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Liquidity and Securitization

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Abstract

In the run up to the financial crisis, the essential functions intermediaries played seemed to become less important. Commercial and industrial loans, as well as residential mortgages, the quintessential banking products, were securitized and sold. At the same time, the "skin in the game" intermediaries held in their activities (including in securitizations) diminished, while their leverage increased. Some have suggested these developments stemmed from rising agency problems in the financial sector. Instead, we attribute the diminution of traditional intermediation activities, as well as the reduced intermediaries' skin in the game, to rising liquidity in real asset markets. Under a variety of circumstances, prospective liquidity tends to enhance leverage, which crowds out both internal and external corporate governance as supports to debt. This tends to make debt returns more skewed. We develop a more general theory of the interaction between intermediary activities, intermediary capital structure, and real asset market liquidity.

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How does economy-wide liquidity affect corporate leverage and the leverage of the financial intermediaries that firms borrow from? How do securitizations and loan sales vary across the financing cycle? How does securitization affect the quality of newly issued credit? Since the Global Financial Crisis of 2007-2008, a large literature has examined the wave of securitization that took place just before. Some see the increased ability to securitize and sell claims against financial assets such as loans as problematic because it reduces originators' incentives to do due diligence on the underlying assets being originated. For example, Keys et al. (2010) examine sub-prime low documentation non-agency mortgages and conclude that the easier ability to sell these mortgages through securitization vehicles, especially in the low-documentation segment where hard information was unavailable, made originating banks less careful about screening out low quality credits. In contrast, Begley and Purnanandam (2016) find in their study of residential mortgage backed securities (RMBS) originated between 2001-2002 and 2005 that even low-documentation informationally opaque pools can be securitized effectively so long as they are structured appropriately to give originators skin in the game. They find when originators held a higher level of the equity tranche, deals had lower abnormal default rates ex post, and ex ante they commanded a higher price. So is the Keys et al. (2010) finding an aberration or is it due to some features of the economy in the period examined?

Benmelech et al. (2012) study collateralized loan obligations (CLO), which are pooled vehicles for securitized loans, and find little evidence of adverse selection before 2005 – securitized loans performed no differently from loans held on bank balance sheets. However, the evidence is more mixed in the 2005-2007 sample. Much like Begley and Purnanandam (2016), they suggest that structuring helped give originators the right incentives; CLOs primarily held syndicated loans, where originators had substantial skin in the game by holding on to a fraction of the originated loans on their balance sheets. However, despite relatively modest losses, the CLO market shut down through much of 2009 and 2010, suggesting that an incentive-compatible structure alone was not enough to ensure the popularity of the CLO market.

In sum, there seems to be evidence that the ability to securitize does not automatically drive down credit quality, originators can create structures that signal they will screen carefully while originating, and they do get rewarded for this. At the same time, the evidence also suggests there seems to have been some deterioration in the relative quality of securitizations in the years immediately before the financial crisis, at least as reflected in greater defaults in the underlying loans. We argue in this paper that a common factor that drives all these patterns is the underlying liquidity of the real assets being financed. Higher expected liquidity can make securitization more attractive, increase the extent to which real assets are leveraged, but also reduce the due diligence required of intermediaries, and hence the need for structures that give them incentives. It can also increase the volatility of returns on the underlying assets, and in some cases, of the securities issued.

Let us be more specific. Consider an economy where a number of firms (equivalently, projects, which constitute the real asset) are available for sale. Each firm will be sold in an auction, with bidders funding their bid partly with their wealth and partly with a loan against the firm's asset. The loans to fund the winning bidder in each auction will be pooled in a securitization vehicle, which will be funded by selling securities. Now consider one such firm. To produce cash flows, we assume the firm will have to be run by an expert manager with special managerial knowledge. There are a number of such experts who are willing to bid for each firm, but they have little money of their own. In addition to experts, the other agents in the model are securitizers and investors. Securitizers arrange securitizations; they screen applicants (we will describe this shortly), making the loan to the winning bidder, pool loans, sell securities against the pooled loan repayments, and hold some securities, often the junior tranches, as "skin in the game" to provide incentives. Our securitizer undertakes all the activities in the securitization process, some of which in practice are done by different intermediaries. Investors buy the securities. They can also finance experts directly, though they cannot screen. Neither securitizers nor investors know how to run firms.

The size of the loan that experts can receive for their bid depends on how much debt capacity the firm can support. Financiers have two sorts of control rights, which allow them to be repaid and are the basis for the firm's debt capacity; first, control through the right to repossess and sell the underlying asset being financed if payments are missed and, second, control over cash flows generated by the asset. The first right only requires the frictionless enforcement of property rights in the economy, which we assume. It has especial value when there are a large number of capable potential buyers willing to pay a high price for the firm's assets. Greater wealth amongst experts (which we term *liquidity*) increases the availability of this asset-sale-based financing, as in Shleifer and Vishny (1992). Clearly, this kind of control right is exogenous to the firm and depends on economic conditions.

The second type of control right is more endogenous, and conferred on creditors by the firm's incumbent expert manager as she makes the firm's cash flows more *pledgeable* to, or appropriable by, creditors over the medium term. She could do this, for example, by improving accounting quality or setting up escrow accounts so that cash flows are hard to divert. We assume enhancing pledgeability takes time to set up but is also semi-durable (improving accounting quality is not instantaneous because it requires adopting new systems and hiring reputable people; equally, firing a reputable accountant or changing accounting practices has to be done slowly, perhaps at the time the accountant's term ends, if it is not to be noticed). So the incumbent manager sets pledgeability one period in advance, and it lasts a period. In general, both higher prospective wealth for experts (that is, liquidity) as well as the higher ability of an expert to borrow against the future cash flow of the firm they buy (that is, pledgeability) will increase their bids for the firm. Higher prospective bids will increase debt recovery, and thus the willingness of creditors to lend up front. So *higher liquidity and pledgeability increase debt capacity*.

However, pledgeability is endogenously determined. Let us understand an incumbent firm manager's incentives while choosing cash flow pledgeability for the next period. We assume she may have some reason to sell some or all of the firm next period with some probability – either because she loses ability and is no longer capable of running it, or because she needs to raise finance for new investment. If she owned the firm and had no debt claims outstanding, she would undoubtedly want to increase pledgeability, especially if the direct costs of doing so are small – this would simply increase the amount she would obtain by selling the firm to experts if she lost ability. When she has taken on debt, however, enhancing *cash flow pledgeability* is a double-edged sword. The higher bid from experts also enables existing creditors to collect more if the incumbent stays in control because the creditors have the right to seize assets and sell them when not paid in full. In such situations, the incumbent has to "buy" the firm from creditors, by outbidding experts (or paying debt fully). The higher the probability she will retain ability and stay in control and the higher the outstanding debt, the lower her incentive to raise pledgeability. *Higher outstanding debt reduces the incumbent's incentive to raise pledgeability*.

Now consider the effect of industry liquidity on pledgeability choice. If experts are rational, they will never pay more for the firm than its fundamental value. When future industry liquidity is very high, experts will have enough wealth to buy the firm at full value without needing to borrow more against the firm's future cash flows. If so, higher pledgeability has no effect on how much experts will bid to pay for the firm. In other words, *high future liquidity crowds out the need for pledgeability* in enhancing debt payments. Therefore, we have two influences on pledgeability – the level of outstanding debt and the anticipated liquidity of experts. The key results of the paper stem from the interaction between the two.

In normal times, the need to provide the incumbent incentives for pledgeability keeps up-front borrowing moderate. As prospective liquidity increases, though, the incumbent is able to borrow more to finance the asset, while still retaining the incentive to set pledgeability high. Eventually, though, when prospective liquidity is very high – that is, experts will have enough wealth to bid full value for the firm without needing to pledge its cash flows – any earlier corporate borrowing is enforced entirely by the potential high resale value of the firm, and high pledgeability is not needed for them to make their bid.

Since pledgeability is not needed to enforce repayment in a future highly liquid state, a high probability of such a state encourages high borrowing up front, which crowds out the incumbent's incentive to enhance pledgeability, even if there is a possible low liquidity state where pledgeability is needed to enhance creditor rights. In other words, when prospective liquidity gets very high, lenders can profitably stop imposing any constraint on leverage, and take their chances if that liquidity does not materialize. Bidders, competing to buy the firm up front, bid more, but are financed with risky debt.

A crisis or downturn under these circumstances is when anticipated high liquidity does not materialize. If the low liquidity state is realized, the enforceability of the firm's debt, as well as its borrowing capacity will fall significantly. Experts, also hit by the downturn, no longer have much personal wealth, nor does the low cash flow pledgeability of the firm allow them to borrow against future cash flows to pay for acquiring the firm. Unable to raise funds to repay debt, the firm gets into financial distress even if the firm's earning potential is still high. Credit spreads rise substantially, and they will stay high till the firm raises pledgeability, which will take time, or liquidity comes back up, which could take even longer. The neglect of pledgeability because of high leverage at the end of a sustained boom, makes the recovery difficult and drawn out.

Now let us return to the securitizer's problem. We assume his job is to distinguish between reliable experts and unreliable experts. Reliable experts have a low cost of setting pledgeability high when they run the firm and unreliable experts have an impossibly high cost of doing so. In normal times when pledgeability is needed to enhance debt capacity, the securitizer does screen out the unreliable applicants, finances only reliable experts, and arranges the configuration of securities he sells against the pool of loans so that he signals a commitment to screening (by having skin in the game).[2] Investors buy the securities at a price that rewards the securitizer for undertaking the screening. Given that they would face substantial adverse selection if they financed experts directly, the extent of direct financing of experts by investors is small. As

[2] We follow the securitization literature by designing tranched and pooled securities to overcome the incentive problems faced by securitizers. We use results in DeMarzo (2005), DeMarzo-Duffie (1999), and Gorton-Souleles (2006). See Gorton-Metrick (2013) for a survey.

prospective liquidity increases, though, eventually up front lending is high enough that even the reliable expert has no incentive to enhance pledgeability if she buys the firm. At this point, there is really no point screening out the unreliable experts.

Put differently, as the market becomes more liquid, governance becomes less important for debt recovery – analogously, if a house can be easily repossessed and sold profitably because they are selling like hot cakes, what need is there to determine if the mortgage applicant has a job or income? Securitizers no longer need to signal they have enough skin in the game to screen since they no longer screen. Indeed, they become no different from investors, and securitization vehicles become complete "passthroughs". The speed of securitization (which we do not model) will increase since little due diligence is being done, and the volume of issuances will increase for a given underlying capacity. None of this is an aberration – financial intermediaries such as securitizers are able to rely on liquidity for recovery at such times, and this forces them to abandon their usual due diligence. One can question whether such expectations of high liquidity make the economy better off (see Diamond, Hu, and Rajan (2018)) but our focus is on securitization here.

Changes in the underlying liquidity for the assets being securitized may therefore explain some of the differences in the empirical evidence described earlier. Arguably, liquidity was moderate but increasing as the economy recovered from the Dot Com bust. Securitizers did substantial due diligence, and securitization structures reflected their desire to signal their commitment, as suggested by Begley and Purnanandam (2016). As the recovery picked up and policy interest rates stayed lower than normal, liquidity increased, and the need for screening diminished, until very little screening was done just before the crisis, as suggested by Keys et al. (2010). Seen with the benefit of hindsight from the depth of the crisis, this may have seemed to be an aberration, and some indeed was. Yet it was also consistent with the kind of behavior induced by expectations of high liquidity. It is also possible that the expectations were too extreme, with the probabilities of the low liquidity state underestimated as in Gennaioli, Shleifer and Vishny (2015), yet that does not take away from the fundamental thrust of our arguments.

As explained above, anticipated high levels of future liquidity crowds out pledgeability, which leads to both high firm and intermediary leverage. Current levels of liquidity, as measured by the wealth of the initial bidders for the firm, however, drive firm and intermediary leverage differently. This is consistent with the evidence presented in Adrian and Shin (2010). At low levels of current liquidity, the analysis we just described continues to hold. At higher levels of current liquidity, however, leverage at both levels is reduced. It is reduced at the firm level since the need for the initial bidder to borrow to pay full value diminishes. Moreover, the value of the firm is also higher under the low firm leverage that encourages high pledgeability. At the intermediary level, the intermediary needs skin in the game to incentivize screening, so leverage levels, as measured by the value of securities he sells, are also moderate. As the initial bidder's wealth goes higher still, her need to borrow to make up the gap between the wealth she already has and the full valuation of the asset is so low that she can borrow unscreened directly from investors. In this case, firm leverage is low, but since the securitizer does not screen, his skin in the game is low, and leverage high.

We are not the first to describe conditions where securitizer "skin in the game" retention might vary with conditions and possibly be zero, but we are the first to show why this may happen during times of high asset valuations. Chemla and Hennessy (2014) presents a signaling model where retention is zero when asset prices are sufficiently informative of true value, implying that the amount of private information known by securitizers is small. By a similar logic, we get low or zero retention when industry liquidity is high implying little value in providing incentives to securitizers to screen for borrowers who can be induced to increase pledgeability. Unless high industry liquidity (high asset valuations) are very highly correlated with informative asset prices, the models have very different predictions.

In the rest of the paper, we will formalize our arguments. In Section I, we describe the basic framework and the timing of decisions in a two-period model. To illustrate the basic ideas, we present two simple motivating examples in Section II. In Section III, we solve the basic model, and in Section IV we examine first how future or anticipated liquidity affects securitization and then how current liquidity affects securitization. In Section V we relate our paper to the literature, and then conclude.

I. The Framework

A. The Economy and States of Nature

Consider an economy with three dates (0,1,2) and two periods between these dates. Date t marks the end of period t. We focus on a representative firm. In period 1, the economy is in state $s_1 \in \{G, B\}$, with the probability of state G being q. State G and B respectively stand for economy-wide prosperity and distress. When the state is G in period 1, the firm produces cash flows C_1 when managed by the incumbent. When the state is B, however, the firm does not produce any cash flow. In period 2, we assume the economy returns to state G and produces cash flows C_2 for sure. Figure 1 illustrates the evolution of the state of nature. The firm does not face any idiosyncratic risk.

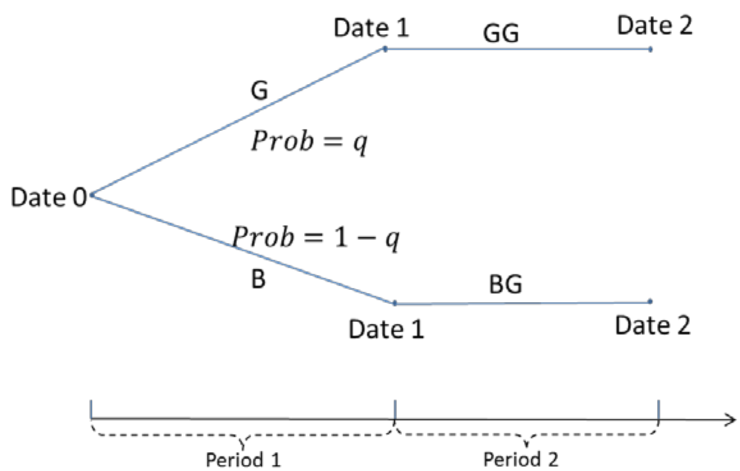

Figure 1: States of Nature

B. Agents and the Asset

There are three groups of agents in the economy: experts who know how to manage the firm to produce cash flows, securitizers, and investors. All agents are risk neutral. Experts and investors do not discount future cash flows. Securitizers are less patient: their discount rate is $\rho < 1$. This can also be thought of as a rough proxy for persistent intermediary capital constraints.[3] We will present the results of the general model, but our focus will be on the case $\rho \to 1$.

At date 0, one expert acquires control of the firm by winning a competitive auction (described in Section I.G) for the firm's assets and therefore becomes the *incumbent manager.* Other experts stay in the economy, hoping to gain control at date 1. Let θ be the stability of the firm – the extent to which the skills needed in the firm are stable. In a rapidly changing industry, the incumbent manager's ability may not continue to match the industry's needed skill set. So, after cash flows (if any) are produced, the incumbent may lose her ability with probability $1-\theta$, in which case she is forced to sell the asset to another expert. If that happens, we assume there are plenty of experts at that time to bid for the firm and their skills are compatible with the industry's

[3] Securitizers have a limited amount of inside capital and want to utilize it as intensively as possible. This gives them a shadow cost of any additional capital invested today that exceeds the market interest rate.

needs.[4] The event of losing ability is publicly observable but not verifiable and cannot be written into contacts. Equivalently, the entire model could be reinterpreted as one in which the firm will need additional interim financing with probability $1-\theta$. In either case (loss of ability or need for financing), the incumbent has to sell the firm or a portion thereof, which gives them some incentive up front to increase the resale value of the firm.

There are a set of competitive securitizers who have the ability to screen and lend directly to experts. They follow the "originate-to-distribute" model. Specifically, they originate a portfolio of loans and sell tranched claims on this portfolio to investors. Since securitizers are more impatient than investors, they would always prefer selling claims to the entire portfolio. However, the securitizer may also be forced to hold some claims to incentivize them to screen loan applicants—a process we will describe in details in Section I.E. Finally, investors have deep pocket and are willing to invest in any security that breaks even in expectation.

C. Pledgeability

Any creditor to the firm has two ways of recovering payments from the manager. An improvement in governance could enhance the fraction of generated cash flows that the manager pays in the normal course to the creditor. Alternatively, an improvement in the ability of experts to bid for the firm's assets could give the creditor a credible threat (through the right to seize the asset and auction it if payments are not made) with which to force repayment. These methods of recovery usually complement each other, but may also be substitutes under certain circumstances, as we will explain shortly.

Let us define *cash flow pledgeability* as the fraction of realized cash flow that goes directly to the firm's creditor, in this case, the securitizer.[5] Pledgeability can be thought as the fraction of cash flow that can be verified by a court and therefore recovered by the lender. Let γ_1 be the preset pledgeability in period 1, reflecting the existing governance of the firm. So $\gamma_1 C_1$ is the cash the securitizer receives directly if cash flows C_1 are produced in period 1. During period 1, the incumbent can set pledgeability γ_2 for cash flows produced during period 2 in the range $\left[\underline{\gamma},\overline{\gamma}\right]$ that satisfies $0<\underline{\gamma}<\overline{\gamma}<1$. The range of feasible values for pledgeability is determined by the economy's institutions supporting corporate governance, both operating within the firm

[4] The results are unaffected as long as more than two bidders bid for the firm at date 1.
[5] We assume the securitizer also performs other roles traditionally associated with securitization such as servicing the loan, even if part of (or the entire) the cash flow from loan is sold.

(such as better auditors, more transparent subsidiary structures, contracts, and accounting, etc.) and through outside institutions (such as regulators and regulations, investigative agencies, laws and the judiciary). Pledgeability can be raised by adopting more informative accounting practices, hiring better accountants, setting up escrow accounts for cash flows, simplifying corporate organizational structures and enhancing their transparency, or putting in place better governance structures such as a more expert and independent board. We can also think of increasing pledgeability as closing off tunnels, which divert cash flows generated in the firm. It is because all these procedures take significant time to accomplish that we assume the incumbent can only affect pledgeability one period ahead. Since governance can also be changed over time, we assume pre-set pledgeability lasts only one period. Our intent is to capture the dynamic nature of firm governance, and the important role played by management in setting it.

Experts can be reliable or unreliable. The two types of experts differ in the cost each incurs in raising pledgeability. A reliable expert incurs a small cost $\varepsilon \geq 0$ to set γ_2 above $\underline{\gamma}$. Throughout the paper, the analysis will be presented for the limiting case $\varepsilon \to 0$ so that none of our results relies on the cost of raising pledgeability being significant. By contrast, we assume the cost of raising pledgeability incurred by an unreliable expert is so high that she will never do so.[6] The two types of experts can be thought of as having different abilities to tunnel cash flow out of the reach of investors – the unreliable manager discovers she has many more such options or fewer scruples, so the cost of binding her is disproportionately higher. Equivalently, she could be ineffective at increasing pledgeability. Henceforward, we sometimes refer to (un)reliable experts also as (un)reliable managers.

A large fraction $\lambda \to 1$ of experts are unreliable and they are well aware of their types. Therefore, they will only apply to securitizers for a loan if they anticipate the securitizers will not screen. Otherwise, they will simply borrow from uninformed investors.[7] Among the remaining experts, a fraction μ correctly believe they are reliable, whereas $(1-\mu)$ consist of unreliable managers who believe themselves to be reliable. The latter group of experts will discover their mistake only when screened by the securitizer, or when they attempt to set pledgeability.[8] To

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[6] A sufficient condition is this cost is higher than C_2.

[7] We assume they borrow from securitizers when they are indifferent, i.e., when the securitizers do not screen.

[8] The presence of this type is necessary only to get screening in equilibrium. Some uncertainty about types is sufficient.

summarize, among the experts, a fraction λ correctly know they are unreliable; a fraction $(1-\lambda)\mu$ correctly know they are reliable; and $(1-\lambda)(1-\mu)$ incorrectly think they are reliable.

D. Financial Contracts

At date 0, each expert can raise money against the firm's assets and cash flows by writing one-period financial contracts. An expert can borrow from one securitizer or directly from investors who never screen borrowers. The aggregate state s_t is observable but not verifiable, so we will focus on debt contracts D_t with fixed promised payment across states at the end of period t. More specifically, the debt contract takes the form of a loan commitment (l_{t-1}, D_t): the securitizer commits a loan amount l_{t-1} on date $t-1$ and the gross interest rate of the loan is $\frac{D_t}{l_{t-1}}$.

At date *t-1*, the incumbent manager wins the auction while funded by the loan and manages the firm. She is forced to repay the debt at date t in two ways. First, the lender has automatic rights over the pledgeable portion of the cash flow $\gamma_t C_t$ if the state is G. Second, if the claim has not been paid in full, the lender gets the right to auction the firm. In other words, the lender obtains control rights over the asset through default, which allows them to extract repayment either by actually selling the firm or through the threat of seizing and selling. In this auction, both experts and the incumbent manager are allowed to bid. Implicitly, we assume the incumbent can always bid using other proxies, so contracts that ban her from participating in the auction are infeasible.

E. Screening

At date 0, before approving a loan, the securitizer may screen the loan applicant. We assume there is no fixed cost associated with screening but instead, a per-applicant cost ψ is incurred if the securitizer screens the loan applicant. After paying this cost, the securitizer can tell whether the loan applicant is reliable or not without error. The cost ψ includes the administrative resources spent in processing the application and doing due diligence on the specific applicant. We assume the screening outcome is private so that other securitizers and investors cannot observe it. The lender is referred to as informed if he has screened the applicant. By contrast, a lender who does not screen is referred to as uninformed.

One expert can apply to at most one securitizer. In reality, preparing relevant loan application files and materials takes time and effort. After screening, an informed securitizer essentially has an information monopoly over the applicant's type, in which case we assume he makes a take-it-or-leave-it loan offer to the applicant. Alternatively, the applicant can turn to uninformed investors who offer credit as long as they can break even. Since they have no ability to distinguish between various expert types, with the share of the unreliable tending to 1, investors will offer any applicant the rate associated with an unreliable investor.

In period 2, there is no further pledgeability decision since the economy ends at date 2, and pledgeability has already been set for period 2 in period 1. As a result, all experts can bid without screening, since there is no value to determining who is reliable and who is not.

F. Securitization

Each securitizer extends loans to a large number of experts (each of whom wins an auction for a different firm). These loans are then pooled into a trust (or a special purpose vehicle) which in turn tranches them into different claims. Some claims are subsequently sold to investors. The rest—if any—are retained by the securitizer. All these claims can be broadly interpreted as asset-backed securities.

In practice, the entire securitization package is typically announced before the underlying loans are originated. For example, more than 90 percent of the agency MBS trading is on a to-be-announced (TBA) basis in which the buyer and seller decide on general trade parameters, such as coupon, settlement date, par amount, and price, but the buyer typically does not know which pools will actually be delivered until two days before settlement (Vickery and Wright, 2013). Therefore, we assume the securitizer commits to a final securitization structure with investors *before* he actually screens loan applicants. Importantly, the structure specifies the securities that will be issued to investors as well as securities the securitizer will retain, all of which are backed by the loans to be originated. The securitization structure, as well as the distribution of cash flows to the various tranches, can be verified by a third party such as the court. Therefore, the structure will effectively enable the securitizer to commit to subsequently screen applicants (or not). We show shortly that the securitizer will have to retain some claims to show commitment, while structures without any retention will be proposed by those who do not plan to screen.

Specifically, the securitization structure is denoted as $\left\{F^G\left(x\right), F^B\left(x\right)\right\}$, where the function $F^{s_1}\left(x\right)$ represents the cash flows that investors will receive as a function of x, the cash flows that the securitizer (or the servicer) receives on date 1 in state s_1. We assume $F^{s_1}\left(x\right) \le x$, to allow the lender to have limited liability. For the main analysis, we will examine the case

$F^G(x) = F^B(x)$ so that the securities are not state-contingent and only depend on the received cash flow, x.

G. Wealth and Initial Conditions

Let ω_1^{I,s_1} and ω_1^{E,s_1} respectively be the wealth of the incumbent and experts in state s_1 after cash flows are generated. We term ω_1^{E,s_1} *liquidity* at date 1. The wealth of both the incumbent and experts (who work in the economy when not running a firm) is augmented by more when the economy is in state G than when the economy is in state B (so $\omega_1^{E,G} > \omega_1^{E,B}$ and $\omega_1^{I,G} > \omega_1^{I,B}$). Note that $\omega_1^{I,G}$, the incumbent's wealth in state G also includes the unpledged cash flows $(1-\gamma_1)C_1$.

At date 0, there is no prior incumbent, and each firm is sold in a competitive auction. For simplicity, we assume experts, whose type is not common knowledge, apply to different securitizers for loans, and if financed, bid. Among them, only two believe they are reliable.[9] Investors, who cannot screen, are willing to finance experts as if they are unreliable, but only if such investors break even conditional on making the loan. The highest bidder wins the auction and pays his/her bid amount, borrowing from the securitizer/investors who have financed them. Let ω_0 be an expert bidder's initial wealth at date 0. Also let (l_0, D_1) denote the contract signed between the bidder and the securitizer, where l_0 is the initial amount raised from the bank at date 0, and D_1 is the amount the winning bidder promises to repay on date 1. Therefore, in any auction, experts can bid $\omega_0 + l_0$, conditional on this being weakly less than the value of the firm to them. The winning bidder (henceforth the incumbent) has to repay D_1 by date 1.

H. Timing

The timing of events is described in Figure 2. Three events occur consecutively on date 0. First, each securitizer specifies securities $\{F^G(x), F^B(x)\}$ to be sold to investors given the loans that will be made, where x is the cash flow received by the securitizer on date 1. Next, experts whose type is not publicly known choose whether to borrow from a securitizer or

[9] We can easily handle more such bidders, but two is enough to introduce some competition while giving each securitizer some rents from screening.

investors. Given the securitization structure, each securitizer decides whether to screen the applicant and potentially offer a loan commitment $\left(l_0, D_1\right)$. Finally, each expert bids with their wealth and the loan commitment they have received. The bidder with highest bid wins and acquires control.

In period 1, the incumbent sets γ_2, the pledgeability for period 2's cash flow. If there was no screening conducted at date 0, the incumbent learns whether she is reliable or not at this stage through the act of trying to set pledgeability. Next, the aggregate state s_1 is realized. Production takes place and the pre-set pledgeable fraction γ_1 of cash flows goes to the securitizer automatically if state G is realized. Subsequently, the incumbent's ability in period 2 becomes known to all. At date 1, the incumbent either pays the remaining debt due or enters the auction. The period ends with potentially a new incumbent in control.

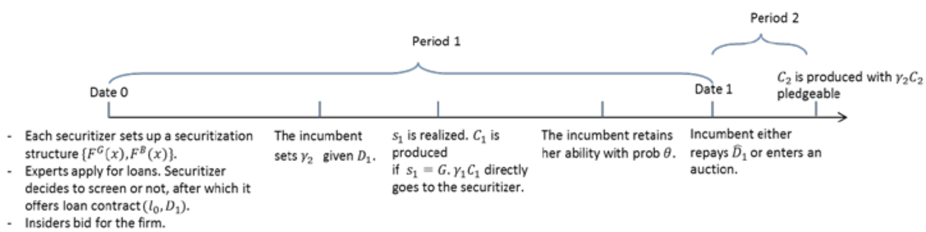


Figure 2: Timeline and Decisions

II. Two Motivating Examples

In the numerical examples below, we will focus on the initial bidders' demand for screening and financial intermediation service. To do so, we let the cost of screening ψ to be vanishingly small. Since only reliable borrowers (who become incumbents) can increase pledgeability and they need appropriate incentive to do so, the benefits of increased pledgeability (whether the associated debt level allows them to commit to pay a greater amount than unscreened borrowing), will drive the demand for screening.

Let the parameters for the examples be: C_1=0, C_2=1, θ=0.5, $\underline{\gamma}$=0.3, $\overline{\gamma}$=0.6, $\omega_1^{I,G}$=0.8, $\omega_1^{I,B}$ =0, $\omega_1^{E,B}$=0, γ_1=0, q=0.8, $\varepsilon \to 0$, μ=0.5, ρ=1.

Example 1: Low anticipated industry liquidity: $\omega_1^{E,G}$ =0.2

Debt repayment at date 1 is enforced by the lender, who can seize the firm and auction it to experts. The incumbent has to either pay the amount due or match the auction price, and will therefore choose to pay the lower of the two, defaulting strategically if the anticipated auction price is less than the debt payment. Of course, if the incumbent loses ability, she has no option but to sell in an auction since she cannot run the firm. She will use the auction proceeds to pay off debt and retain the residual proceeds.

A reliable incumbent manager is able to costlessly raise the pledgeability of future cash flows, which can increase the amount that experts can borrow against the firm and (weakly) increase their bids for the firm's assets. Similarly, higher liquidity – the realized expert wealth will also increase expert bids. In state G, an expert can bid using her personal wealth 0.2 and the amount that she can borrow against future cash flows. If period-2 pledgeability had been set high (this is set earlier in period 1 before the state is known), she can borrow 0.6 times the date-2 cash flow of 1 and therefore will bid up to 0.8 in total. If pledgeability had been set low, the amount she can borrow against date-2 cash flows falls to 0.3, in which case she can only bid up to 0.5. Similarly in state B where her liquidity is zero, the expert can bid up to 0.6 if pledgeability has been set high and 0.3 if set low. In sum, *higher liquidity and higher pledgeability increase expert bids, and thus enforce greater repayment*. Note that all of these bids fall below 1, the value of the future cash flows from the asset, which means the asset is underpriced and an expert who acquires the asset on date 1 will enjoy some positive rents.

Now let us examine the effect of higher debt on a reliable incumbent's pledgeability choice. Consider first an incumbent manager's choice when she owns the entire firm and has no debt due at date 1. In this case, pledgeability choice will of course have no effect on how much the incumbent manager needs to pay in order to remain control of the firm. As a result, if the incumbent manager retains her ability, she will also be the incumbent in the next period. On the other hand, if the incumbent manager loses ability and needs to sell the firm, higher pledgeability will increase expert bids by 0.3 and thus the selling price in both state G and state B by 0.3. If the cost of increasing pledgeability is small, as assumed, a reliable incumbent will choose to increase pledgeability. Note that as long as the debt due at date 1 is below 0.3 (the lowest possible expert bid which occurs in state B under low pledgeability), high pledgeability will similarly increase the resale value of the asset but will not affect the amount that the incumbent need to repay to retain control of the firm. In that case, a reliable incumbent still only sees the benefit from raising pledgeability.

Consider next what happens if a reliable incumbent manages an identical but highly levered firm with payment of 0.8 due on date 1. In this case, the incumbent does not benefit from high pledgeability when she loses ability, because the proceeds from selling the asset must be first used to repay the outstanding debt. Since expert bids never exceed 0.8 (the bid in state G with high pledgeability), debt consumes all the auction proceeds. Moreover, higher pledgeability increases the amount that the incumbent manager has to pay to stay in control when she retains ability. To see this, note that the incumbent can retain control either by fully repaying the outstanding debt of 0.8, or by defaulting strategically and outbidding other experts in the auction (similar to Chapter 11 bankruptcy). High pledgeability increases experts' bids by 0.3 in both states B and G, implying that the incumbent has to pay 0.3 more in either state. In this case, high pledgeability will not be chosen even if the incumbent is reliable. *Higher debt reduces the reliable incumbent's incentive to raise pledgeability*, so that even reliable managers will behave as if they are unreliable. In this case, there is no need to separate different types of managers through screening.

It is easy to see that, if the state was sure to be state B, a promised date-1 debt payment of 0.45 would make the reliable incumbent is indifferent between setting pledgeability low or high: when she loses ability she is able to receive (0.6-0.45) if she sets pledgeability high but nothing if low, whereas when she retains ability, she has to pay 0.45 if she had set pledgeability high but only 0.3 if low. The expected benefits and costs balance when promised debt is 0.45, since the probability that she loses ability is 0.5. At any higher debt she would set pledgeability low. A similar calculation shows this indifference level of debt is 0.65 if the state was certain to be state G. When the incumbent manager knows only the probability of the G state to be 0.8, we will show formally how we calculate the outstanding debt level that will make her indifferent in expectation, but for now note that it is 0.6125.[10] This promised debt level also enables a reliable manager to repay the most in expectation. Having set pledgeability high, she repays the full amount 0.6125 in the G state, which falls below expert bids 0.8, and hence is enforceable. In state B, she will default strategically and repays expert bids of 0.6. In expectation, she is able to commit to payment of: 0.8(0.6125) + 0.2(.6) = 0.61. In contrast, any debt level above 0.6125

[10] This is the payment level which makes the expected (across the two states) increase in payments when ability is retained equal to the expected increase in proceeds from selling when ability is lost.

will induce low pledgeability choice, so the incumbent will default strategically in both state G and B and only repay the amount that experts bid when period-2 pledgeability is low: 0.5 in G, 0.3 in B, and 0.46 in expectation. Unreliable incumbents can only commit to pay this amount, 0.46, as would reliable incumbents who owed more than 0.6125.

To summarize, the ability to raise pledgeability enables the reliable manager to repay more on date 1 and therefore borrow a higher amount initially at date 0. Since an unreliable manager is not capable of raising pledgeability, there is a need to screen them out, which is achieved by financial intermediaries such as securitizers. Furthermore, as we will see, these securitizers must hold some tranche of the cash flows from the underlying pooled loans – their skin in the game – so that they will find it incentive-compatible to screen. In periods of low or moderate future liquidity, there will be screening and securitizers will be forced to hold some skin in the game.

Example 2: High anticipated industry liquidity $\omega_1^{E,G} = 0.8$

Suppose now that the anticipated liquidity in state G increases to 0.8. The increased net worth enables the expert to bid up to 1.4 in state G when pledgeability has been set high and 1.1 when pledgeability has been set low (because the expert can borrow 0.3). In either case, though, she will bid no more than 1, the full value of the future cash flows, C_2, generated by the asset. Given the expert can bid that amount even if pledgeability were set low, higher pledgeability has no effect on the expert bid, and hence recovery at date 1 in state G. In effect, *high liquidity crowds out the need for pledgeability*. Ex ante, when the incumbent manager chooses pledgeability in period 1 prior to the aggregate state being realized, her incentives for high pledgeability can only come from state B.

Following example 1, 0.45 is still the promised date-1 debt payment in state B at which the incumbent is indifferent between setting pledgeability low or high. Since high liquidity crowds out the need for pledgeability in state G, the incentive for high pledgeability can only come from state B. In sum, when anticipated industry liquidity $\omega_1^{E,G}$ is high, 0.45 is the highest level of debt that incentivizes high pledgeability because no incentives emanate from the G state.

Unlike example 1, this maximum payment consistent with incentives is no longer the debt level that that enables the incumbent to commit to pay financiers the most and thus raise the most upfront. If the incumbent borrows at date 0 by setting date-1 debt payment at or above 1, she will set pledgeability low, fully repay the debt in state G (which happens with probability 0.8) but default in state B, where creditors will only recover 0.3. In expectation, the reliable incumbent is able to repay 0.86 even though pledgeability is set low. In contrast, by setting the face value at 0.45—which is the maximum debt level that still admits high pledgeability, the incumbent can only repay 0.45. So *liquidity enhances leverage, which crowds out the need for pledgeability*. The reliable manager will find no value to being screened, and since screening is not needed, securitzers will hold no skin in the game.

We now analyze the model more generally to show how the demand for screening and the form of securitization vary with liquidity (and other conditions) when screening costs are significant, $\psi > 0$, and securitizers face an opportunity cost to retention of securities as $\rho < 1$.

III. Solving the Model Formally

With a single state in period 2, and the economy ending after that, the analysis in that period is straightforward. Experts as well as the incumbent who retains ability can only commit to repay $D_2 = \gamma_2 C_2$ in period 2, where γ_2 is the pledgeability set in period 1. As a result, they can borrow up to $D_2 = \gamma_2 C_2$ when bidding for control at date 1. During period 2, there is no distinction between a reliable and an unreliable manager, since no further pledgeability choice will be made. With no need for screening at date 1, the securitizer finances new lending by selling all securities to investors – effectively, everyone will borrow directly from investors. We now proceed to the analysis during period 1 and at date 0. We make some assumptions to focus the analysis.

Assumption 1:

a. $\omega_1^{I,G} \geq \omega_1^{E,G}$, $\omega_1^{I,B} \geq \omega_1^{E,B}$

b. $\omega_1^{E,B} < \left(1-\overline{\gamma}\right)C_2$

c. $\gamma_1 C_1 + \omega_1^{E,G} + \underline{\gamma} C_2 > \omega_1^{E,B} + \overline{\gamma} C_2$

d. $q > \theta$

Assumption 1a stipulates that in every state the incumbent has weakly more wealth than experts, so she can retain control regardless of her choice of pledgeability by outbidding them in any possible date-1 auction if she retains ability – this is because her choice of pledgeability increases what both parties can borrow by the same amount. Assumption 1b further stipulates that in state B, experts' wealth $\omega_1^{E,B}$ is insufficent to allow them to bid the full value of the asset, C_2, even when pledgeability is set high, $\gamma_2 = \overline{\gamma}$. By contrast, we don't put any restriction on the level of liquidity in state G. Assumption 1c ensures the difference in the liquidity between the two future states is large enough that regardless of choice of pledgeability, repayment is strictly more in future state G than in future state B. Finally, Assumption 1 d effectively limits the degree of moral hazard in setting pledgeability by requiring the probability of the good state q to be higher than the probability of the incumbent keeping her ability, θ. We will discuss how results change if this assumption doesn't hold.

We now study payments at date 1 and decisions made in period 1. We start by analyzing the incumbent's incentive in setting pledgeability and how the promised payment D_1 affects the decision.

A. Incumbent's Pledgeability Choice

An expert can borrow $\gamma_2 C_2$ against future cash flows at date 1. So in a possible date-1 auction, he can bid up to $\omega_1^{E,s_1} + \gamma_2 C_2$ for the firm. Since the value of the future cash flows is C_2, an expert's date-1 bid will be $B_1^{E,s_1}(\gamma_2) = \min\{\omega_1^{E,s_1} + \gamma_2 C_2, C_2\}$. In the auction at that date, the incumbent will match if she can, but will not exceed the expert (we assume ties go in her favor). So in order to retain control, the incumbent either pays the minimum of the remaining debt or outbids experts. That is, she pays $\min\{\widehat{D}_1^{s_1}, B_1^{E,s_1}(\gamma_2)\} = \min\{\widehat{D}_1^{s_1}, \omega_1^{E,s_1} + \gamma_2 C_2, C_2\}$, where $\widehat{D}_1^G = D_1^G - \gamma_1 C_1$ and $\widehat{D}_1^B = D_1^B$ are the remaining debt payment due on date 1. Clearly, through the choice of pledgeability, γ_2, the incumbent could potentially affect the amount of payment needed for her to stay in control. The maximum the incumbent can bid is $B_1^{I,s_1}(\gamma_2) = \min\{\omega_1^{I,s_1} + \gamma_2 C_2, C_2\}$. Comparing $B_1^{I,s_1}(\gamma_2)$ and $B_1^{E,s_1}(\gamma_2)$, we see that the incumbent will outbid experts whenever she has (weakly) more wealth ($\omega_1^{I,s_1} \geq \omega_1^{E,s_1}$), since both parties can borrow up to $\gamma_2 C_2$ if needed. The incumbent is always willing to retain the firm if she retains ability since the continuation value of the firm, C_2, is identical for the incumbent and experts.

A few points that we illustrated in the examples are worth noting here. First, the greater the anticipated liquidity, ω_1^{E,s_1}, the greater will be the bid of experts, and the greater will be the debt face value that can be enforced. Second, the greater the pledgeability γ_2 chosen, the greater again the enforceability of debt payments. Finally, because no bidder will pay more than the residual value of the firm, C_2, when liquidity is sufficiently high (that is, $\omega_1^{E,s_1} \geq (1-\underline{\gamma})C_2$), higher pledgeability is no longer needed to enhance debt capacity – bidders have enough wealth of their own to make a bid for full value, without borrowing any more than the minimum pledgeable cash flows of the asset, $\underline{\gamma}C_2$. In other words, high liquidity can crowd out the need for pledgeability. We will use all these in what follows.

Let $V_1^{I,s_1}\left(\widehat{D}_1^{s_1}, \gamma_2\right)$ be the incumbent's payoff when she chooses γ_2, given the remaining payment $\widehat{D}_1^{s_1}$ that an incumbent needs to pay to avoid the auction. In both state $s_1 = G$ and $s_1 = B$,

$$V_1^{I,s_1}\left(\widehat{D}_1^{s_1}, \gamma_2\right) = \theta\left(C_2 - \min\left\{\widehat{D}_1^{s_1}, B_1^{E,s_1}(\gamma_2)\right\}\right) + (1-\theta)\left(B_1^{E,s_1}(\gamma_2) - \min\left\{\widehat{D}_1^{s_1}, B_1^{E,s_1}(\gamma_2)\right\}\right) - \varepsilon 1_{\{\gamma_2 > \underline{\gamma}\}}, \tag{1}$$

The terms on the R.H.S. of (1) are straightforward. With probability θ, the incumbent retains her ability and needs to pay $\min\left\{\widehat{D}_1^{s_1}, B_1^{E,s_1}(\gamma_2)\right\}$ to retain control and receive cash flows C_2 in period 2. With probability $1-\theta$, the incumbent loses her ability, in which case she has to sell the asset at price $B_1^{E,s_1}(\gamma_2)$, repay creditors $\min\left\{\widehat{D}_1^{s_1}, B_1^{E,s_1}(\gamma_2)\right\}$, and keep the remaining proceeds. A cost ε is incurred whenever she sets pledgeability γ_2 above $\underline{\gamma}$.

Note from (1) that the incumbent faces a tradeoff in raising pledgeability. A higher γ_2 (weakly) increases the amount the incumbent has to pay the financier when she retains capability and control, therefore (weakly) decreasing the first term, while it (weakly) increases the amount the incumbent gets in the auction if she loses capability, thus (weakly) increasing the second term. In choosing to increase γ_2, the incumbent therefore trades off being forced to make higher possible repayments -- when she *buys* the firm from the lender conditional on retaining ability -- against the higher possible resale value when she *sells* the firm after losing ability. More generally, the incumbent trades off the cost of the boost to the value of existing claims on the firm against the benefit from the boost to the value of new future claims. The higher the stability θ, the more the costs loom large relative to the benefits, and higher is the moral hazard associated with raising pledgeability.

The level of current outstanding claims clearly shifts how the incumbent sees this tradeoff. The incumbent's benefit from choosing high versus low pledgeability if state s_1 is known to be realized for sure is $\Delta_1^{s_1}\left(\widehat{D}_1^{s_1}\right)=V_1^{I,s_1}\left(\widehat{D}_1^{s_1},\overline{\gamma}\right)-V_1^{I,s_1}\left(\widehat{D}_1^{s_1},\underline{\gamma}\right)$, which (weakly) decreases in the level of outstanding debt, $\widehat{D}_1^{s_1}$. The reason is straightforward. If the incumbent retains her ability, she has to pay the securitizer more on the outstanding debt when she raises pledgeability, and the higher the outstanding debt, the more this is. Similarly, if she loses her ability, she gets the residual value after the selling the firm, and higher the outstanding debt, the less this is. So higher outstanding debt reduces the incumbent's incentive to raise pledgeability. Proposition 2.1 summarizes the incumbent's incentive from state s_1 for any given D_1.

Proposition 2.1: Under Assumption 1,

1. A reliable incumbent's net benefit from choosing high pledgeability in state $s_1 \in \{G,B\}$ is
$$\Delta_1^{s_1}\left(\widehat{D}_1^{s_1}\right)=\begin{cases}-\theta\left[B_1^{E,s_1}\left(\overline{\gamma}\right)-B_1^{E,s_1}\left(\underline{\gamma}\right)\right]-\varepsilon & \text{if } \widehat{D}_1^{s_1}>B_1^{E,s_1}\left(\overline{\gamma}\right)\\ \theta B_1^{E,s_1}\left(\underline{\gamma}\right)+\left(1-\theta\right)B_1^{E,s_1}\left(\overline{\gamma}\right)-\varepsilon-\widehat{D}_1^{s_1} & \text{if } B_1^{E,s_1}\left(\underline{\gamma}\right)<\widehat{D}_1^{s_1}\le B_1^{E,s_1}\left(\overline{\gamma}\right)\\ \left(1-\theta\right)\left[B_1^{E,s_1}\left(\overline{\gamma}\right)-B_1^{E,s_1}\left(\underline{\gamma}\right)\right]-\varepsilon & \text{if } \widehat{D}_1^{s_1}\le B_1^{E,s_1}\left(\underline{\gamma}\right).\end{cases}$$
2. There exists a unique threshold D_1^{IC} such that the incumbent sets high pledgeability if and only if $D_1 < D_1^{IC}$.
3. An unreliable incumbent manager will always choose low pledgeability: $\gamma_2=\underline{\gamma}$.

These results are derived in the appendix and follow from Diamond, Hu, and Rajan (2018). Let us graph $\Delta_1^{s_1}$ as a function of $\widehat{D}_1^{s_1}$ as described in Proposition 2.1.

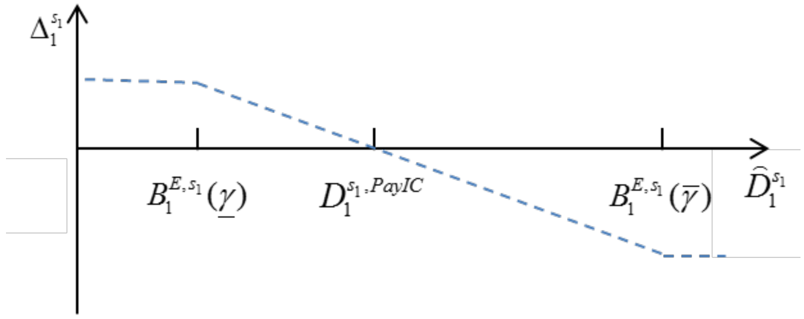


Figure 3: The net payoff to high pledgeability

For $\widehat{D}_1^{s_1} \leq B_1^{E,s_1}\left(\underline{\gamma}\right)$, debt repayment is not increased by higher pledgeability because of the low value of outstanding debt. Instead higher pledgeability only increases outside bids, which is beneficial when the incumbent loses ability and sells the asset. The benefits of high pledgeability are $\left(1-\theta\right)\left[B_1^{E,s_1}\left(\overline{\gamma}\right)-B_1^{E,s_1}\left(\underline{\gamma}\right)\right]-\varepsilon$, which is the difference between the price that the incumbent can sell the asset at by setting pledgeability high versus setting it low. As $\widehat{D}_1^{s_1}$ rises above $B_1^{E,s_1}\left(\underline{\gamma}\right)$, the incumbent has to pay more in expectation to debt holders when she raises pledgeability, so as the face value of debt increases further $\Delta_1^{s_1}\left(\widehat{D}_1^{s_1}\right)$ falls to zero and then goes negative. When $\widehat{D}_1^{s_1} > B_1^{E,s_1}\left(\overline{\gamma}\right)$, the incumbent has to pay the entire increment in sale price from increasing pledgeability to debt holders when she loses ability – she gets nothing from increasing pledgeability under those circumstances – while she has to pay $B_1^{E,s_1}\left(\overline{\gamma}\right)$ instead of $B_1^{E,s_1}\left(\underline{\gamma}\right)$ if she retain ability. Hence there is no benefit but only cost to the incumbent by increasing pledgeability, and the cost is capped at $\theta\left[B_1^{E,s_1}\left(\overline{\gamma}\right)-B_1^{E,s_1}\left(\underline{\gamma}\right)\right]-\varepsilon$.

Note also that if liquidity in the G state, $\omega_1^{E,G}$, gets sufficiently high such that $\omega_1^{E,G} \geq \left(1-\underline{\gamma}\right)C_2$, experts can pay the full price of the asset C_2 even with low pledgeability – they have no need for additional borrowing to make a full bid. In that case, both $B_1^{E,G}\left(\overline{\gamma}\right)$ and

$B_1^{E,G}\left(\underline{\gamma}\right)$ equal C_2, and $\Delta_1^G\left(\widehat{D}_1^G\right)=-\varepsilon$ for any $\widehat{D}_1^G$. Put differently, when liquidity crosses the threshold of $\left(1-\underline{\gamma}\right)C_2$ in state G, no incentive to raise pledgeability can come from that state.

For lower levels of $\omega_1^{E,G}$, i.e., if $\omega_1^{E,G}<\left(1-\underline{\gamma}\right)C_2$, Proposition 2.1 implies there is a maximum debt level for each state where the incumbent has the incentive to set pledgeability high were that state to occur with certainty. That debt level, $D_1^{s_1,PayIC}=\theta B_1^{E,s_1}\left(\underline{\gamma}\right)+\left(1-\theta\right)B_1^{E,s_1}\left(\overline{\gamma}\right)-\varepsilon$, is obtained by setting $\Delta_1^{s_1}\left(D_1^{s_1,PayIC}\right)=0$. Note that the higher the probability the incumbent retains ability, θ, the higher the moral hazard associated with pledgeability, and the lower is $D_1^{s_1,PayIC}$. It is easily checked that $D_1^{G,PayIC}>D_1^{B,PayIC}$.

These state-contingent incentive constraints allow us to present the condition for a reliable incumbent to increase pledgeability, given that it is selected before the ex-post state is known. For any levels of $\omega_1^{E,G}$, given the probability of the good state being q, the risk-neutral incumbent will choose high pledgeability for any given D_1 if and only if $q\Delta_1^G\left(D_1-\gamma_1C_1\right)+(1-q)\Delta_1^B\left(D_1\right)\geq 0$. A value of D_1 which makes this weak inequality equal zero is a payment level, D_1^{IC}, which makes the expected (across the two states) increase in payments when ability is retained equal to the expected increase in proceeds from selling when ability is lost. Since $\Delta_1^{s_1}$ is weakly decreasing in $\widehat{D}_1^{s_1}$, it must be that D_1^{IC}, the threshold of debt below which higher pledgeability is incentivized given the incumbent's knows the probabilities of each future state, lies between $D_1^{B,PayIC}$ and $\gamma_1C_1+D_1^{G,PayIC}$. If $\omega_1^{E,G}\geq\left(1-\underline{\gamma}\right)C_2$, all the incentive to raise pledgeability comes from state B so that $D_1^{IC}=D_1^{B,PayIC}$. Very high liquidity, by reducing the need for pledgeability, reduces the incentive compatible level of debt.

This implies the maximum amount that a borrower can repay may not be D_1^{IC}. Even with low pledgeability choice, the incumbent is able to promise repayment of $\underline{l}=q^G\left(\gamma_1C_1+B_1^{E,G}(\underline{\gamma})\right)+(1-q^G)B_1^{E,B}(\underline{\gamma})$ at date 0. By contrast, to incentivize high pledgeability, the promised payment cannot exceed D_1^{IC}, which will imply expected repayment of $\overline{l}=qD_1^{IC}+(1-q^G)\min\left\{D_1^{IC},B_1^{E,B}(\overline{\gamma})\right\}$. If $\gamma_1C_1+B_1^{E,G}(\underline{\gamma})$ is much larger than D_1^{IC} (either because liquidity in the G state is high or the moral hazard associated with pledgeability θ is high so that D_1^{IC} is low) and if the probability of the good state q is sufficiently high, the incumbent could pledge more repayment (and thus raise more) by setting $D_1 = \gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})$. The broader point is that the prospect of a highly liquid future state not only makes feasible greater promised payments, but these promised payments also eliminate incentives to enhance pledgeability that only emanates from the low liquidity state. To restore those incentives, debt may have to be set so low that funds raised are greatly reduced – something the incumbent will not want to do if she is bidding at date 0 for the firm. Note that this can happen even if the probability of the low state is significant, and even if the direct cost ε of enhancing pledgeability is infinitesimal or zero.

Corollary 2.1: Under Assumption 1, the face value that enables the manager to pledge out the most at date 0 is either $D_1 = \gamma_1 C_1 + B_1^{E,G}\left(\underline{\gamma}\right)$ or $D_1 = D_1^{IC}$. If $\omega_1^{E,G} < \left(1-\overline{\gamma}\right)C_2$, then $D_1^{IC} > \gamma_1 C_1 + B_1^{E,G}\left(\underline{\gamma}\right)$ so that D_1^{IC} is the debt level that enables the manager to pledge out the most at date 0.

Proof: See appendix.

B. Optimal Lending and Securitization

In stage 1, the securitizer chooses a securitization structure, which specifies securities sold $F\left(x\right)$ and consequently his retention. We assume for now that the securitizer keeps the junior claim with payoff $\max\left\{x - F\left(x\right), 0\right\}$. In stage 2, the securitizer sets l_0, the amount that will be committed to the reliable bidder to finance the bid. If the bidder wins the auction, the amount lent l_0 is observable and verifiable, as is the required and actual repayment. All loans are subsequently pooled, tranched, and sold to investors according to the securitization structure chosen in stage 1.

The expected amount repaid under $D_1 = D_1^{IC}$ when the bidder is found reliable (which implies the reliable incumbent will choose $\gamma_2 = \overline{\gamma}$) is $\overline{l} = qD_1^{IC} + (1-q)\min\left\{D_1^{IC}, B_1^{E,B}(\overline{\gamma})\right\}$. If $\gamma_1 C_1 + B_1^{E,G}\left(\underline{\gamma}\right) > D_1^{IC}$, the expected amount repaid under $D_1 = \gamma_1 C_1 + B_1^{E,G}\left(\underline{\gamma}\right)$ (which implies the reliable incumbent will choose $\gamma_2 = \underline{\gamma}$) is

$\underline{l} = q^G\left(\gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})\right) + (1-q^G)B_1^{E,B}(\underline{\gamma})$.[11] This is also what the unreliable incumbent will repay, since he will not be able to set pledgeability high. A precondition for screening and securitization to be implementable is $\overline{l} > \underline{l}$, else everyone is better off with unscreened lending, since incentivizing pledgeability does not enhance borrowing capacity. This condition was illustrated in example 2 in Section II (and the reverse in example 1).

Three necessary and sufficient conditions have to be met for screening and securitization to be viable.

(i) Given the securitization structure F, the present value of what the securitizer receives by lending to a reliable manager should exceed what the unreliable manager can borrow from uninformed investors, else the reliable manager will never get enough to bid to win the auction.

(ii) Conditional on setting up the securitization structure, the securitizer should have the incentive to screen rather than lend unscreened – he should have sufficient "skin in the game" to screen after selling securities. (IC constraint)

(iii) The securitizer should earn enough informational rents to offset the cost of setting up the screening mechanism. (Participation constraint)

An informed lender can never earn any profit from lending to the unreliable. Intuitively, unreliable managers can always borrow $\underline{l}$ from uninformed investors and since $\rho < 1$, they always borrow strictly less from the informed lender (unless the lender sells out the entire loan in which case there is no difference between different types of lenders). Therefore no expert who knows they are unreliable will apply to be screened, since screening is accurate. Only those who believe they are reliable will apply. Each (of the two) securitizers will support the bid of the expert they respectively screen if she is found to be reliable. The large number of other experts will bid unscreened, borrowing from investors. Because there are many of these experts, no such

[11] If $\gamma_1 C_1 + B_1^{E,G}\left(\underline{\gamma}\right) \le D_1^{IC}$, then all lenders will ask borrowers to repay $D_1 = D_1^{IC}$. If so, the reliable manager will repay $\overline{l} = qD_1^{IC} + (1-q)\min\left\{D_1^{IC}, B_1^{E,B}(\overline{\gamma})\right\}$ and the unreliable will repay $\underline{l} = q\left(\gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})\right) + (1-q)B_1^{E,B}(\underline{\gamma})$. Given that the fraction λ of unreliable applicants to investors tends to 1, the amount investors will be willing to lend each applicant if they win the auction will converge to $\underline{l}$.

bidder makes more than a vanishingly small expected rent. Experts who are rejected in the screening do not bid.[12] We now characterize each of the three conditions.

Consider without loss of generality any pre-chosen securitization structure $F(x) \le D_1^{IC}$ in stage 1. Let $m(F) = qF + (1-q)\min\{B_1^{E,B}(\overline{\gamma}), F\}$ be the total proceeds from selling the security F when investors anticipate high pledgeability will be chosen by the incumbent, which also implies the securitizer's IC constraint and the participation constraint will be satisfied. After selling F, the securitizer expects to receive $(\overline{l} - m)$ at date 1, discounted at ρ. Therefore, the total amount that the securitizer will receive under screening is $\rho(\overline{l} - m) + m$. Given this, he would never lend any amount above $\rho(\overline{l} - m) + m$. That implies for any securitization structure $F(x)$, if $\rho(\overline{l} - m) + m \le \underline{l}$, the securitizer can never lend more to a reliable manager than would uninformed investors, and condition (i) is not satisfied. Note that this feasibility constraint loosens as ρ, F, and m increase. Intuitively, the screening securitizer finds it more feasible to lend if his cost of investing capital gets lower, or if he is able to securitize a large fraction of the loan commitment thus retaining little. For the main analysis, we will focus on the case $\rho \to 1$ so that condition (i) becomes $\overline{l} > \underline{l}$.

Next, we study the informed lender's choice of loan amount lent l_0 when the applicant is found to be reliable after screening. Given the assumption that the securitizer makes a take-it-or-leave-it offer, we focus on the strategic interactions between the securitizers who finance the bidders. Because there are possibly two screened bidders for a firm (in addition to a vast number of unreliable bidders), both the informed lender and the reliable applicant realize that with probability μ, the other bidder is also reliable, whereas with probability $1-\mu$, the other bidder will be found to be unreliable. In this case, the competitive bid will be $\underline{l}$ from the "reserve army" of the unreliable, financed by investors. Furthermore, whenever the highest possible competing bid is known in advance and is below the highest amount that a reliable applicant can be lent, it

[12] The results would not change if they then bid after securing loans from investors, who assume they are unreliable. Essentially, the probability for any unreliable bidder to win is vanishingly small, and so are the expected rents from bidding. Thus opening this option has little effect on incentives.

will be in the informed lender's interest to finance a slightly higher bid. The following lemma shows that, as a result, the choice of l_0 cannot be a pure-strategy equilibrium.

Lemma 2.2: In the auction where the informed securitizer finances the reliable manager, no pure strategy equilibrium exists for the choice of l_0. In the mixed strategy equilibrium, the lender sets $l_0 = y \in [\underline{l}, \overline{y}]$, where $\overline{y} = (1-\mu)\underline{l} + \mu\{\rho(\overline{l}-m)+m\}$ and

$$\Gamma(y) = \frac{1}{\mu}\left\{\frac{(1-\mu)\times\left[\rho(\overline{l}-m)+m-\underline{l}\right]}{\left[\rho(\overline{l}-m)+m-y\right]} - (1-\mu)\right\}$$

is the CDF of y. The informed lender's expected profits are: $(1-\mu)\times\left[\rho(\overline{l}-m)+m-\underline{l}\right]$. As $\rho \to 1$, $\overline{y} \to (1-\mu)\underline{l} + \mu\overline{l}$. The lender's expected profits will converge to $(1-\mu)\times(\overline{l}-\underline{l})$.

Proof: See appendix.

C. Screening and Securitization

We now solve for screening and securitization choices and characterize the incentive and participation constraints.[13] The securitizer has the choice whether to screen or not, given the structure $F(x)$ that he has set up.

The amounts that the securitizer receives in each state may depend on whether he screens or not. If he screens and therefore only lends to a reliable manager at $D_1 = D_1^{IC}$, he receives D_1^{IC} in state G for sure. If he does not screen, with probability μ, the applicant is reliable, in which case he can still receive D_1^{IC}. With probability $1-\mu$, however, the applicant will turn out unreliable, in which case the securitizer only receives $\min\left[D_1^{IC}, \gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})\right]$. Therefore, in

[13] If the size of each loan commitment l_0 is observable and verifiable by outside investors, whenever the securitizer sells securities against a pool of loans, the distribution of l_0 within this pool must satisfy the cumulative distribution function $\left[\Gamma(y)\right]^2$, where $\Gamma(y)$ is the CDF of y, the size of the loan commitment. The quadratic form applies because there are two bidders and only the winning bidder actually takes out the loan. In the off-equilibrium path when investors observe an alternative distribution of l_0, a refinement such as intuitive criteria makes it clear that the belief is always the lender did not screen. So once the securitizer sets up the securitization structure consistent with screening (see shortly), he is locked into the distribution of loan amounts $\left[\Gamma(y)\right]^2$.

state G, he receives $\max\left\{\underline{x}^G - F, 0\right\}$ without screening and $\overline{x}^G - F$ with screening, where

$\underline{x}^G = \mu D_1^{IC} + (1-\mu)\min\left[D_1^{IC}, \gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})\right]$ and $\overline{x}^G = D_1^{IC}$.

Given $\underline{x}^G$ and $\overline{x}^G$, the additional amount that the securitizer will receive through screening is $R^G(F) = \overline{x}^G - \max\left\{\underline{x}^G, F\right\}$, which decreases (weakly) with F. Intuitively, the securitizer has a lower incentive to screen the more the senior claims that have been sold and the lower his skin in the game. The analysis in state B is similar. The securitizer receives $\max\left\{\underline{x}^B - F, 0\right\}$ without screening and $\max\left\{\overline{x}^B - F, 0\right\}$ with screening, where

$\underline{x}^B = \mu \min\left\{D_1^{IC}, B_1^{E,B}(\overline{\gamma})\right\} + (1-\mu) B_1^{E,B}(\underline{\gamma})$ and $\overline{x}^B = \min\left\{D_1^{IC}, B_1^{E,B}(\overline{\gamma})\right\}$. Therefore, the additional amount he will receive is $R^B(F) = \max\left\{\overline{x}^B, F\right\} - \max\left\{\underline{x}^B, F\right\}$,

which again decreases (weakly) with F. Let $R(F) = \rho\left[qR^G(F) + (1-q)R^B(F)\right]$ be the expected gains to the securitizer from screening, which clearly decrease with F. Therefore, the maximum expected gains to the securitizer from screening is

$$R(0) = \rho(1-\mu)\left[\begin{array}{l} q\left(D_1^{IC} - \min\left\{D_1^{IC}, \gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})\right\}\right) \\ +(1-q)\left(\min\left\{D_1^{IC}, B_1^{E,B}(\overline{\gamma})\right\} - B_1^{E,B}(\underline{\gamma})\right)\end{array}\right].$$

According to Corollary 2.1, $D_1^{IC} > \gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})$ if $\omega_1^{E,G} < (1-\overline{\gamma})C_2$, in which case $R(0) = \rho(1-\mu)(\overline{l} - \underline{l})$.

The expected screening cost associated with each granted loan equals the cost of screening ψ divided by the probability of extending the loan conditional on screening. With probability μ, an applicant is reliable, in which case her probability of winning the auction equals $\left(\frac{\mu}{2} + (1-\mu)\right)$.[14] Therefore the probability an applicant wins is $\mu\left(\frac{\mu}{2} + (1-\mu)\right)$. If

[14] She is equally likely to win the auction if her opponent is reliable, and will win for sure if her opponent is unreliable.

$R(0)$ is less than the expected per-loan screening cost $\frac{\psi}{\mu\left(\frac{\mu}{2}+(1-\mu)\right)}$, no securitization structure can ever incentivize the lender to screen. This will be the case when $\left(\bar{l}-\underline{l}\right)$ is small so there is little value in telling the reliable from the unreliable. When the loan applicant is highly likely to be reliable (higher μ), the additional amount received from screening is also small, however the effective per-loan screening cost is also lower so that the overall result on screening incentives is ambiguous.

For any given securitization structure F, a securitizer screens if and only if $R(F)\geq\frac{\psi}{\mu\left(\frac{\mu}{2}+(1-\mu)\right)}$. Given that $R(F)$ decreases with F, let $F^{\max}$ be the maximum F that satisfies $R(F)=\frac{\psi}{\mu\left(\frac{\mu}{2}+(1-\mu)\right)}$, the securitizer's IC constraint becomes $F\leq F^{\max}$.

Finally, we discuss the securitizer's participation constraint. According to Lemma 2.2, the informed securitizer's expected profits are $(1-\mu)\times\left[\rho(\bar{l}-m)+m-\underline{l}\right]$, which increase in m and therefore F. Intuitively, the securitizer's profits are higher if he can set up a securitization structure that sells a higher fraction of loans (due to the assumption that he is less patient). Given there's no fixed cost in screening, the participation constraint in this case becomes

$$\underbrace{(1-\mu)\times\left[\rho(\bar{l}-m)+m-\underline{l}\right]}_{\text{expected profits}}\geq\frac{\psi}{\mu\left(\frac{\mu}{2}+(1-\mu)\right)}.$$

Let $F^{\min}$ be the minimum face value that satisfies $(1-\mu)\times\left[\rho(\bar{l}-m)+m-\underline{l}\right]=\frac{\psi}{\mu\left(\frac{\mu}{2}+(1-\mu)\right)}$. The participation constraint requires $F\geq F^{\min}$. Note that as $\rho\rightarrow 1$ and if $D_1^{IC}>\gamma_1 C_1+B_1^{E,G}\left(\underline{\gamma}\right)$ holds, both the IC and PC constraint become $\left(1-\mu\right)\left(\overline{l}-\underline{l}\right)\geq\dfrac{\psi}{\mu\left(\dfrac{\mu}{2}+(1-\mu)\right)}$. In this case, the IC constraint can always be satisfied conditional on the participation constraint holding, and vice versa.

To summarize, the IC constraint in screening requires $F\leq F^{\max}$, whereas the participation constraint requires $F\geq F^{\min}$. In the general solution, the securitizer chooses $F^{\max}$ if $F^{\min}\leq F^{\max}$. Otherwise, no securitization structure can incentivize both screening and participation simultaneously. In the appendix, we will examine the kinds of securities the securitizer might hold to maximize incentives while minimizing retention.

IV. How Liquidity Affects Securitization

Now that we have laid out the framework, let us study first how an increase in future liquidity, and then how an increase in current liquidity affects the extent of debt, screening, and securitization.

A. The Effect of Anticipated Liquidity

Consider an increase in expert wealth $\omega_1^{E,G}$ from low levels. We assume the screening cost ψ is sufficiently low such that for the lowest $\omega_1^{E,G}$ (and thus also the lower $\omega_1^{E,B}$) the firm is underpriced at date 1 in both states even with high pledgeability (in that maximum date-1 bids are below C_2). In this case, retained claims in either state G or state B alone may provide sufficient incentive to screen. In addition, we assume Assumption 1 continues to hold.

Low anticipated liquidity

When $\omega_1^{E,G}<\left(1-\overline{\gamma}\right)C_2$ so that $B_1^{E,G}\left(\overline{\gamma}\right)<C_2$, then Corollary 2.1 implies $D_1^{IC}>\gamma_1C_1+B_1^{E,G}(\underline{\gamma})$. In this region, increased pledgeability increases the bids by a constant amount, making D_1^{IC} increase with $\omega_1^{E,G}$. Moreover, both $R^G\left(0\right)$ and $R^B\left(0\right)$ are strictly positive so that screening will affect the amount the securitizer receives in both future states. Specifically, $R^G\left(0\right)=\left(1-\mu\right)\left[D_1^{IC}-\gamma_1C_1-B_1^{E,G}(\underline{\gamma})\right]$ and $R^B\left(0\right)=\left(1-\mu\right)\left[B_1^{E,B}(\overline{\gamma})-B_1^{E,B}(\underline{\gamma})\right]$. Since we have assumed ψ to be sufficiently low

($\dfrac{\psi}{\mu\left(\dfrac{\mu}{2}+(1-\mu)\right)} \le q^G R^G(0)$ is satisfied) so that the claims in state G alone can provide sufficient incentives to screen, the securitizer chooses $F \in \left(\underline{x}^G, \overline{x}^G\right)$ such that

$$q^G R^G(F) = \frac{\psi}{\mu\left(\dfrac{\mu}{2}+(1-\mu)\right)}.$$

Intermediate levels of anticipated liquidity

As $\omega_1^{E,G}$ increases further and exceeds $(1-\overline{\gamma})C_2$, $D_1^{IC} - B_1^{E,G}(\underline{\gamma})$ starts to decrease with $\omega_1^{E,G}$. So does $R^G(0)$, the maximum gains to the securitizer in state G. By contrast, $R^B(0)$ is unaffected. Ultimately, $q^G R^G(0)$ falls below the per-loan screening cost $\dfrac{\psi}{\mu\left(\dfrac{\mu}{2}+(1-\mu)\right)}$. In that case, the retained claim from state G alone is unable to provide sufficient incentive for screening and therefore F needs to drop dramatically to some level below $B_1^{E,B}(\overline{\gamma})$. In other words, the securitizer must chooses $F \in \left(\underline{x}^B, \overline{x}^B\right)$ such that $qR^G(F)+(1-q)R^B(F) = \dfrac{\psi}{\mu\left(\dfrac{\mu}{2}+(1-\mu)\right)}$. As a result, there will be a discontinuous drop in the face value F that is sold and therefore an increase in retention.

High anticipated liquidity

As $\omega_1^{E,G}$ further increases so that D_1^{IC} falls below $\gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})$, the need to maintain pledgeability incentives would require the promised payment to fall below what can be paid in state G with low pledgeability. As a result, the amount paid to lenders in expectation may be higher if the promised payment violates the incentive for a reliable incumbent to raise pledgeability: $\underline{l}$ may be higher than $\overline{l}$. In this case, there is no value to screening and thus no need for retention. Intuitively, high liquidity facilitates debt of higher face value than D_1^{IC}, which crowds out the incentive for pledgeability. All loans are sold to investors or to securitizers who do not screen, and who therefore retain nothing and sell out the securities against the loan entirely, with no skin in the game.

To summarize, as liquidity $\omega_1^{E,G}$ increases, one of the three events may occur and subsequently reduce (or eliminate) the incentive to screen. First, $R^G(0)$, the additional amount the securitizer gets in the G state from screening gets smaller. Second, D_1^{IC} may fall below $\gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})$ so that incentives to screen cannot come from retentions in state G. In both cases, the IC and participation constraints in screening are more likely to get violated. Finally, $\underline{l}$ may increase beyond $\overline{l}$ as $\omega_1^{E,G}$ increases, so that screening does not enable a larger loan to be made, and there is no demand for screening. The more general point is that liquidity tends to diminish the differences between screened and unscreened lending, because it reduces the need for incentives at the borrower level, and hence reduces the need for incentives at the screener level (as also increases the difficulty of providing incentives to the screener).

Let us illustrate of the effect of anticipated liquidity with a numerical example using the same parameter values as in Section II, example 2, except for increasing the screening cost from zero to ψ =0.01.

Parameters: q =0.8, θ=0.5, $\overline{\gamma}$ =0.6, $\underline{\gamma}$ =0.3, C_1 =0, C_2 =1, $\omega_1^{I,G}$ =0.8, $\omega_1^{I,B}$ =0, $\omega_1^{E,G} \in [0.1, 0.8]$, $\omega_1^{E,B}$ =0, $\gamma_1 = \overline{\gamma}$, μ =0.5, $\rho \to 1$, ψ =0.01.

Under these parameters, a reliable incumbent can always outbid experts in an auction at date 1. The bids in state G and $D_1^{G,PayIC}$ will depend on $\omega_1^{E,G}$. The bids in state B (conditional on the chosen pledgeability) are $B_1^{E,B}(\overline{\gamma})$ =0.6 and $B_1^{E,B}(\underline{\gamma})$ =0.3. As we have explained, $D_1^{B,PayIC}$ =0.45.

The per-applicant screening cost equals $\dfrac{\psi}{\mu\left(\dfrac{\mu}{2}+(1-\mu)\right)}$ =0.0267. In Figure 4, Panel A shows D_1^{IC}, $D_1^{\max}$, $\overline{x}^{s_1} - \underline{x}^{s_1}$ (the maximum screening benefits in state $s_1 \in \{G, B\}$). Panel B shows $F^{\max}$, and $1-\dfrac{m}{\overline{l}}$, which is the fraction of retention. D_1^{IC} initially increases at slope q

=0.8 until it reaches $B_1^{E,B}\left(\overline{\gamma}\right)$=0.6. After that, it increases even steeper at slope of 1 until $B_1^{E,G}\left(\overline{\gamma}\right)$ reaches C_2 (at which point full value is paid in state G and the bid by experts in that state no longer increases with $\omega_1^{E,G}$ when pledgeability is set high), after which D_1^{IC} increases more gently at θ=0.5. When $\omega_1^{E,G}$ increases from 0.62 to 0.63, D_1^{IC} drops discontinuously because the benefit of high pledgeability in state G, given the high liquidity, gets sufficiently low that incentives for setting pledgeability high have to come from state B. This then requires the incentive compatible level of debt (for setting pledgeability high) to drop significantly.

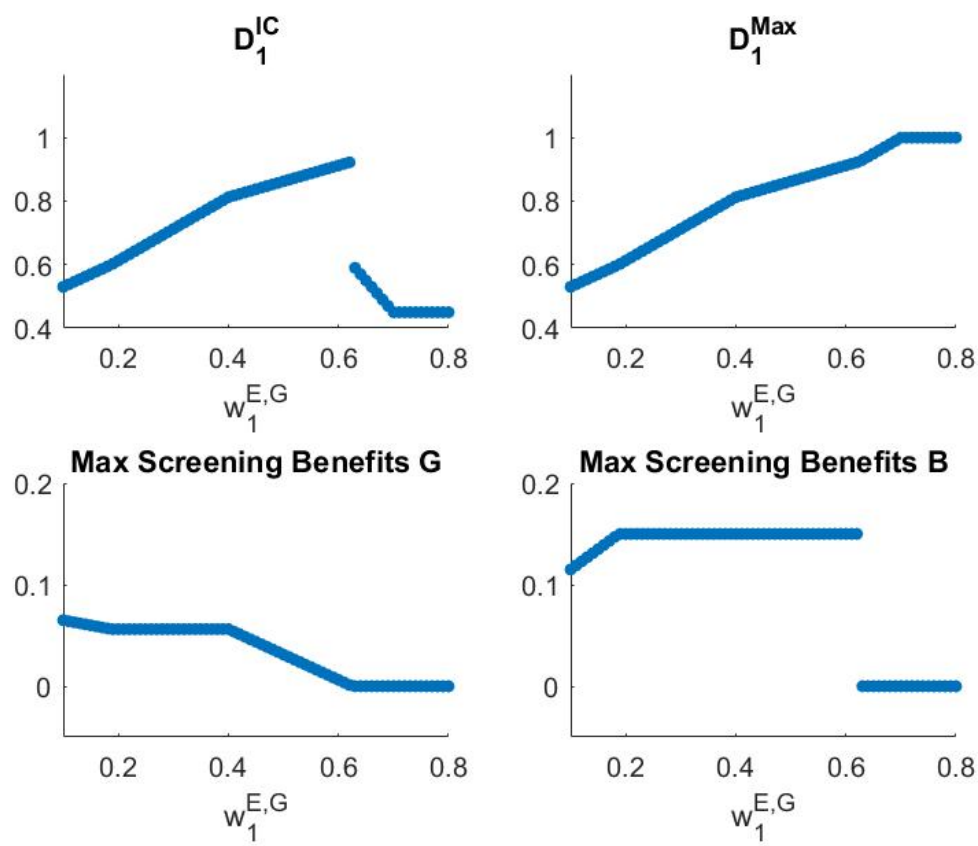
Next, we examine $\overline{x}^G - \underline{x}^G$ and $\overline{x}^B - \underline{x}^B$, the maximum screening benefits in both states. By definition, $\overline{x}^G - \underline{x}^G = (1-\mu)\left[D_1^{IC} - \min\left(D_1^{IC}, \gamma_1 C_1 + B_1^{E,G}\left(\underline{\gamma}\right)\right)\right]$. When $\omega_1^{E,G} \in [0.2, 0.4]$, it equals $(1-\mu)\left[D_1^{IC} - \gamma_1 C_1 - B_1^{E,G}\left(\underline{\gamma}\right)\right]$, which is constant over the range because both D_1^{IC} and $B_1^{E,G}\left(\underline{\gamma}\right)$ increase with $\omega_1^{E,G}$ at slope 1. Note that $q\rho\left(\overline{x}^G - \underline{x}^G\right)$=0.045, which exceeds the per-loan screening cost 0.0267. As a result, the incentive to screen can be fulfilled by the securitizer retaining claims whose payoff depends only on the benefits of screening in state G.

Given all this, F can be set very high and still incentivize the securitizer to screen. Since both $\overline{x}^G$ and $\underline{x}^G$ increase with $\omega_1^{E,G}$, so does the maximum F. With a higher F, m, the amount of date-1 cash flows that can be sold to investors at date 0 also goes up. In fact, when $\omega_1^{E,G} < 0.4$, m and $\overline{l}$ increase with $\omega_1^{E,G}$ at slope q=0.8 (and therefore by the same amount) so that the fraction of retention $1-\frac{m}{\overline{l}}$ actually decreases while intermediary leverage, $\frac{m}{1-\frac{m}{\overline{l}}}$, increases. The value of the claim retained is constant, but a larger amount can be lent and securitized. As a result, increasing liquidity reduces the fraction retained when $\omega_1^{E,G} < 0.4$.

When $\omega_1^{E,G}$ further increases between 0.4 and 0.62, the maximum screening benefit in state G, $(1-\mu)\left[D_1^{IC} - \gamma_1 C_1 - B_1^{E,G}\left(\underline{\gamma}\right)\right]$, starts decreasing as D_1^{IC} no longer increases with $\omega_1^{E,G}$ at slope 1, forcing the securitizer to retain more of the repayment in state G to maintain incentives. Ultimately, the benefits from state G alone is insufficient to cover the cost (when

$\omega_1^{E,G}$ increases from 0.49 to 0.50), in which case F needs to drop significantly to allow the securitizer to retain claims on repayments in state B as well. Interestingly, F decreases with $\omega_1^{E,G}$ when $\omega_1^{E,G}$ varies between 0.5 and 0.62. Intuitively, the maximum screening benefit in G continues to decrease and therefore the securitizer needs to retain more (lower F) to incentivize screening. With a lower F, the securitizer sells out less to investors (m is lower) and therefore retention also increases. If retention were more costly (ρ sufficiently small), unscreened lending (with no retention) would dominate.

Finally, when $\omega_1^{E,G}$ gets sufficiently high ($\omega_1^{E,G} > 0.62$), D_1^{IC} drops below $\gamma_1 C_1 + B_1^{E,G}\left(\underline{\gamma}\right)$ so that screening does not affect the amount that the initial borrower will repay in state G. Under the parameters in this example, after the discontinuous drop in D_1^{IC}, $\overline{l}$ also falls below $\underline{l}$ so that the incumbent cannot borrow more with incentives for increased pledgeability, and screening is dominated by unscreened lending. At this very high level of future liquidity, no skin in the game is retained by securitizers.



Comparative Statics with Low Screening Cost: Figure 4 Panel A

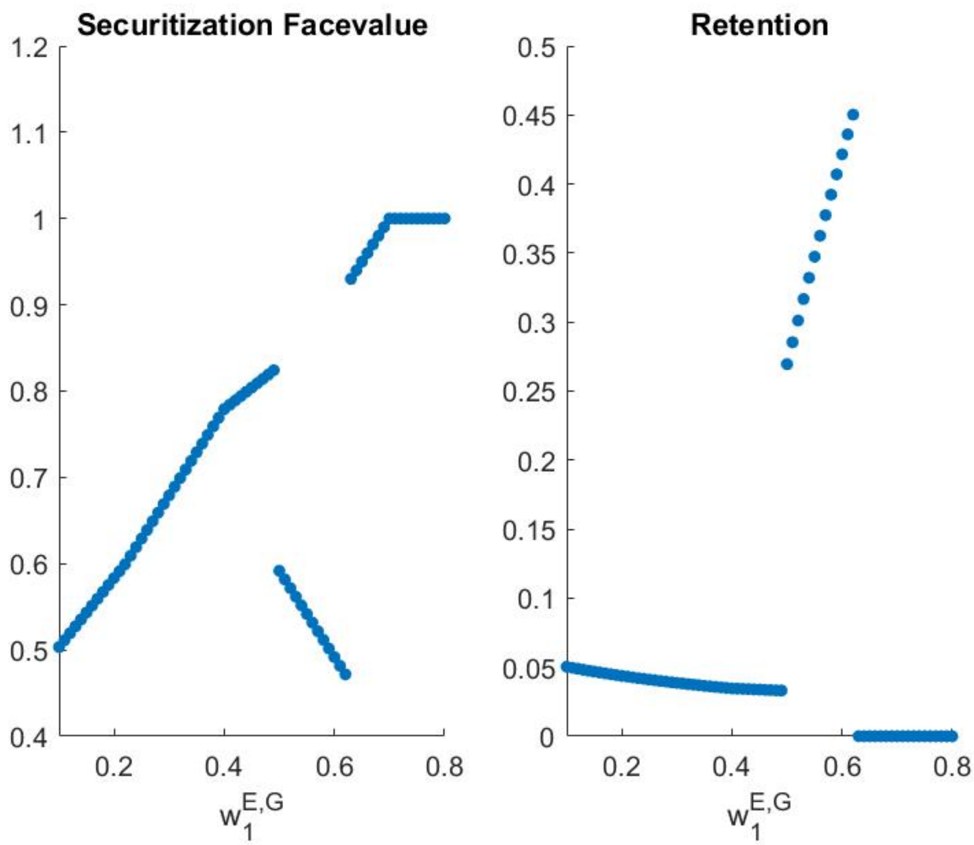


Figure 4 Comparative Statics with Low Screening Cost: Panel B

B. Summary and Implications

In times of very high liquidity, the advantages of pledgeability are low or zero, screening is squeezed out and retention goes to zero as compared to more normal times where substantial retention is required. Intermediary leverage will increase to one hundred percent. The analysis predicts that securitization will lead to unscreened lending during these periods of high liquidity with high liquidity growth. This may explain the Keys, Mukherjee, Seru, and Vig (2008) result that increased access to the securitization process reduced screening by financial intermediaries of subprime and low documentation borrowers. Our model suggests that it was not securitization per se, but changes in market liquidity that changed the need for screening in securitizations that drives their results. In the period 1997-2003 when house price growth was moderate (and therefore liquidity moderate and securitized screening in effect) they find no difference in default performance of loans just above the rating threshold for securitization and those just below. Their differential effect is concentrated in the period 2004 to first half of 2006, a time of high and rapidly rising housing prices when our model would suggest that securitizers would be unlikely to screen. Interestingly, in the sample from the second half of 2006 and the first half of 2007, when house prices stabilized and even started falling, our model would suggest securitizers would once again start screening. Here again, they find no differential effect in defaults between loans just above the rating threshold for securitization and those just below.

C. The Effect of Current Liquidity on Firm and Intermediary Leverage

In our previous analysis, borrowers have been forced to raise the maximum funding initially. A sufficient condition is that initial liquidity $\omega_0 = 0$. In times of moderate future liquidity, we then showed that reliable borrowers want to increase pledgeability to raise additional funding, and this will create a demand for screened lending by securitizers. These borrowers benefit ex-ante, by raising more to increase their chances of acquiring the firm initially, and ex-post, when they choose to raise pledgeability to increase the resale value of the firm should they later lose their abilities. In contrast, when the future liquidity is so high that a borrower can raise more at very high leverage (removing the incentive for increased pledgeability), it is exactly the need to raise more that forces reliable borrowers to lever up, which eliminates their incentive to be screened or to increase pledgeability. In summary, when we assumed that current liquidity was low and allowed only future liquidity to vary, we had high firm leverage and high intermediary leverage at times of possible very high future liquidity. With low future liquidity, we had low firm leverage (to provide incentives for pledgeability) and low intermediary leverage (to provide incentives for screening).

In this subsection, we relax the assumption of very low initial liquidity, and assume that $\omega_0 > 0$. Borrowers now need not always choose the capital structure that leads to the largest possible expected payment to financiers and securitizers. We now examine its effects, assuming that $\omega_1^{E,G} > (1-\underline{\gamma})C_2$ and bidders can always pay a full value of the asset at date 1 in future state G. The rest of our assumption 1 still applies. Therefore, promised payments must be low enough to provide pledgability incentives in state B (since no incentives will emanate from state G), and $D_1^{IC} = D_1^{B,PayIC}$. Therefore, if initial bidders are reliable, the face value that pledges out the most (commits to the largest value of payments) is either $\gamma_1 C_1 + C_2$ or $D_1^{B,PayIC}$. Let $\underline{l} = q(\gamma_1 C_1 + C_2) + (1-q) B_1^{E,B}(\underline{\gamma})$ and $\overline{l} = D_1^{B,PayIC}$.

The value of owning the asset to an initial reliable bidder depends on the level of the initial debt D_1. Let it be V. Specifically,

$$V(D_1)=\begin{cases}\overline{V}=q(C_1+C_2)+(1-q)\left[\theta C_2+(1-\theta)B_1^{E,B}(\overline{\gamma})\right] & \text{if } D_1\le D_1^{B,PayIC}\\ \underline{V}=q(C_1+C_2)+(1-q)\left[\theta C_2+(1-\theta)B_1^{E,B}(\underline{\gamma})\right] & \text{if } D_1> D_1^{B,PayIC}.\end{cases}$$

Because there is no underpricing in state G, the initial bidder always recoups the full value of the asset C_1+C_2 if state G is realized. If $D_1\le D_1^{B,PayIC}$ and state B is realized, the incumbent will set pledgeability high and will sell the firm for $B_1^{E,B}(\overline{\gamma})$ if she loses ability. The value she collects before debt payment is $\overline{V}$. If $D_1>D_1^{B,PayIC}$, the incumbent chooses $\gamma_2=\underline{\gamma}$. In this case, if state B occurs and if the incumbent loses her ability, she only sells the firm at price $B_1^{E,B}(\underline{\gamma})$, so she expects to receive $\underline{V}$ overall.

We will analyze two cases, depending on whether screening allows for a larger loan to a borrower identified as reliable ($\overline{l}>\underline{l}$) or not. If liquidity in state B is quite low compared to liquidity in the boom in state G, $\overline{l}=D_1^{B,PayIC}$ will be low.

Case 1: $\overline{l}\le\underline{l}$ (A Known Reliable Incumbent cannot raise more than an unreliable one)

Low current liquidity

In this case the unscreened loan amount actually exceeds the screened loan amount. Therefore, if there are rents to initial bidders (no one can afford to bid the full expected value of the asset, which in this case is $\underline{V}$), even a reliable initial bidder would still borrow the maximum (to have a chance of making the winning bid), issuing an unscreened loan with face value $\gamma_1 C_1+C_2$ directly to investors. Figure 6 illustrates this scenario. The dashed lines show respectively the levels of $\overline{V}$ and $\underline{V}$. The solids lines show the maximum amount that the reliable expert can borrow as a function of promised payment D_1. In this case, any bidder will bid $\omega_0+\underline{l}$, and there is no screening and retention.

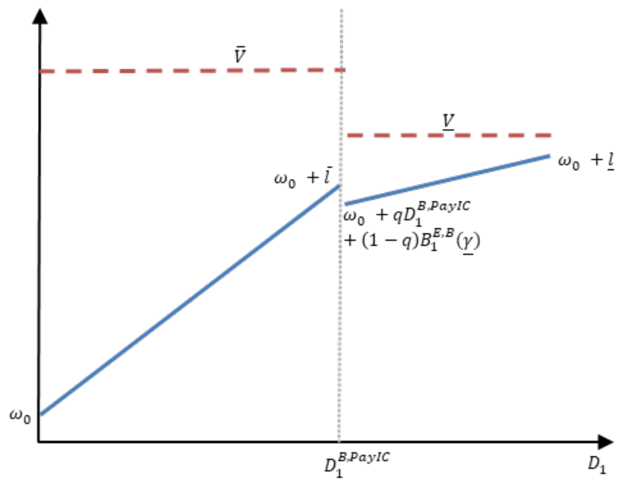


Figure 5 Bids and Values with low levels of ω_0 *The blue solids lines show the maximum amount that the reliable expert can repay as a function of promised payment* D_1 .

Now let ω_0 increase further so $\omega_0 + \underline{l}$ increases above $\underline{V}$ (the value of the asset if pledgeability is set low). The initial bid given an unscreened loan will be $\underline{V}$, which means there are no rents to initial bidders who borrow unscreened loans. However, as long as $\omega_0 + \bar{l} < \underline{V}$, even a reliable bidder must borrow unscreened. Otherwise, there is no chance for her to beat other bidders who borrow unscreened. In this case as well, firm leverage is high because high future liquidity crowds out pledgeability, and securitizer leverage is high (equivalently equity retention is zero or investors lend directly) because prospective liquidity crowds out screening.

Intermediate current liquidity

As ω_0 exceeds $\underline{V} - \bar{l}$, a screened loan can allow a reliable bidder to win if screened, and a reliable manager would rather borrow screened because she captures more of the future value in the firm by selling at a higher value when she loses ability (because she sets pledgeability high). Figure 7 illustrates this scenario. Any bidder who borrows an unscreened loan will bid exactly $\underline{V}$ and does not enjoy any rent. A reliable bidder can pay up to $\min\left(\omega_0 + \bar{l}, \bar{V}\right)$, where $\omega_0 + \bar{l}$ is the amount she can pay and $\bar{V}$ is the value of the asset to her. Following a similar analysis to Lemma 2.2 and due to strategic concerns in the bidding process, a reliable manager bids between $\underline{V}$ and $\underline{V} + \mu\left[\min\left(\omega_0 + \bar{l}, \bar{V}\right) - \underline{V}\right]$. Note that her bid is still below $\bar{V}$ so that she enjoys positive rents upon winning the bid. In this case, there is screening and retention. Both firm leverage and securitizer leverage are low. In other words, reasonably high current liquidity can reduce the need for extreme leverage even while allowing more value to be bid.

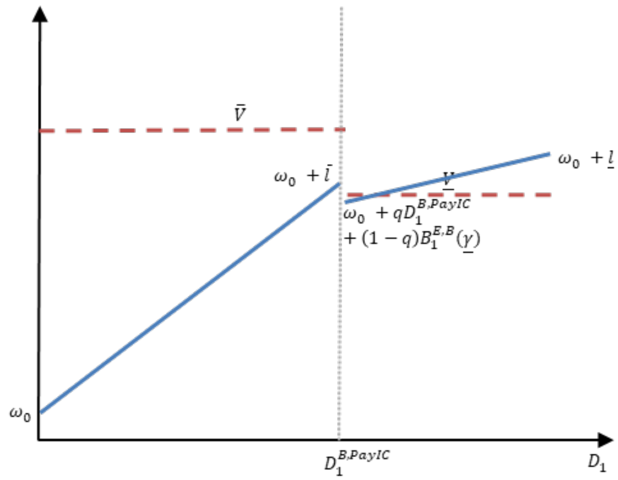


Figure 6 Bids and Values with intermediate levels of ω_0

Note: the red dashed lines show the levels of $\underline{V}$ *and* $\bar{V}$ *. The blue solids lines show the maximum amount that the reliable expert can repay as a function of promised payment* D_1 .

High current liquidity

Let ω_0 get yet higher such that $\omega_0 + B_1^{E,B}\left(\underline{\gamma}\right)$ exceeds $\bar{V}$. As illustrated in Figure 8, the reliable bidder can borrow $B_1^{E,B}\left(\underline{\gamma}\right)$ by setting $D_1 = B_1^{E,B}\left(\underline{\gamma}\right)$. In other words, she borrows from a lender who doesn't screen and receives $B_1^{E,B}\left(\underline{\gamma}\right)$. In this case, however, she would voluntarily set high pledgeability after getting control of the firm. She has sufficient liquidity such that even by borrowing a small amount without screening, she can bid up to the full value of the firm $\bar{V}$. Meanwhile, even an unreliable bidder is able to fully repay $D_1 = B_1^{E,B}\left(\underline{\gamma}\right)$. Therefore, there is no need for the securitizer to screen or retain anything. Firm leverage is low while securitizer leverage is high. The high wealth of initial bidders allows assets to sell at full fundamental values without substantial use of outside borrowing.

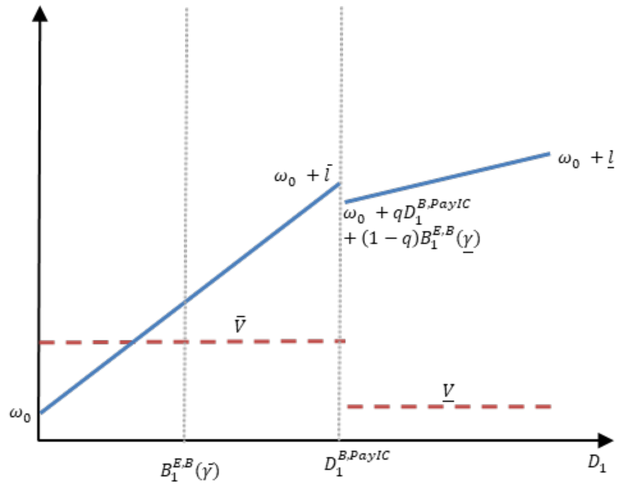


Figure 7 Bids and Values under high levels of ω_0

Note: the red dashed lines show the levels of $\underline{V}$ and $\bar{V}$. The blue solids lines show the maximum amount that the reliable expert can repay as a function of promised payment D_1.

Now let us turn to the case where a screened reliable borrower can raise more.

Case 2: A Known Reliable Borrower can raise more: $\bar{l} > \underline{l}$

Low current liquidity

When future liquidity is always quite high, $\bar{l} = D_1^{B,PayIC}$ is reasonably high. As a result a reliable bidder is never forced to choose extremely high leverage simply to outbid the unscreened. In this case, the analysis is the same as for $\bar{l} \leq \underline{l}$ except for low levels of current liquidity, ω_0. In case 1, there was unscreened borrowing and extreme leverage. In this case, a reliable bidder would like to borrow up to $\bar{l}$ as long as $\omega_0 + \bar{l} < \bar{V}$. As a result, both screening and retention are still needed. A reliable borrower still needs to outbid the unreliable, but need not promise as much as possible to financiers. Both firm and securitizer leverage are moderate.

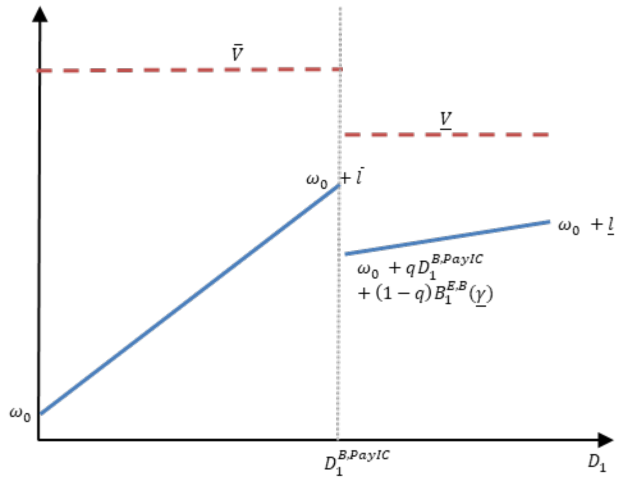


Figure 8 Bids and Values under low levels of ω_0

Note: the red dashed lines show the levels of $\underline{V}$ *and* $\bar{V}$ *. The solids lines show the maximum amount that the reliable expert can borrow as a function of promised payment* D_1 *.*

High current liquidity

Screened lending (low firm and securitizer leverage) will dominate until initial liquidity, ω_0, is high enough that even by borrowing just $D_1 = B_1^{E,B}\left(\underline{\gamma}\right)$, the expert can bid the full value of the asset, $\overline{V}$. Firm leverage is low as the need to borrow is also low. This level of debt can be fully repaid even if the incumbent turns out unreliable. As a result, no screening is needed and securitizer can again take on high leverage. Because we have assumed that a borrower has to pay rents to the screening lender relative to borrowing unscreened, the reliable borrower will not choose to be screened in this case. This was also true in case 1.

In summary, when future liquidity is expected to be high and there is enough uncertainty about future liquidity, unscreened lending and extreme leverage will allow borrowers to raise more and $\overline{l} \leq \underline{l}$. Except in cases where current net worth/liquidity is also high, this future liquidity will squeeze out pledgeability and screening and cause high firm and securitizer leverage. In contrast if there is moderate liquidity in most future states, firm leverage will be low and there will be screening, implying low securitizer leverage, except if current liquidity is so high that little firm leverage is needed and there no screening (securitizer leverage is high, but the underlying loans have little risk).

IV. Relationship to the Literature (incomplete)

4.1. Theory

Our basic theoretical model is related to the seminal work by Shleifer and Vishny (1992) and related work such as Acharya and Vishwanathan (2011), Dow, Gorton, Krishnamurthy (2005), Eisfeldt and Rampini (2006, 2008), Holmström and Tirole (1997) and Rampini and Viswanathan (2010).

The structure of the securitizer draws on work by DeMarzo (2005), DeMarzo-Duffie (1999), and Gorton-Souleles (2006) (see Gorton-Metrick (2013) for a comprehensive survey).

4.2 Empirical

How does securitization affect monitoring and loan quality? The answer is ambiguous. While Purnanandam (2011) and Keys et all (2010) find securitization led to poor-quality mortgages, Begley and Purnanandam (2016) find even low-documentation loans can be securitized. In the market for coporate loans, Wang and Xia (2014) use data from 2000 to 2007 and find banks active in securitization impose looser covenants on borrowers at origination and this induces borrowers to take more risk. Ex-post, banks that did more securitization are more likely to grant waivers without changing loan terms. Similarly, Bord and Santos (2015) use data from 2004 to 2008 and find loans sold to collateralized loan obligations (CLOs) underperform unsecuritized loans originated by the same bank. On the other hand, Benmelech et al. (2012) offer evidence that funded by CLOs had no worse outcomes than other similar loans. Shivdasani and Wang (2011) document that LBOs financed by CLOs did not underperform other LBOs.

V. Conclusion

While this paper has been written to describe how securitization, a form of intermediation, varies with anticipated liquidity and current liquidity in the underlying real borrowing sector, there is a more general point here. Liquidity tends to diminish the consequences of many kinds of moral hazard over repayment. Internal governance matters little if the asset can be seized and sold for full repayment. Similarly, liquidity can also diminish the consequences of adverse selection over borrower types. Once again, it matters less if the manager is reliable or unreliable if the asset she manages can be seized and sold for full value. Therefore, liquidity encourages leverage at both the borrower and intermediary level, even while requiring less governance. Equivalently, because the intermediary performs fewer useful functions, high prospective liquidity encourages disintermediation.

Evidence that intermediaries abandon their natural functions of screening (or monitoring) when markets are very liquid does not mean their functions are without value at other times. Similarly, it may not be appropriate to look back after liquidity collapses to claim securitization is problematic. Both borrowing and securitization may have been optimized for the high liquidity states ex ante, and that may have been the best thing for the borrower and securitizer to do. Effectively, both may have neglected the low liquidity state, but that is a consequence of the liquidity leverage nexus.

We have examined screening intermediaries in this paper. We can also examine monitoring intermediaries – for example, those that can add to the internally set pledgeability. The thrust of the results are similar – liquidity increases borrower leverage, diminishing the value of intermediary monitoring, and enhancing intermediary leverage.

Importantly, intermediary capital in our model serves as skin in the game, giving the intermediary the incentive to screen. Other work tends to focus on the state-contingent variation in the supply of intermediary capital, which can disrupt the process of intermediation.[15] Our analysis, in contrast, can be thought of as variation in the demand for intermediary capital as the necessity of the fundamental functions that intermediaries perform, such as monitoring and screening, vary with liquidity. We hope to take these predictions to the data in future work.

[15] Key studies of the effects of varying supply of intermediary capital are Holmstrom-Tirole (1997), He-Krishnamurthy (2012) and Rampini-Vishwanthan (2018).

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Appendix

Proofs of Lemma 2.2:

Proof: Without loss of generality, we refer to the informed securitizer as Lender 1. Suppose a pure strategy exists. Lender 1's probability of extending a loan is $p^1 = \mu \times 1_{y > l_{0,2}} + (1-\mu)$, where $y \geq \underline{l}$ is the loan amount l_0 it commits to its borrower and $l_{0,2}$ is the choice by Lender 2. Note that Lender 1 always wins conditional on financing a reliable manager when, with probability $(1-\mu)$, Lender 2's applicant turns out to be unreliable. If a loan is extended, Lender 1 receives m from selling the securities immediately and the discounted value $\rho(\overline{l} - m)$ from the retained portion of the loan at date 1. Therefore, Lender 1's objective function after screening and finding out the borrower is reliable is: $p^1 \pi_1(y)$, where $\pi_1(y) = \rho(\overline{l} - m) + m - y$. Clearly, if lender 2 adopts a pure strategy in $l_{0,2}$, Lender 1 can always increase its choice slightly above $l_{0,2}$, in which case its expected profits experience a jump unless $l_{0,2}$ reaches $\rho(\overline{l} - m) + m$. However, this cannot be a pure-strategy equilibrium either because if so, each lender has zero profit and then each lender receives strictly positive profits by deviating to just slightly above $\underline{l}$ and earning $(1-\mu)\left[\rho(\overline{l} - m) + m - \underline{l}\right]$. For a similar reason, there cannot be a mass point in the distribution of $l_{0,2}$. As a result, the probability density function for the distribution of l_0 must be continuous. Let $\Gamma(y)$ be the CDF of y. In that case, the lender's profit by choosing $l_0 = y$ is $\left[\mu \times \Gamma(y) + (1-\mu)\right]\pi_1(y)$, assuming the competing lender also adopts the same mixed strategy. When $y \to \underline{l}$, the securitizer's profits are $(1-\mu)\times\left[\rho(\bar{l}-m)+m-\underline{l}\right]$.

In a mixed strategy, any y must generate the same profits, therefore,

$(1-\mu)\times\left[\rho(\bar{l}-m)+m-\underline{l}\right] = \left[\mu\times\Gamma(y)+(1-\mu)\right]\left[\rho(\bar{l}-m)+m-y\right]$.

If we let $\Gamma(y)=1$, we get $\bar{y} = (1-\mu)\underline{l} + \mu\left[\rho(\bar{l}-m)+m\right]$.

Q.E.D.

The pecking order in retention

Does the securitizer only retain junior claims? We now study his choice of retention without restricting him to junior claims. We start by assuming that $D_1^{IC} > B_1^{E,B}(\bar{\gamma}) > \mu D_1^{IC} + (1-\mu)\left[\gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})\right]$. As illustrated in the figure below, the incentive to screen can come from retention in both state G and state B. Moreover, the payoff relevant regions (dashed rectangle) in the two states have significant overlap. Throughout the exercise, we assume the securitization structure F is also not explicitly state-contingent. It is intuitive that the securitizer wants to retain any claim that provides him with incentives while selling any claim that does not. The difficulty, as we will see, arises with claims that provides him with incentives in one state but not in another.

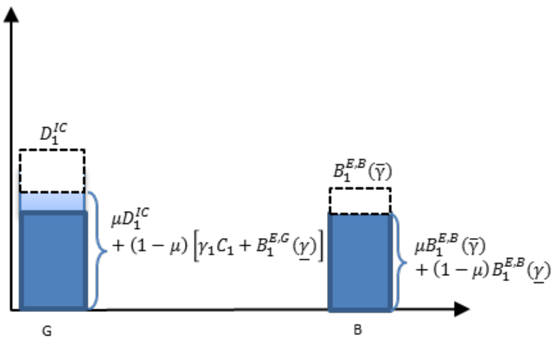


Figure 9 Retention Policy when both states matter

Given that retention provides incentive to screen, the optimal retention policy for the securitizer is always to retain the claim that only pays off when the realized cash flow x exceeds

$\mu D_1^{IC} + (1-\mu)\left[\gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})\right]$, which is the cash flow that would be realized if he lent D_1^{IC} to the applicant without screening. In this case, he is indifferent between the fully-overlapped claims $\left[\mu D_1^{IC} + (1-\mu)\left[\gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})\right], B_1^{E,B}(\overline{\gamma})\right]$ and the claim that only pays off in state G $\left[B_1^{E,B}(\overline{\gamma}), D_1^{IC}\right]$: both claims offer him incentive to screen and do not involve unnecessary retentions. If holding the entire tranche above $\underline{x}^G = \mu D_1^{IC} + (1-\mu)\left[\gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})\right]$ is still insufficient, the IC constraint requires the incumbent to retain a fraction of the claims that pays off if the realized cash flows x exceed $\underline{x}^B = \mu B_1^{E,B}(\overline{\gamma}) + (1-\mu) B_1^{E,B}(\underline{\gamma})$. However, such retention is more costly, because the securitizer is essentially holding some claims in state G (the range between $\mu B_1^{E,B}(\overline{\gamma}) + (1-\mu) B_1^{E,B}(\underline{\gamma})$ and $\mu D_1^{IC} + (1-\mu)\left[\gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})\right]$) that do not enhance his incentives).

When screening affects the amount that the securitizer receives in both state G and state B, assuming the securitizer holds the junior claim is without loss of generality. If screening only affects the amount received in state B, the securitizer would like to sell both the senior and junior claims while holding the mezzanine stake. As illustrated in the figure below, when $\gamma_1 C_1 + B_1^{E,G}(\underline{\gamma}) > D_1^{IC}$, both the reliable and unreliable experts can make the required payments in the G state. The incumbent would hold claims that only pay off if realized cash flows $x \in \left(\mu D_1^{IC} + (1-\mu) B_1^{E,B}(\underline{\gamma}), D_1^{IC}\right)$, where there is a difference between repayment if unscreened and if screened.

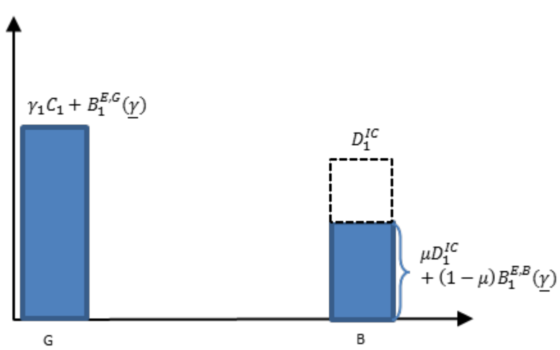


Figure 10 Retention Policy when only state B matters

General case on The Effect of Current Liquidity

In this subsection, we conduct the comparative static analysis for the effect of current liquidity of the more general case. To proceeds, let us define

$$V(D_1) = \begin{cases} \overline{V} = q\left[\theta C_2 + (1-\theta) B_1^{E,G}(\overline{\gamma})\right] + (1-q)\left[\theta C_2 + (1-\theta) B_1^{E,B}(\overline{\gamma})\right] & \text{if } D_1 \leq D_1^{IC} \\ \underline{V} = q\left[\theta C_2 + (1-\theta) B_1^{E,G}(\underline{\gamma})\right] + (1-q)\left[\theta C_2 + (1-\theta) B_1^{E,B}(\underline{\gamma})\right] & \text{if } D_1 > D_1^{IC}. \end{cases}$$

Also, let $\overline{l} = qD_1^{IC} + (1-q)\min\left\{D_1^{IC}, B_1^{E,B}(\overline{\gamma})\right\}$ and $\underline{l} = q\left(\gamma_1 C_1 + B_1^{E,G}(\underline{\gamma})\right) + (1-q)B_1^{E,B}(\underline{\gamma})$.

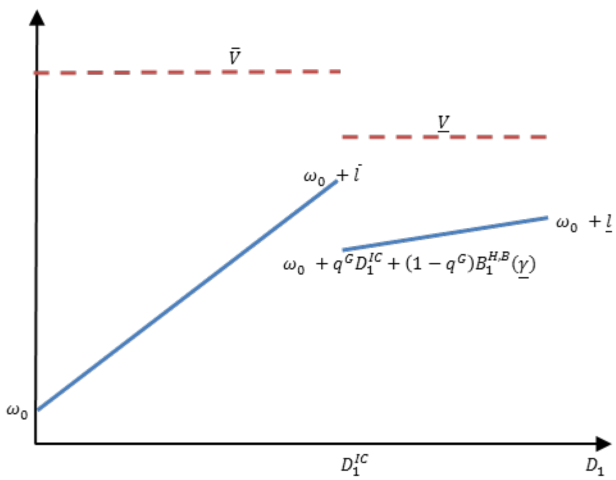
Clearly, $\overline{V} - \underline{V} = (1-\theta)\left[q\left(B_1^{E,G}(\overline{\gamma}) - B_1^{E,G}(\underline{\gamma})\right) + (1-q)\left(B_1^{E,B}(\overline{\gamma}) - B_1^{E,B}(\underline{\gamma})\right)\right] > 0$.

We again differentiate between two cases.

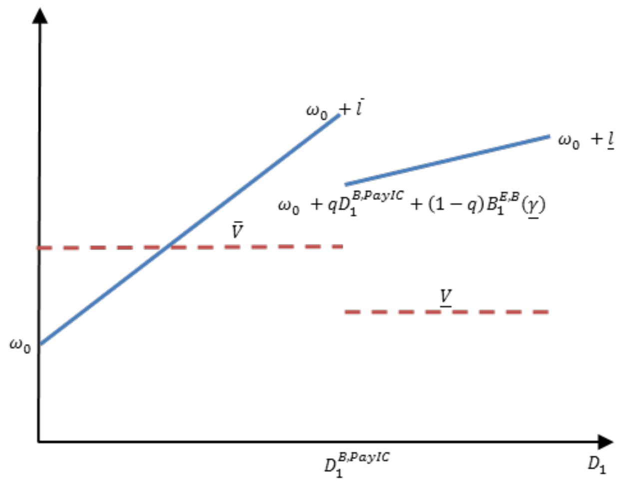
Case 1: $\underline{l} < \overline{l}$

We start with low levels of ω_0. As illustrated below, when there are rents to initial acquirers, $D_1 = D_1^{IC}$ is preferred and the initial bidder can borrow up to

$y \in \left(\omega_0 + \underline{l}, \omega_0 + \underline{l} + \mu\left(\overline{l} - \underline{l}\right)\right)$.

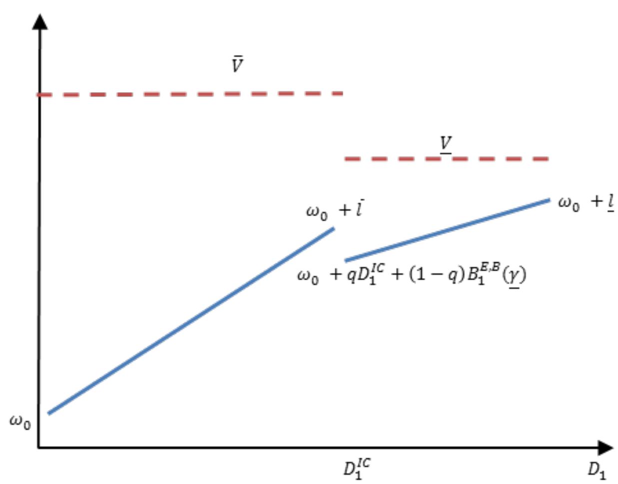


As ω_0 gets higher such that $\omega_0 + qD_1^{IC} + (1-q) B_1^{E,B}(\underline{\gamma})$ exceeds $\overline{V}$, even the reliable bidder can borrow $qD_1^{IC} + (1-q) B_1^{E,B}(\underline{\gamma})$ by setting $D_1 = D_1^{IC}$. In other words, she borrows from a lender who doesn't screen and therefore gets treated as an unreliable one as $\lambda \to 1$. In this case, however, she would voluntarily set high pledgeability after getting control of the firm. She has sufficient liquidity such that even by borrowing a small amount without screening, she can bid up to the full value of the firm $\overline{V}$. Therefore, there is no need for the securitizer to screen or retain anything. Firm leverage is low while securitizer leverage is high.

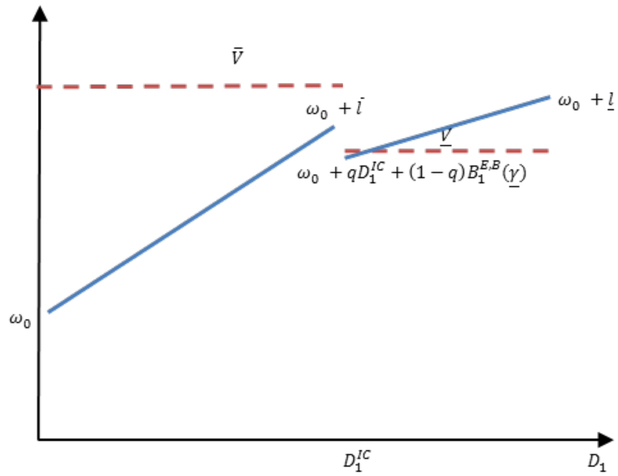


Case 2: $\overline{l} \leq \underline{l}$

At low levels of ω_0, all manager borrow $\underline{l}$. Both firm leverage and intermediary leverage are high.



When ω_0 increases above $\underline{V} - \overline{l}$, both firm and intermediary leverage are low. The reliable bidder receives $y \in \left(\underline{V}, \underline{V} + \mu\left(\omega_0 + \overline{l} - \underline{V}\right)\right)$.



As ω_0 gets higher such that $\omega_0 + qD_1^{IC} + (1-q)B_1^{E,B}(\underline{\gamma})$ exceeds $\bar{V}$, firm leverage is low, and intermediary leverage is high.