $\alpha C_3 \geq (1 - \rho)C_3$. Moreover, the maximum debt she can borrow will be $B^{H,s}_2(\gamma^g)$.

That leaves $B^{H,s}_2(\gamma^g) > \alpha C_3 \geq B^{H,s}_2(\gamma^g)$. To determine $D^s_{2\text{PayIC}}$, we need to first consider the case where $B^{H,s}_2(\gamma^i) \geq B^{H,s}_2(\gamma^g)$, that is the incumbent can outbid industry insiders at date 2 if she retains her ability, even after choosing high pledgeability. For her to have the incentive to do so (and along the lines of our analysis for Lemma 1), it must be that

$$
\theta^H(C_3 - D^s_{2\text{PayIC}}) + (1 - \theta^H)(B^{H,s}_2(\gamma^g) - D^s_{2\text{PayIC}}) - \varepsilon \\
\geq \theta^H(C_3 - B^{H,s}_2(\gamma^g)) + (1 - \theta^H)(\alpha C_3 - B^{H,s}_2(\gamma^g))
$$

The left hand side is what the incumbent can get by choosing high pledgeability and selling when she loses ability, and the right hand side is what she gets by choosing low pledgeability and retaining control.
even after losing ability. It is easily seen that

\[ D_{2}^{\text{PayIC}} = (1 - \theta^H)B_{2}^{H,s}(\bar{y}^{g}) + \theta^H B_{2}^{H,s}(\gamma^{g}) - (1 - \theta^H)[\alpha C_{3} - B_{2}^{H,s}(\gamma^{g})] - \varepsilon \]

Similarly, when \( B_{2}^{H,s}(\bar{y}^{g}) > B_{2}^{H,s}(\bar{y}^{i}) \geq B_{2}^{H,s}(\gamma^{g}) \), it can be shown that

\[ D_{2}^{\text{Control IC}} = B_{2}^{H,s}(\bar{y}^{g}) - \theta^H[(1 - \rho)C_{3} - B_{2}^{H,s}(\gamma^{g})] - (1 - \theta^H)[\alpha C_{3} - B_{2}^{H,s}(\gamma^{g})] - \varepsilon \]

Comparing with our earlier values for lemma 1, we can see that these values, indicating the maximum incentive compatible debt capacity under different circumstances, are lower by

\( (1 - \theta^H)[\alpha C_{3} - B_{2}^{H,s}(\gamma^{g})] \), which is the expected rent the incumbent earns if she chooses low pledgeability and turns out to be of disabled.

Somewhat paradoxically, the higher the retention of ability \( \alpha \) by the incumbent, the lower the incentive to pledge, and lower the debt she can raise. The consequences of debt overhang, even under state-contingent contracts, are thus even more serious – because “pledgeable” debt capacity is so low for an industry insider, the incentive for creditors to seize and sell assets to an industry outsider when liquidity falls off increases. In a richer model with differentiated firms, productivity differentials will increase as liquidity falls off, based on how much debt a firm had taken on during the period of high liquidity. We complete the analysis for earlier dates in the appendix.

Example contd.

Consider the situation where the disabled incumbent retains a small fraction of her ability, \( \alpha = 0.1 \). It turns out that the high ability industry insider wins control at date 0, similar to when \( \alpha = 0 \). Interestingly, the main change in period 1 is in state B, where the high ability incumbent now chooses high general pledgeability. This is because while she knows she will lose ownership if she retains ability (because the industry outsider can outbid her, given the incumbent’s moral hazard), she will be able to outbid the industry outsider if she loses ability (not only does the disabled incumbent suffers no
moral hazard because she wants to sell out at date 2, she also can pledge some cash flow earned in state BG in period 2 and thus can outbid the industry outsider at date 1). However, while the date 0 owner retains ownership of the firm at date 1 in more situations, and also gets more surplus, she cannot pay any more at date 0, because the payment that can be forced out of her in state B at date 1 is limited to what the industry outsider is willing to bid for the firm.

Now consider $\alpha = 0.4$, so the disabled incumbent retains more ability. It now turns out that the disabled incumbent is efficient enough that $\alpha C_2 = 0.6 > B^{H, BB}_2 (\gamma^B) = 0.505$. This implies the IC constraint to choose high pledgeability will bind at a lower level of promised payment. As a result, the maximal amount that the incumbent can promise in state BB is reduced from $\hat{D}_{2, max}^{BB} = \hat{D}_{2, PayIC} = 0.586$ to $\hat{D}_{2, max}^{BB} = \hat{D}_{2, PayIC} = 0.5575$. While the disabled incumbent’s maximum bid at date 1, $B^{H,B} (\gamma^i)$, is reduced, she still can outbid the industry outsider.

However, if $\alpha = 0.6$, the amount of incentive compatible payment at date 2 that the disabled incumbent can commit to is so low that she cannot outbid the industry outsider at date 1. Outcomes are now the same as with $\alpha = 0$. Interestingly, in situations where insiders cannot outbid the incumbent at date 1 (e.g., $w^H_0 = 0$) outsiders now perform a valuable service – of taking the asset from the disabled incumbent at date 1 and transferring it to an able insider at date 2, thus reducing the extent of entrenchment. This is unlike their role in previous examples, where they merely transferred assets from able incumbents to other able insiders. The role of outsiders in promoting more efficient allocations could be thought of as part of the “cleansing” that occurs in recessions.

IV. Discussion and 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. When the bidder can pay full dollar up front for the asset or the asset goes to the outsider, the first moral hazard problem disappears, and so does the
moral hazard over pledgeability. Low pledgeability is chosen. When the future bidder can appropriate over and above what she pays, high pledgeability can reduce rents. So the second moral hazard problem also becomes relevant, and debt capacity is limited by the need to retain incentives for pledgeability.

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 promise to be good. Also, institutions supporting pledgeability, such as forensic accountants, regulations, and regulators, may atrophy from disuse at such times. Moral hazard increases as bad times become more likely because incumbents have the incentive to enhance their own value by reducing the value of outside financial claimants. Hence financial capacity falls in bad times until outsiders take control. 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 seamlessly 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 seamless. Economic activity can be

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16 While we do not model investment, the point we make would become stronger still if we did. 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, over and above the effects of leverage.
disrupted until enforcement is restored. Real investment, which we do not model, could fall significantly under these circumstances, even when it is positive net present value.

Another way of thinking about these financing cycles is that the pre-peak stage of the industry, where debt capacity relies on the creditors ability to threaten asset sales, may be associated with arm’s length debt. The post-crash stage, where debt capacity relies on cash flow pledgeability (and probably close monitoring), may be more associated with bank or intermediated credit. So our model suggests a pattern of change in the source of credit over time. It also 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. The haircuts fall in proportion to both the liquidity of industry insiders (on the upturn) and the restoration of pledgeability (in the downturn), with a possible steep increase as the state of the economy switches from upturn to downturn.

Finally, the fluctuation in debt capacity may be larger if the range of possible values of cash flow pledgeability that can be chosen is larger. To the extent that financial infrastructure such as accounting standards or collateral registries as well as contractual right 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 (forensic accountants retrain as brokers during the boom), 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 are asset price booms and busts.

This paper has focused on the choice of general pledgeability, assuming incumbent pledgeability to be costless. We develop implications for pledgeability enhancing devices such as accounting choice, routine production plans and bond covenants. Incumbent pledgeability could be thought of as relationship lending, which may have varying importance over the cycle. We plan to explore more of these implications in future work.
References


Appendix I: Proof of Corollary 1.

If \( \phi_{2}^{H,s} = 0 \) and there are potential rents to acquirers, then
\[
D_{2}^{\text{Pay IC}} = \theta^{H} B_{2}^{H,s}(\gamma^{g}) + (1 - \theta^{H}) B_{2}^{H,s}(\gamma^{g}) - \varepsilon = \theta^{H}(\gamma^{g} C_{3}) + (1 - \theta^{H}) \max \{\gamma^{g} C_{3}, (1 - \rho C_{3})\} - \varepsilon \\
\leq B_{2}^{i,s}(\gamma^{i}) \text{ because } \gamma^{i} \leq \gamma^{g} \text{ and we thus are in case (3ii) of Lemma 1. In case (3iii)},
\]
\[
\tilde{D}_{2}^{i,\text{Max}} = D_{2}^{\text{Pay IC}} - \varepsilon , \text{ which is increasing in } \phi_{2}^{H,s} \text{ until it approaches } B_{2}^{i,s}(\gamma^{i}) - \varepsilon . \text{ As } \phi_{2}^{H,s}
\]
increases, eventually \( D_{2}^{i,\text{Max}} > B_{2}^{i,s}(\gamma^{i}) - \varepsilon \) and we are in case (3iii) where
\[
\tilde{D}_{2}^{i,\text{Max}} = B_{2}^{i,s}(\gamma^{i}) - \varepsilon \text{ and is not a function of } \phi_{2}^{H,s} . \text{ A sufficient increase in } \phi_{2}^{H,s} \text{ implies case (3iii)}
\]
where \( \tilde{D}_{2}^{i,\text{Max}} > B_{2}^{i,s}(\gamma^{i}) - \varepsilon \) and \( \tilde{D}_{2}^{i,\text{Max}} = D_{2}^{\text{Control IC}} - \varepsilon \) again increasing in \( \phi_{2}^{H,s} \).

Further increases in \( \phi_{2}^{H,s} \) bring us to \( B_{2}^{H,s}(\gamma^{g}) > B_{2}^{i,s}(\gamma^{i}) \) which is case (2) (because
\[
(1 - \rho)C_{3} > B_{2}^{H,s}(\gamma^{g}) \geq B_{2}^{i,s}(\gamma^{i}) \text{ and } \tilde{D}_{2}^{i,\text{Max}} = B_{2}^{H,s}(\gamma^{g}) - \varepsilon , \text{ which is increasing in } \phi_{2}^{H,s} .
\]
Further increases in \( \phi_{2}^{H,s} \) yield \( B_{2}^{H,s}(\gamma^{g}) \geq (1 - \rho)C_{3} \) and we are in case 1 with \( \tilde{D}_{2}^{i,\text{Max}} = (1 - \rho)C_{3} \) and there are no longer rents to acquirers.

Q.E.D.

Appendix II: Characterization of simple debt contracts when the current period state is known when the choice of pledgeability is made.

Lemma 3
Let the state in date 1 be \( s \),

1. (No potential rents in either state) If \( B_{2}^{H,sB}(\gamma^{g}) \geq (1 - \rho)C_{3} \), \( D_{2}^{\text{Max}} = \gamma_{2} C_{2} + (1 - \rho)C_{3} \) is the maximum face value of the debt and \( \gamma^{g}_{3} = \gamma^{g} \),

For any promised payment \( D_{2}^{s} \leq D_{2}^{\text{Max}} \), financiers recover \( D_{2}^{sG} = D_{2}^{s} \) in state \( sG \) and \( D_{2}^{sB} = \min \{D_{2}^{s},(1 - \rho)C_{3}\} \) in state \( sB \).

The incumbent’s value function is as follows:
\[
\begin{cases}
J_{2}^{sG}(D_{2}^{s}) = V_{2}^{sG}(D_{2}^{s} - \gamma_{2} C_{2}, \gamma^{g}) \\
J_{2}^{sB}(D_{2}^{s}) = V_{2}^{sB}(D_{2}^{s}, \gamma^{g})
\end{cases}
\]

2. (Potential rents in State B) Else if \( (1 - \rho)C_{3} > B_{2}^{H,sB}(\gamma^{g}) \),
(i) (If only in state B) If \( B_{2}^{H,sG}(\gamma^{g}) \geq (1 - \rho)C_{3} \),
\[ a. \text{ If } q^{G} = \frac{D_{2}^{H,sG}(\gamma^{g})}{B_{2}^{H,sB}(\gamma^{g})} > \frac{1 - q^{G}}{B_{2}^{H,sB}(\gamma^{g})} \geq D_{2}^{B,\text{Max}} ,
\]
\[ D_{2}^{B,\text{Max}} = \gamma_{2} C_{2} + (1 - \rho)C_{3} , \gamma^{g}_{3} = \gamma^{g} \text{ in both state } sG \text{ and state } sB \text{. For any promised payment } D_{2}^{B,\text{Max}} < D_{2}^{s} \leq D_{2}^{s,\text{Max}} , \text{ financiers recover } D_{2}^{sG} = D_{2}^{s} \text{ in state } sG \text{ and }
\]
\[ D_{2}^{sB} = B_{2}^{H,sB}(\gamma^{g}) \text{ in state } sB \].

The incumbent’s value function is as follows:
\[
\begin{align*}
J_{2}^{i,sG}(D_{2}^{s}) &= V_{2}^{i,sG}(D_{2}^{s} - \gamma_{2}C_{2}, \gamma^{s}) \\
J_{2}^{i,sB}(D_{2}^{s}) &= V_{2}^{i,sB}(D_{2}^{s}, \gamma^{s})
\end{align*}
\]

b. Else if \(q^{sG}[\tilde{D}_{2}^{s,Max} + \gamma_{2}C_{2}] + (1 - q^{sG})[B_{2}^{H,sB}(\gamma^{s})] \leq \tilde{D}_{2}^{s,Max},\)
\[
D_{2}^{s,Max} = \tilde{D}_{2}^{s,Max}. \quad \gamma^{s}_{3} = \gamma^{s} \text{ in state } sG \text{ and } \gamma^{s}_{3} = \gamma^{s} \text{ in state } sB.
\]

For any promised payment \(D_{2}^{s} \leq D_{2}^{s,Max},\) financiers recover \(D_{2}^{sG} = D_{2}^{s}\) in state \(sG\) and \(D_{2}^{sB} = D_{2}^{s}\) in state \(sB.\)

The incumbent’s value function is as follows:
\[
\begin{align*}
J_{2}^{i,sG}(D_{2}^{s}) &= V_{2}^{i,sG}(D_{2}^{s} - \gamma_{2}C_{2}, \gamma^{s}) \\
J_{2}^{i,sB}(D_{2}^{s}) &= V_{2}^{i,sB}(D_{2}^{s}, \gamma^{s})
\end{align*}
\]

(ii) (Potential rents in both states) Else if \((1 - \rho)C_{3} > B_{2}^{H,sG}(\gamma^{s}),\)

a. If \(q^{sG}[\tilde{D}_{2}^{s,Max} + \gamma_{2}C_{2}] + (1 - q^{sG})[B_{2}^{H,sB}(\gamma^{s})] > \tilde{D}_{2}^{s,Max},\)
\[
D_{2}^{s,Max} = \tilde{D}_{2}^{s,Max} + \gamma_{2}C_{2}, \quad \gamma^{s}_{3} = \gamma^{s} \text{ in state } sG \text{ and } \gamma^{s}_{3} = \gamma^{s} \text{ in state } sB. \text{ For any promised payment } \hat{D}_{2}^{s,Max} < D_{2}^{s} \leq D_{2}^{s,Max}, \text{ financiers recover } D_{2}^{sG} = D_{2}^{s} \text{ in state } sG \text{ and } D_{2}^{sB} = B_{2}^{H,sB}(\gamma^{s}) \text{ in state } sB.
\]

The incumbent’s value function is as follows:
\[
\begin{align*}
J_{2}^{i,sG}(D_{2}^{s}) &= V_{2}^{i,sG}(D_{2}^{s} - \gamma_{2}C_{2}, \gamma^{s}) \\
J_{2}^{i,sB}(D_{2}^{s}) &= V_{2}^{i,sB}(D_{2}^{s}, \gamma^{s})
\end{align*}
\]

b. Else if \(q^{sG}[\tilde{D}_{2}^{s,Max} + \gamma_{2}C_{2}] + (1 - q^{sG})[B_{2}^{H,sB}(\gamma^{s})] \leq \tilde{D}_{2}^{s,Max},\)
\[
D_{2}^{s,Max} = \tilde{D}_{2}^{s,Max}. \quad \gamma^{s}_{3} = \gamma^{s} \text{ in both state } sG \text{ and state } sB.
\]

For any promised payment \(D_{2}^{s} \leq D_{2}^{s,Max},\) financiers recover \(D_{2}^{sG} = D_{2}^{s}\) in state \(sG\) and \(D_{2}^{sB} = D_{2}^{s}\) in state \(sB.\)

The incumbent’s value function is as follows:
\[
\begin{align*}
J_{2}^{i,sG}(D_{2}^{s}) &= V_{2}^{i,sG}(D_{2}^{s} - \gamma_{2}C_{2}, \gamma^{s}) \\
J_{2}^{i,sB}(D_{2}^{s}) &= V_{2}^{i,sB}(D_{2}^{s}, \gamma^{s})
\end{align*}
\]

A.1 Decisions on Date 1
In the end of date 1 auction, all bidders, including industry outsiders will bid. We will back out the maximum bid by each type. This then allows us to determine who wins the auction in each state at date 1.

For any \(D_{2}^{s} \leq D_{2}^{s,max},\) the insider has the resource to bid up to
\[
\omega_{1}^{H,s} + q^{sG}D_{2}^{sG}(D_{2}^{s}) + (1 - q^{sG})D_{2}^{sB}(D_{2}^{s}) \text{ where } D_{2}^{sG}(D_{2}^{s}) \text{ and } D_{2}^{sB}(D_{2}^{s}) \text{ are the actual amount that financiers are able to recover as a function of a given face value } D_{2}^{s}. \text{ The additional surplus he hopes to}
gain by acquiring the firm at date 1 is
\[
q^G \left( (1 - \rho)C_2 + D^G_2 (D^s_2) - \gamma C_2 + J_{1^s}^G (D^s_2) - \theta^H \rho C_3 \right) + (1 - q^G) (D^G_2 (D^s_2) + J_{1^s}^{i^s} (D^s_2) - \theta^H \rho C_3).
\]
So the industry insider’s maximum bid with promised \( D^G_2 (D^s_2), D^B_2 (D^s_2) \) and pre-set pledgeability \( \gamma^s \) is
\[
B^H,s_1 (\gamma^s) = \max_{D^s_2 \leq D^s_2} \min \left[ \omega^H,s_1 + q^G D^G_2 (D^s_2) + (1 - q^G) D^B_2 (D^s_2),
q^G \left( (1 - \rho)C_2 + D^G_2 (D^s_2) - \gamma C_2 + J_{1^s}^G (D^s_2) - \theta^H \rho C_3 \right) + (1 - q^G) (D^G_2 (D^s_2) + J_{1^s}^{i^s} (D^s_2) - \theta^H \rho C_3) \right] .
\]
The industry outsider also bids, he pays up to
\[
B^L,s_1 = \max \{ B^H,s_2 (\gamma^s) - \epsilon, q^G [ B^H,s_2 (\gamma^s) - \epsilon ] + (1 - q^G) B^H,s_2 (\gamma^s) \} .
\]
The higher face value \( B^H,s_2 (\gamma^s) - \epsilon \) enables him to pledge more in state G. In the meantime, he cannot commit to set pledgeability high in state B. Let \( B^I_{1,\min,s} = \min \{ B^L,s_1, B^H,s_1 (\gamma^s) \} \).

Consider now the incumbent at date 1. He can pay up to
\[
B^I_{1,s} (\gamma^s) = (1 - \gamma^s) C_1 i_{s=G} + q^G D^G_2 (D^s_2) + (1 - q^G) D^B_2 (D^s_2)
\]
where \( i_{s=G} \) is an indicator variable for the period 1 state, \( \gamma^s \) is the date-1 pledgeability set before date 0, and \( D^G_2 (D^s_2) \) and \( D^B_2 (D^s_2) \) are the state contingent date-2 payments that financiers can recover by setting face value \( D^s_2 \). Here \( D^s_2 \leq D^s_2,\max \) and \( D^s_2,\max \) is an implicit function of \( \gamma^s \).

Finally, consider the period 1 incentive problem for the incumbent in setting \( \gamma^s \). To derive the incentive effects of promised payments in each state, we examine the effects of an arbitrary promised payment a given state at date 1 with knowledge that a simple debt contract is used at date 2. This allows us to analyze the effects on any given debt contract. Following the earlier analysis when contracts are state contingent, we define \( D^s_2,\max IC = \theta^H B^I_{1,\min,s} + (1 - \theta^H) B^H,s_1 (\gamma^s) - \epsilon \) and \( D^s_2,\max IC = B^H,s_1 (\gamma^s) + \theta^H (q^G \rho C_2 + \theta^H \rho C_3) - \theta^H \gamma^s \rho (\gamma^s, B^I_{1,\min,s} - \epsilon) \) where \( J^i_{1^s} (\gamma^s, B^I_{1,\min,s}) \) is the maximum expected rent a high type incumbent can get if he wins the auction at date 1 after setting general pledgeability low, incumbent pledgeability at its maximum \( \gamma^s \), and promised repayments enough to beat the outside bid \( B^I_{1,\min,s} \). Specifically, if the incumbent must make a payment of \( D^s_2 \) to maintain control in state \( s \), the value of retaining control and making that payment in state \( s \) is given by:
\[
J^s_{1} (\gamma^s, D^s_2) = \max_{D^s_2 \leq D^s_2,\max IC} q^G \left( (1 - \gamma^s) C_2 + J_{1^s}^G (D^s_2) \right) + (1 - q^G) J_{1^s}^{i^s} (D^s_2)
\]

Such that
\[
(1 - \gamma^s) C_1 i_{s=G} + q^G D^G_2 (D^s_2) + (1 - q^G) D^B_2 (D^s_2) \geq D^s_2.
\]

Similar to Lemma 3, we discuss three cases: in neither state is the borrower on her IC constraint; only in state B is she on her IC constraint and in both states is she on her IC constraint. Again, there are two candidates for the maximum pledgeable face value of debt. We assume that
\[
D^G_2 ,\max IC + \gamma^s C_1 \geq D^B_2 ,\max IC \gamma^s IC and the rest of the analysis is identical to that at date 2.
Lemma 4 below describes the maximal pledgeable face value $D^\text{Max}_1$, the specific amount the financiers recover as a function of the face value $D^i_1 = D^i_1(D_1)$ in state G and B, as well as the associated payoff the incumbent gets $J^{i,s}_1(D^i_1)$ (including any payoffs he gets as an industry insider if he loses control) beyond date 2 for any $D_1 \leq D^\text{Max}_1$.

**Lemma 4**

1. (Neither state is on IC constraint) If $B^\text{min, B}_1 \geq (1 - \rho)(q^BG C_2 + C_3)$ or \((1 - \rho)(q^BG C_2 + C_3) > B^\text{min, B}_1 \geq B^H,G_1(\overline{\gamma})\), and if $B^\text{min,G}_1 \geq (1 - \rho)(q^GG C_2 + C_3)$, or if \((1 - \rho)(q^GG C_2 + C_3) > B^\text{min,G}_1 \geq B^H,G_1(\overline{\gamma})\),

   $$D^\text{Max}_1 = \gamma^g C_1 + \hat{D}^\text{G,Max}_1$$

   is the maximum face value of the debt and $\gamma^g_2 = \overline{\gamma}_g$ in both states.

   For any promised payment $D_1 \leq D^\text{Max}_1$, financiers recover $D^G_1 = D_1$ in state G and

   $$D^B_1 = \min\{D_1, B^\text{min, B}_1\}$$

   in state B.

   The incumbent’s value function is as follows:

   $$\begin{cases} J^{i,G}_1(D_1) = V^{i,G}_1(D_1 - \gamma^G_1 C_1, \gamma^g_2) \\ J^{i,B}_1(D_1) = V^{i,B}_1(D_1, \gamma^g_2) \end{cases}$$

2. Else if $B^H,B_1(\overline{\gamma}) > B^L,B_1$,

   (i) (Only state B is on IC constraint) If $B^\text{min,G}_1 \geq (1 - \rho)(q^GG C_2 + C_3)$, or if \((1 - \rho)(q^GG C_2 + C_3) > B^\text{min,G}_1 \geq B^H,G_1(\overline{\gamma})\),

   a. If $q^G[B^\text{min,B}_1 + \gamma_1 C_1] + (1 - q^G)B^\text{min,B}_1 > \hat{D}^\text{B,Max}_1$,

   $$D^\text{Max}_1 = \hat{D}^\text{G,Max}_1 + \gamma_1 C_1, \gamma^g_2 = \overline{\gamma}_g$$

   in both state G and state B. For any promised payment $\bar{D}^\text{B,Max}_1 < D_1 \leq D^\text{Max}_1$, financiers recover $D^G_1 = D_1$ in state G and $D^B_1 = B^\text{min,B}_1$ in state $sB$.

   The incumbent’s value function is as follows:

   $$\begin{cases} J^{i,G}_1(D_1) = V^{i,G}_1(D_1 - \gamma_1 C_1, \gamma^g_2) \\ J^{i,B}_1(D_1) = V^{i,B}_1(D_1, \gamma^g_2) \end{cases}$$

   b. Else if $q^G[B^\text{min,B}_1 + \gamma_1 C_1] + (1 - q^G)B^\text{min,B}_1 \leq \hat{D}^\text{B,Max}_1$,

   $$D^\text{Max}_1 = \hat{D}^\text{B,Max}_1, \gamma^g_2 = \overline{\gamma}_g$$

   in state G and $\gamma^g_2 = \overline{\gamma}_g$ in state B.

   For any promised payment $D_1 \leq D^\text{Max}_1$, financiers recover $D^G_1 = D_1$ in state G and

   $$D^B_1 = D_1$$

   in state B.

   The incumbent’s value function is as follows:
\[
\begin{align*}
&J_{1}^{i,G}(D_1) = V_{1}^{i,G}(D_1 - \gamma_1 C_1, \underline{\gamma}_G) \\
&J_{1}^{i,B}(D_1) = V_{1}^{i,B}(D_1, \underline{\gamma}_B)
\end{align*}
\]

(ii) (Both states are on IC constraint) If \( B_{1}^{H,G}(\overline{\gamma}_G) > B_{1}^{L,G} \),

a. If \( q^G [\tilde{D}_{1}^{G,\text{Max}} + \gamma_1 C_1 ] + (1 - q^G) [B_{1}^{\text{min},B}] > \tilde{D}_{1}^{B,\text{Max}} \),
\[
D_{1}^{\text{Max}} = \tilde{D}_{1}^{G,\text{Max}} + \gamma_1 C_1, \quad \gamma_2^G = \overline{\gamma}_G \quad \text{in state } G \quad \text{and} \quad \gamma_2^B = \underline{\gamma}_B \quad \text{in state } B.
\]
For any promised payment \( \tilde{D}_{1}^{B,\text{Max}} < D_1 \leq D_{1}^{\text{Max}} \), financiers recover \( D_1^G = D_1 \) in state \( G \) and \( D_1^B = B_{1}^{\text{min},B} \) in state \( B \).

The incumbent’s value function is as follows:
\[
\begin{align*}
&J_{1}^{i,G}(D_1) = V_{1}^{i,G}(D_1 - \gamma_1 C_1, \underline{\gamma}_G) \\
&J_{1}^{i,B}(D_1) = V_{1}^{i,B}(D_1, \underline{\gamma}_B)
\end{align*}
\]

b. Else if \( q^G [\tilde{D}_{1}^{G,\text{Max}} + \gamma_1 C_1 ] + (1 - q^G) [B_{1}^{\text{min},B}] \leq \tilde{D}_{1}^{B,\text{Max}} \),
\[
D_{1}^{\text{Max}} = \tilde{D}_{1}^{B,\text{Max}}. \quad \gamma_2^G = \overline{\gamma}_G \quad \text{in both states}.
\]
For any promised payment \( D_1 \leq D_{1}^{\text{Max}} \), financiers recover \( D_1^G = D_1 \) in state \( G \) and \( D_1^B = D_1 \) in state \( B \).

The incumbent’s value function is as follows:
\[
\begin{align*}
&J_{1}^{i,G}(D_1) = V_{1}^{i,G}(D_1 - \gamma_1 C_1, \underline{\gamma}_G) \\
&J_{1}^{i,B}(D_1) = V_{1}^{i,B}(D_1, \underline{\gamma}_B)
\end{align*}
\]

3. Else if \( B_{1}^{H,G}(\overline{\gamma}_G) > B_{1}^{L,G} \)

If \( B_{1}^{\text{min},B} \geq (1 - \rho)(q^G C_2 + C_3) \), or if \( (1 - \rho)(q^G C_2 + C_3) > B_{1}^{\text{min},G} \geq B_{1}^{H,G}(\overline{\gamma}_G) \) (Only state \( G \) is on IC constraint)
\[
D_{1}^{\text{Max}} = \tilde{D}_{1}^{G,\text{Max}} + \gamma_1 C_1, \quad \gamma_2^G = \overline{\gamma}_G \quad \text{in state } G \quad \text{and} \quad \gamma_2^B = \underline{\gamma}_B \quad \text{in state } B.
\]
For any promised payment \( D_1 \leq D_{1}^{\text{Max}} \), financiers recover \( D_1^G = D_1 \) in state \( G \) and \( D_1^B = \min\{B_{1}^{\text{min},B}, D_1\} \) in state \( B \).

The incumbent’s value function is as follows:
\[
\begin{align*}
&J_{1}^{i,G}(D_1) = V_{1}^{i,G}(D_1 - \gamma_1 C_1, \underline{\gamma}_G) \\
&J_{1}^{i,B}(D_1) = V_{1}^{i,B}(D_1, \underline{\gamma}_B)
\end{align*}
\]

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A.2 Decisions on Date 0

We now know the amount of financing each type of bidder can raise at date 0 against the assets. Following the earlier logic, an industry insider can bid the minimum of what he can raise plus her initial wealth, and the surplus she expects. So she will bid:

$$B_0^H (\gamma^s) = \max_{D_1 \leq D_1^{\text{max}}} \min \{\omega_0^H + q^G D_1^G (D_1) + (1 - q^G) D_1^B (D_1)\},$$

$$q^G \left[ (1 - \rho)C_1 + D_1^G (D_1) - \gamma_1 C_1 + J_1^{i.G} (D_1, \gamma_2^s) - \theta^H (q^{BG} \rho C_2 + \theta^H \rho C_3) \right] +$$

$$\left(1 - q^G\right)\left[ D_1^B + J_1^{i.B} (D_1, \gamma_2^s) - \theta^H (q^{BG} \rho C_2 + \theta^H \rho C_3) \right].$$

An industry outsider will bid differently. He chooses the face value which maximizes his expected payment. When $$B_1^{L,B} \geq B_1^{H,B} (\bar{\gamma}^g) - \varepsilon$$, $$B_0^L = q^G \max \{B_1^{H,G} (\bar{\gamma}^g) - \varepsilon, B_1^{L,G}\} + (1 - q^G)B_1^{L,B}$$. When $$B_1^{L,B} < B_1^{H,B} (\bar{\gamma}^g) - \varepsilon$$, if $$q^G \max \{B_1^{H,G} (\bar{\gamma}^g) - \varepsilon, B_1^{L,G}\} + (1 - q^G)B_1^{\text{min},B} > B_1^{H,B} (\bar{\gamma}^g) - \varepsilon$$, then $$B_0^L = q^G \max \{B_1^{H,G} (\bar{\gamma}^g) - \varepsilon, B_1^{L,G}\} + (1 - q^G)B_1^{\text{min},B}$$. If $$q^G \max \{B_1^{H,G} (\bar{\gamma}^g) - \varepsilon, B_1^{L,G}\} + (1 - q^G)B_1^{\text{min},B} \leq B_1^{H,B} (\bar{\gamma}^g) - \varepsilon$$, then $$B_0^L = B_1^{H,B} (\bar{\gamma}^g) - \varepsilon$$. 

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Appendix III: Simple debt with pledgeability choice made before the current period state is known.

Lemma 6

Let the state in date 1 be $s$.

1. (Neither state is on IC constraint) If $B_{H,sB}^2(\gamma^g) \geq (1 - \rho)C_3$, $D_{2,Max}^{i,s} = \gamma_2 C_2 + (1 - \rho)C_3$ is the maximum face value of the debt and $\gamma_3^g = \gamma^g$.

For any promised payment $D_{2}^{s} \leq D_{2,Max}^{s}$, financiers recover $D_{2}^{G} = D_{2}^{s}$ in state $sG$ and $D_{2}^{B} = \min \{D_{2}^{s}, (1 - \rho)C_3\}$ in state $sB$.

The incumbent’s value function is as follows:

\[
\begin{align*}
J_{2}^{i,sG}(D_{2}^{s}) &= V_{2}^{i,sG}(D_{2}^{s} - \gamma_2 C_2, \gamma^g) \\
J_{2}^{i,sB}(D_{2}^{s}) &= V_{2}^{i,sB}(D_{2}^{s}, \gamma^g)
\end{align*}
\]

2. (State B is on IC constraint) Else if $(1 - \rho)C_3 > B_{H,sB}^2(\gamma^g)$,

(i) If $B_{H,sB}^2(\gamma^g) + \gamma_2 C_2 \leq D_{2,Max}^{s,IC}$

$D_{2,Max}^{s,IC}$ is the maximum face value of the debt and $\gamma_3^g = \gamma^g$.

For any promised payment $D_{2}^{s} \leq D_{2,Max}^{s,IC}$, financiers recover $D_{2}^{G} = D_{2}^{s}$ in state $sG$ and $D_{2}^{B} = \min \{D_{2}^{s}, B_{H,sB}^{i,sB}(\gamma^g)\}$ in state $sB$.

The incumbent’s value function is as follows:

\[
\begin{align*}
J_{2}^{i,sG}(D_{2}^{s}) &= V_{2}^{i,sG}(D_{2}^{s} - \gamma_2 C_2, \gamma^g) \\
J_{2}^{i,sB}(D_{2}^{s}) &= V_{2}^{i,sB}(D_{2}^{s}, \gamma^g)
\end{align*}
\]

(ii) Else if $B_{H,sB}^2(\gamma^g) + \gamma_2 C_2 > D_{2,Max}^{s,IC}$

a. If $q^{\gamma_2 C_2} / B_{H,sB}^2(\gamma^g) + (1 - q^{\gamma_2 C_2})B_{H,sB}^{i,sB}(\gamma^g) > q^{\gamma_2 C_2} + (1 - q^{\gamma_2 C_2}) \min \{D_{2,Max}^{s,IC}, B_{H,sB}^{i,sB}(\gamma^g)\}$,

$D_{2,Max}^{s,IC} = B_{H,sB}^2(\gamma^g) + \gamma_2 C_2$, $\gamma_3^g = \gamma^g$.

For any promised payment $D_{2}^{s,IC} < D_{2}^{s} \leq D_{2,Max}^{s,IC}$, financiers recover $D_{2}^{G} = D_{2}^{s}$ in state $sG$ and $D_{2}^{B} = B_{H,sB}^{i,sB}(\gamma^g)$ in state $sB$.

The incumbent’s value function is as follows:

\[
\begin{align*}
J_{2}^{i,sG}(D_{2}^{s}) &= V_{2}^{i,sG}(D_{2}^{s} - \gamma_2 C_2, \gamma^g) \\
J_{2}^{i,sB}(D_{2}^{s}) &= V_{2}^{i,sB}(D_{2}^{s}, \gamma^g)
\end{align*}
\]

b. Else if $q^{\gamma_2 C_2} / B_{H,sB}^2(\gamma^g) + (1 - q^{\gamma_2 C_2})B_{H,sB}^{i,sB}(\gamma^g) \leq q^{\gamma_2 C_2} + (1 - q^{\gamma_2 C_2}) \min \{D_{2,Max}^{s,IC}, B_{H,sB}^{i,sB}(\gamma^g)\}$,

$D_{2,Max}^{s,IC}$, $\gamma_3^g = \gamma^g$.

For any promised payment $D_{2}^{s} \leq D_{2,Max}^{s,IC}$, financiers recover $D_{2}^{G} = D_{2}^{s}$ in state $sG$ and $D_{2}^{B} = \min \{B_{H,sB}^{i,sB}(\gamma^g), D_{2}^{s}\}$ in state $sB$.

The incumbent’s value function is as follows:
\begin{align*}
J_{2, i, sGB}^{i, sG}(D_2^s) &= V_{2, i, sG}^{i, sG}(D_2^s - \gamma_2 C_2, \tilde{y}^g) \\
J_{2, i, sGB}^{i, sB}(D_2^s) &= V_{2, i, sB}^{i, sB}(D_2^s, \tilde{y}^g)
\end{align*}

**A3.2 Choices on Date 1**

Lemma 7 below is the date 1 version of Lemma 5.

**Lemma 7**

If \( B_1^{H,s}(\tilde{y}^g) > B_{1, \text{min,s}} \), we have \( \Delta_i(\hat{D}^i_t) > 0 \) when \( \hat{D}^i_t < \hat{D}^i_{t, \text{max}} \) and \( \Delta_i(\hat{D}^i_t) < 0 \) when \( \hat{D}^i_t > \hat{D}^i_{t, \text{max}} \).

Else, \( \Delta_i(\hat{D}^i_t) = -\varepsilon \).

The analysis at date 1 is similar to that when incumbent knows the end of period state. The functional form of the bid by the incumbent at date 1 is identical. For industry insiders, they bid up to

\[
(1 - \rho - \gamma_1 C_2 + D_2^{sG}(D_2^s) + J_2^{i, sG}(D_2^s) - \theta^H \rho C_3) + (1 - q^{sG})(D_2^{i, sB}(D_2^s) + J_2^{i, sB}(D_2^s) - \theta^H \rho C_3)]
\]

Note here \( D_2^{i, \text{max}} \) is different. The industry outsider also bids, he sets the face value a bit below

\[
B_2^{H,sGB}(\tilde{y}^g) - \varepsilon \text{ and pays up to } B_1^{L,s} < q^{sG}[B_2^{H,sGB}(\tilde{y}^g) - \varepsilon] + (1 - q^{sG})[B_2^{H,sGB}(\tilde{y}^g)].
\]

Note that inequality is strict due to the loss of \( \varepsilon \) in state B.

Following the same logic, again we define \( D_1^{\text{iPay IC}} = \theta^H B_1^{\text{min,s}} + (1 - \theta^H)B_1^{H,s}(\tilde{y}^g) - \varepsilon \) and

\[
D_1^{\text{Control IC}} = B_1^{H,s}(\tilde{y}^g) + \theta^H(q^{sG}\rho C_2 + \theta^H \rho C_3) - \theta^H J_1^{i, sG}(\tilde{y}^i, B_1^{\text{min,s}}) - \varepsilon,
\]

where

\[
J_1^{i, sG}(\tilde{y}^i, D_1^G) = \max_{D_1^{i, sG} \leq D_1^{i, sG, \text{max}}} q^{sG}((1 - \gamma_1 C_1)C_2 + J_2^{i, sG}(D_2^G)) + (1 - q^{sG})J_2^{i, sGB}(D_2^G)
\]

such that

\[
(1 - \gamma_1 C_1)C_2 + q^{sG}D_2^{sG}(D_2^G) + (1 - q^{sG})D_2^{sGB}(D_2^G) \geq D_1^G - \gamma_1 C_1.
\]

As before, we assume that \( \tilde{D}_1^{G, \text{Max}} + \gamma_1 C_1 \geq \tilde{D}_1^{B, \text{Max}} \) and the rest of the analysis is identical to that at date 2. There are potentially two candidates for the face value, \( D_1^{IC} \) and \( B_1^{H,G}(\tilde{y}^g) + \gamma_1 C_1 \). \( D_1^{IC} \) always maximizes the expected payment if \( B_1^{H,G}(\tilde{y}^g) + \gamma_1 C_1 \leq D_1^{IC} \). Otherwise, it depends on whether

\[
q^{sG}[B_1^{H,G}(\tilde{y}^g) + \gamma_1 C_1] + (1 - q^{sG})[B_1^{\text{min,b}}(D_{1, \text{max}}^G)] > q^{sG}D_1^{IC} + (1 - q^{sG})\min\{B^{H,B}(\tilde{y}^g), D_1^{IC}\}.
\]

**Lemma 8**

1. (Neither state is on IC constraint) If \( B_1^{\text{min,b}} \geq (1 - \rho)(q^{sG}C_2 + C_3) \) or

\[
(1 - \rho)(q^{sG}C_2 + C_3) > B_1^{\text{min,b}} \geq B_1^{H,B}(\tilde{y}^g), \text{ and if } B_1^{\text{min,g}} \geq (1 - \rho)(q^{sG}C_2 + C_3), \text{ or if}
\]

\[
(1 - \rho)(q^{sG}C_2 + C_3) > B_1^{\text{min,g}} \geq B_1^{H,g}(\tilde{y}^g),
\]

\[
D_1^{\text{Max}} = \gamma_1 C_1 + \tilde{D}_1^{G, \text{Max}} \text{ is the maximum face value of the debt and } \gamma_2^g = \gamma_2^G \text{ in both states.}
\]
For any promised payment \( D_1 \leq D_{1\text{Max}} \), financiers recover \( D_1^G = D_1 \) in state \( G \) and
\[
D_1^B = \min \{D_1, B_{1\text{min},B}\} \text{ in state } B.
\]

The incumbent’s value function is as follows:
\[
\begin{cases}
J_{1,i,G}(D_1) = V_{1,i,G}(D_1 - \gamma_1 C_1, \gamma_G) \\
J_{1,i,B}(D_1) = V_{1,i,B}(D_1, \gamma_G)
\end{cases}
\]

2. Else if \( B_{1,H,B}^G(\gamma_G) > B_{1,L,B}^I \),

(i) If \( B_{1,H,G}^I(\gamma_G) + \gamma_1 C_1 \leq D_{1IC} \),
\[
D_{1Max}^I = D_{1IC} \text{ and } \gamma_2^B = \gamma_G.
\]

For any promised payment \( D_1 \leq D_{1\text{Max}} \), financiers recover \( D_1^G = D_1 \) in state \( G \) and
\[
D_1^B = \min \{B_{1,H,B}^G(\gamma_G), D_1\} \text{ in state } B.
\]

The incumbent’s value function is as follows:
\[
\begin{cases}
J_{1,i,G}(D_1) = V_{1,i,G}(D_1 - \gamma_1 C_1, \gamma_G) \\
J_{1,i,B}(D_1) = V_{1,i,B}(D_1, \gamma_G)
\end{cases}
\]

(ii) Else if \( B_{1,H,G}^I(\gamma_G) + \gamma_1 C_1 > D_{1IC} \),

a. If \( q^G[B_{1,H,G}^I(\gamma_G) + \gamma_1 C_1] + (1-q^G)[B_{1\text{min},B}] > q^G D_{1IC} + (1-q^G) \min \{B_{1,H,B}^G(\gamma_G), D_{1IC}\} \),
\[
D_{1Max}^I = B_{1,H,G}^I(\gamma_G) + \gamma_1 C_1, \gamma_2^B = \gamma_G.
\]

For any promised payment \( D_{1IC} < D_1 \leq D_{1\text{Max}} \), financiers recover \( D_1^G = D_1 \) in state \( G \) and
\[
D_1^B = B_{1\text{min},B} \text{ in state } B.
\]

The incumbent’s value function is as follows:
\[
\begin{cases}
J_{1,i,G}(D_1) = V_{1,i,G}(D_1 - \gamma_1 C_1, \gamma_G) \\
J_{1,i,B}(D_1) = V_{1,i,B}(D_1, \gamma_G)
\end{cases}
\]

b. Else if \( q^G[B_{1,H,G}^I(\gamma_G) + \gamma_1 C_1] + (1-q^G)[B_{1\text{min},B}] \leq q^G D_{1IC} + (1-q^G) \min \{B_{1,H,B}^G(\gamma_G), D_{1IC}\} \),
\[
D_{1Max}^I = D_{1IC}, \gamma_2^B = \gamma_G.
\]

For any promised payment \( D_1 \leq D_{1\text{Max}} \), financiers recover \( D_1^G = D_1 \) in state \( G \) and
\[
D_1^B = \min \{B_{1,H,B}^G(\gamma_G), D_1\} \text{ in state } B.
\]

The incumbent’s value function is as follows:
\[
\begin{cases}
J_{1,i,G}(D_1) = V_{1,i,G}(D_1 - \gamma_1 C_1, \gamma_G) \\
J_{1,i,B}(D_1) = V_{1,i,B}(D_1, \gamma_G)
\end{cases}
\]
Date 0

We now know the amount of financing each type of bidder can raise at date 0 against the assets. Following the earlier logic, an industry insider will bid
\[ B^H_0 (\gamma_i^g) = \max_{d_i} \min \{ \omega_i^g + q^G D_i^G (D_i) + (1 - q^G) D_i^B (D_i) \}, \]

\[ q^G \left[ (1 - \rho - \gamma_i^g) C_i + D_i^G (D_i) + J_i^G (D_i) - \theta^H (q^G \rho C_2 + \theta^H \rho C_3) \right] + (1 - q^G) \left[ D_i^B (D_i) + J_i^B (D_i) - \theta^H (q^G \rho C_2 + \theta^H \rho C_3) \right] \]

An industry outsider will bid differently. He will set face value a bit below
\[
\max \{ B^H_1 (\bar{\gamma}^g) - \epsilon, B^L_1 \} \quad \text{and pays up to} \quad B^L_0 < q^G \max \{ B^H_1 (\bar{\gamma}^g) - \epsilon, B^L_1 \} + (1 - q^G) \max \{ B^H_1 (\bar{\gamma}^g), B^L_1 \}. \]

The strict inequality holds because of \( \epsilon \) loss in state B.