Safe Assets and Dangerous Liabilities:
How Bank-Level Frictions Explain Bank Seniority*

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Abstract

This paper uses bank fragility to explain why bank loans are senior in firm capital structure. High leverage makes banks more vulnerable to financial distress than the typical bond investor, and thus makes banks willing to pay for seniority. Bank seniority emerges even when banks need skin in the game, as bank effort has more impact on a large senior loan than on a smaller junior claim with the same systematic risk. Adding deposit insurance or bailouts adds a subsidy to tail risk, which makes large senior claims even more attractive to banks. Empirically, this model explains why procyclical firms avoid bank loans and provides a host of debt structure predictions.

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1 Introduction

When a firm goes bankrupt, that firm’s bank jumps the queue and gets paid before other creditors. Bondholders lose an average of half of their principal in corporate bankruptcies, while banks recover eighty cents on the dollar.¹ Banks recover much more than bondholders because banks have stronger contractual protections. The loan contracts that banks write give them the shortest maturities, the maximum seniority, the most collateral, and the strongest covenants.² These protective features shelter banks from losses on their loans by passing those losses on to other creditors.

Why are banks protected from the consequences of their own lending decisions? Prioritizing banks above other investors seems puzzling from a contracting point of view. Intuitively, junior loans would give banks more skin in the game and stronger incentives to screen and monitor borrowers. However, in practice banks are senior in the vast majority of debt contracts.

Financial scholars and legal scholars have put forward a plethora of models that justify banks’ senior status.³ The existing literature focuses on borrower-level frictions that impact a single firm or a single loan.⁴ In contrast, I look at bank-level capital structure frictions and argue that these frictions make

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¹ These numbers are from Acharya, Bharath, and Srinivasan (2007). Moody’s data (Ou, Chiu, and Metz 2011) from 1983–2011 shows a similar pattern with bank loan recoveries averaging 79-80% and corporate bond recoveries averaging 18-64% depending on seniority.

² A multitude of studies find that banks have stronger contractual protections than other debt holders. For example, James (1987) shows that bank loans have shorter maturities than other types of debt; Carey (1995) that that banks are almost-universally senior; Bradley and Roberts (2004) that banks have tighter covenants and shorter maturities than other lenders; and Rauh and Sufi (2010) that banks get more collateral and tighter covenants.


⁴ This literature offers many compelling stories for bank seniority; however, most are based on very specific firm-level frictions that are too narrow to explain why banks are senior across heterogeneous firms, countries, and time. For example, Welch (1997) argues that making banks senior reduces the cost of bankruptcy negotiations by putting the creditor with the most litigation muscle in the senior position. The absolute priority rule violations drive this model have become dramatically less common (Bharath, Panchapagesan, and Werner 2014), and yet seniority persists. Park (2000) argues
banks more willing to pay for seniority. My results persist even when loan-level frictions push banks to take on junior claims to get more skin in the game.

A bank that held junior debt would face large losses in recessions. Because banks have extremely high leverage, they are ill-suited to weather such losses. Imposing these losses on a highly levered financial intermediary would lead to fire sales of assets, bank runs, or other wasteful financial distress costs. Because senior debt is sheltered from borrower default, it is less likely to trigger those bank distress costs. Avoiding those bank-level costs allows banks to offer lower interest rates or take higher profits.

I set up a contract design problem where a bank with capital structure frictions lends to a risky firm. Contracts that make the bank senior reduce bank portfolio variance and thus bank capital structure costs. This result emerges both from a Diamond (1984)-style model with non-pecuniary punishments and from a trade-off theory model with bank-level distress costs. In a trade-off theory model, banks issue debt for tax benefits and that debt makes them vulnerable to financial distress. Public market debt is held by mutual funds, individuals, and pension funds that do not face double taxation and choose lower leverage than banks. Giving highly levered banks priority over these other investors reduces bank-level frictions, which reduces firms’ total borrowing costs.

This remarkable result persists even when seniority creates moral hazard for banks. In principal-agent models with limited liability, such as Innes (1990), the agent is given equity to minimize the total cost of providing incentives. In my setup, the optimal contract minimizes intermediary capital structures cost while providing incentives. Although junior contracts produce stronger incentives than senior contracts with the same value, they produce much more capital structure costs. This makes junior contracts less efficient as they produce more capital structure cost per unit of incentive. The intuition that since junior creditors lose the most in liquidation, a senior bank has stronger incentives to monitor if liquidation is the remedy. Again, this is likely true in many cases; however, the result only to firms with very strong moral hazard.

Gornall and Strebulaev (2014) show that bank leverage ranges from 85-95% and that this high leverage is a natural result of bank-level tax benefits and banks’ status as diversified and senior creditors. High bank leverage is the focus of papers on both bank capital structure, such as Diamond and Rajan (2000), Harding, Liang, and Ross (2007), Shleifer and Vishny (2010), Acharya, Mehran, Schuerman, and Thakor (2011), Acharya, Mehran, and Thakor (2013), Allen and Carletti (2013), DeAngelo and Stulz (2013), Thakor (2013), or Sundaresan and Wang (2014); and papers on bank regulation, such as Hanson, Kashyap, and Stein (2011), Admati, DeMarzo, Hellwig, and Pfleiderer (2013), Bulow and Klemperer (2013), and Harris, Opp, and Opp (2014). Other banking papers related to my work include Myers (1977), Rajan (1992), Hart and Moore (1995), and Becker and Ivashina (2011).
here is that efficient contracts minimize wasteful capital structure costs by creating bank losses only when the bank is most likely to have shirked. If bank shirking makes low firm values relatively more likely than high values, the probability that the bank shirked is highest when firm value is low. Thus, an efficient contract makes the bank senior to create bank losses only when the firm is worth the least and the bank is most likely to have shirked.

Deposit insurance programs or the expectation of bailouts make senior debt even more attractive for banks. These government interventions subsidize bank losses in the worst states of the world. A bank with a large senior claim receives large losses and correspondingly large subsidies in the states where bailouts occur, while a bank holding a small junior claim loses less and so gets less of a subsidy. Thus, bank seniority remains privately optimal, even when government subsidies mean that bank managers do not care about the worst states of the world.

The procyclicality of borrowers drives bank-level costs in my model. More procyclical borrowers lose more value in bad states of the world and impose higher capital structure costs on the banks they borrow from. Because it is more costly for banks to lend to highly procyclical borrowers, my model predicts those borrowers would make less use of bank financing. I find that this pattern holds in the data. Borrowers with high betas, i.e. procyclical borrowers, use fewer bank loans. This holds for several measures of bank debt and for both equity and asset betas.

Bank-level capital structure costs can also explain the dramatic shifts from bank financing to public market financing seen in recessions. Recessions feature an increase in procyclicality and an increase in default costs, both of which would push banks to hoard capital and cut back on lending. Borrowers would respond by substituting to public market borrowing or forgoing investing entirely. This fits well with a world where banks are relatively well capitalized but choose to hoard cash rather than lend.

My model generalizes to lenders other than banks and to investments other than corporate debt. Private equity and venture capital funds actively monitor in the same way banks do but hold very risky claims. That pattern emerges naturally in my model as these investors avoid double taxation, which allows them to use lower leverage and lower fund-level frictions. Without capital structure frictions, these investors can take advantage of the high-powered incentives junior contracts provide. As applied to mortgages, my model justifies the common practice of selling the junior tranches of mortgage-backed securities and retaining the senior tranches. That structure emerges from my model as the way to
minimize capital structure cost while preserving bank incentives. Because mortgage risk creates bank capital structure frictions, government-backed mortgage guarantees, such as those by Fannie Mae or Freddie Mac, add real value in my model by sparing fragile intermediaries from systematic risk.

The rest of the paper is structured as follows. In Section 2, I illustrate the model’s main mechanism using a simplified example. In Section 3, I develop my model of bank capital structure frictions and borrower debt structure. In Section 4, I show that the equilibrium financing contracts make the bank senior and that they vary with borrower procyclicality. In Section 5, I discuss my model’s empirical predictions. Concluding remarks are given in Section 6. In Appendix A, I extend the analysis to banks with different capital structure frictions, banks that expect bailouts, and banks that add value by screening.6

2 Illustrative Example

A simple debt structure example provides intuition for the paper’s main mechanism. Consider a firm with an uncertain future cash flow that wants a bank loan. There are two states of the world: a high state and a low state. In the high state, the firm’s cash flow is \( H \); in the low state, the firm’s cash flow is \( L \). Let us assume that there are two classes of debt: a senior claim with face value \( L \) that is always repaid in full and a junior claim with face value \( H - L \) that is only repaid if the firm’s cash flow equals \( H \).

The firm can get a bank loan by pledging either the senior claim or the junior claim to the bank. If the bank is given the senior claim, the bank gets a repayment of \( L \) with certainty. If instead, the bank is given the junior claim, the bank gets a repayment of \( H - L \) in the high state and nothing in the low state. By contrasting the senior-bank and the junior-bank cases, we can look at the effect of making banks junior or senior.

If the bank holds the junior claim, it adds risk to its balance sheet. The junior claim losses all of its value in the low state. For a highly levered bank, this loss could lead to financial distress costs. As an example, suppose bank distress leads to a costly fire sale. The bank has in-place assets in addition to

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6The online Appendix available at http://ssrn.com/abstract=2526574 contains all proofs.
its loan to the firm. If the bank remains solvent, it gets value $B$ from those assets. If instead the bank is forced into default, it sells those assets at a fire sale price and recovers only $(1 - \alpha)B$, where $\alpha > 0$ is a proportional fire sale cost. Taking high bank leverage as given, holding the junior claim increases the probability of this bank-level financial distress.

If instead the bank holds the senior claim, it does not add risk to its balance sheet. Holding this safe loan does not increase the bank’s risk of financial distress. Thus, making a senior loan does not create additional bank-level financial frictions.

Figure 1 illustrates how making banks junior can create an inefficiency. On the left hand side, we have the case where the bank is senior. Here, the bank does not default because it never loses money on the loan to the firm. On the right hand side, we have the case where the bank is junior. There, the bank enters financial distress in the low state where the firm performs poorly. Making the bank senior avoids exposing the bank to the firm’s cash flow risk and reduces the bank’s expected financial distress costs.

If the bank is senior, another investor must be junior. In my model, the debt claim not promised to the bank is sold to the public debt market. If the bank is senior, corporate bondholders bear the firm’s
losses in the low state. However, typical public debt market investors are less vulnerable to financial distress than the typical bank. The largest holders of corporate debt are individuals, who hold that debt either directly or in pension funds or mutual funds.\(^7\) If a household owns the assets directly, there are no intermediary-level distress costs. Mutual funds and pension funds do not use high leverage and face less severe intermediary-level distress costs than a highly leveraged bank.\(^8\) Further, pension funds and the bond mutual funds are unlikely to face runs, in contrast to banks which operate with overnight liabilities in an environment where liquidity is paramount.\(^9\)

If households are the ultimate owners of all assets, they benefit from a senior bank. As Figure 1, shows, a senior bank means that households absorb the firm’s losses through their bond holdings. A junior bank means that households not only face the firm’s losses but also the bank’s financial distress costs. Making the bank junior creates an additional layer of capital structure costs.

My explanation ties in with other models of intermediary frictions. He and Krishnamurthy (2013) use intermediary capital shortages to explain risk premia. I argue that the same style of friction impacts firm debt structure choices, and firms structure their debt to make the claims priced by intermediaries safe. Other papers look at how intermediary frictions can drive the choice of intermediary. Bond (2004) shows that banks with low risk liabilities finance low-risk projects and riskier conglomerates finance higher risk projects. Hanson, Shleifer, Stein, and Vishny (2014) argue that more run-prone shadow banks hold liquid assets to avoid costly liquidation. In both papers, the choice of intermediary depends on claim-specific risk; my paper takes that one step further by structuring the claims themselves to minimize creditor frictions.


\(^8\)Neither pension funds nor mutual funds ever approach bank-like leverage. Mutual fund leverage is uncommon and limited to 33% by the Investment Company Act of 1940 (Karmel 2004). Pension fund leverage is even rarer and limited by the “prudent person standard”, a very small number of pension funds have started to use some leverage to increase returns. Even the hedge funds that hold corporate debt use dramatically less leverage than banks (Ang, Gorovyy, and Van Inwegen 2011).

\(^9\)See, for example, Diamond and Dybvig (1983) or Ivashina and Scharfstein (2010).
The following section builds up a model with a bank monitoring technology, an endogenous bank capital structure, and a more realistic borrower. The contracts that emerge make the bank senior in order to minimize bank-level capital structure costs and reduce the total cost firms pay to borrow.

3 Model Setup

This section develops my main model of bank and borrower. In this model, a firm can borrow both from a bank and from the public debt market. The bank faces capital structure frictions (Section 3.1) and each new loan incrementally increases those frictions (Sections 3.2 and 3.3). These frictions make a bank loan more expensive than a comparable bond issue.

However, the bank has a unique lending technology that is bundled with these capital structure costs. This technology increases borrower quality, which allows the borrower to secure better financing rates (Section 3.4). The bank cannot commit to using this technology and only does so if it has enough skin in the game (Section 3.5). Section 4 solves this model and shows that senior contracts are the cheapest way to give the bank the correct incentives.

3.1 Bank Financial Structure

Bank capital structure costs are the driving frictions in my model. I model these frictions using a bank with a large portfolio of in-place loans. These in-place assets provide a single cash flow $B$ with

$$\log B = \log B_0 + \beta_B \sigma_M \varepsilon_M,$$

(1)

where $B_0$ governs the bank’s time-zero size, $\beta_B > 0$ governs the bank’s procyclicality, $\sigma_M$ governs the market volatility, and $\varepsilon_M$ is a standard normal random variable representing the market risk factor.

I build my base model around the classic Diamond (1984) agency frictions of a non-verifiable cash flow and non-pecuniary punishment. This explicit form of punishment illustrates a special case of a more general result. Appendix A.1 extends my results to a trade-off model with a tax benefit of debt and a cost of financial distress and Appendix A.2 considers a model with bank bailouts.
Consider a banker who has access to a special lending technology. This banker has zero wealth and must raise money from creditors in order to use this technology. The banker cannot commit to repay, and instead commits to potentially receiving a non-pecuniary punishment. A banker who raises money by promising a repayment $S$ must also commit to receiving a punishment with disutility $\varphi = \max\{0, S - B\}$. This punishment creates a deadweight loss when bank cash flow is low; however, it makes repaying the bank’s creditors incentive compatible for the banker. A zero-wealth banker agrees to this contract if, and only if, it satisfies the banker’s individual rationality condition. We can write that individual rationality condition as

$$\mathbb{E}[\max\{B - S, 0\}] \geq \mathbb{E}[\max\{0, S - B\}].$$

(2)

A competitive banker maximizes the promised repayment to depositors, $S$, and so the banker’s individual rationality condition binds. That occurs for $S = \mathbb{E}[B]$, where the banker commits to a repayment equal to the bank’s expected cash flow. The bank’s value is the maximum of money the banker can raise. I write that as as $W(B)$:

$$W(B) = \mathbb{E}[B] - \mathbb{E}[\max\{\mathbb{E}[B] - B, 0\}].$$

(3)

This expression shows that a more risky portfolio impairs the banker’s ability to raise money. If the banker’s in-place assets have high variance, the banker must be punished more severely in some states and given more payments in other states to offset that punishment. This reduces the banker’s ability to raise money and thus the bank value.

### 3.2 Borrower Financial Structure

In my model, a firm borrows to finance a project with an uncertain payout.\textsuperscript{10} This firm can invest $I$ to generate a random lognormal cash flow $A$ with

$$\log A = \beta_A \sigma_M \varepsilon_M + \sigma_A \varepsilon_A,$$

(4)

\textsuperscript{10}This section is written in terms of a firm; however, similar logic applies to other borrowers, or even a pool of mortgage-backed securities, as discussed in Section 5.2.
where \( \varepsilon_M \) is the standard normal random variable from Expression (1) and \( \varepsilon_A \) is an independent, standard normal random variable.

As in the Vasicek (2002) model used by the Basel Committee on Banking Supervision (2004, 2013), the firm’s cash flow is subject to two types of shock: an idiosyncratic shock, \( \varepsilon_A \), and a systematic shock, \( \varepsilon_M \). The idiosyncratic volatility parameter \( \sigma_A \) governs the magnitude of the idiosyncratic shock the firm faces and the systematic risk parameter \( \beta_A \) governs the firm’s exposure to the systematic shock. I assume \( \beta_A > 0 \), so that all firms are more likely to default when the bank faces financial strain than in the normal times.

The firm needs to raise external financing of \( I \) in order to undertake its project. It can raise this financing using a combination of bank loans and public market debt. Let \( V_B \) denote the proceeds to the firm of a loan from the bank and let \( V_P \) to denote the proceeds of issuing a bond to the public debt market. Similarly, let \( R_B(A) \) denote the amount a firm with cash flow \( A \) pays to the bank, \( R_P(A) \) the amount it pays public debt market investors, and \( R_E(A) \) the residual amount going to the firm’s owners. A rich assortment of debt structures can be represented using this notation. For example, a senior bank claim of \( k_B \) and a junior bondholder claim of \( k_P \) correspond to

\[
R_B = \min \{ k_B, A \}, \quad R_P = \min \{ k_P, \max \{ A - k_B, 0 \} \}, \quad \text{and} \quad R_E = \max \{ A - k_B - k_P, 0 \}; \quad (5)
\]

pari-passu debt claims of \( k_B \) for the bank and \( k_P \) for the bondholders correspond to

\[
R_B = \min \left\{ k_B, \frac{k_B}{k_B + k_P} A \right\}, \quad R_P = \min \left\{ k_P, \frac{k_P}{k_B + k_P} A \right\}, \quad \text{and} \quad R_E = \max \{ A - k_B - k_P, 0 \}; \quad (6)
\]

and equity claims entitling the bank to \( k_B \) fraction of the firm’s cash flow and the bondholders to \( k_P \) fraction of the firm’s cash flow correspond to

\[
R_B = k_B A, \quad R_P = k_P A, \quad \text{and} \quad R_E = (1 - k_B - k_P) A. \quad (7)
\]

I assume that the public debt market claim, \( R_P \); the bank claim, \( R_B \); and the residual claim, \( R_E \), are all non-negative and non-decreasing functions of the firm’s cash flow. This includes almost all contracts used in practice, including the previously mentioned sets. Put options and money burning contracts do not satisfy these restrictions. Contracts where the borrower’s repayment depends on the performance of the bank’s in-place assets are also excluded. However, neither class of contract is common in corporate fund raising.
I call a repayment senior if it is in the form of the senior claim in Expression (5). This lines up with
the conventional notion: senior contracts are paid first in bankruptcy.

**Definition 1**  
Repayment $R_B$ is **senior** if $R_B = \min\{A, k_B\}$ for some $k_B \geq 0$.

### 3.3 Bank-Level Capital Structure Costs Created by Lending

The firm can raise money from either a bank or the public debt market. If a bank lends to the firm, the bank must finance that loan. That creates capital structure frictions for the bank. This section quantifies the bank-level capital structure frictions created by making a new loan.

Consider the bank’s capital structure frictions if it holds not only its in-place assets, but also a new loan to the firm. Making a new loan increases the bank’s cash flow from $B$ to $B + R_B(A)$ and increases the bank’s value from Expression (3) to

$$W(B + R_B(A)) = \mathbb{E}[B + R_B(A)] - \mathbb{E}\left[\max\{\mathbb{E}[B + R_B(A)] - B - R_B(A), 0\}\right]$$  \hspace{1cm} (8)

Adding a new loan to the bank’s assets always increases the bank’s value. However, that increase is less than the loan’s expected repayment, because holding the new loan adds risk to the bank’s portfolio and creates bank-level frictions. I write $\Delta(R_B(A))$ as the intermediary capital structure frictions created by a new loan with repayment $R_B(A)$:

$$\Delta(R_B(A)) = \frac{\mathbb{E}[R_B(A)]}{\text{Expected loan repayment}} - \frac{W(B + R_B(A))}{\text{Bank value with the new loan}} + \frac{W(B)}{\text{Bank value without the new loan}}$$  \hspace{1cm} (9)

$$= \mathbb{E}\left[\max\{\mathbb{E}[B + R_B(A)] - B - R_B(A), 0\}\right] - \mathbb{E}\left[\max\{\mathbb{E}[B] - B, 0\}\right].$$  \hspace{1cm} (10)

Both the bank’s cash flow from in-place assets and the borrower’s cash flow are procyclical. That means that when the borrower has a low cash flow and is unable to repay its loan, the bank is more likely to need cash to repay its own creditors and avoid punishment. Because of this, adding a new loan to the bank’s portfolio always increases the bank’s capital structure frictions, as shown by the following lemma:

**Lemma 1**  
Making a loan to the firm increases the bank’s expected capital structure costs, unless that loan’s repayment is always zero.
Importantly, senior loans lead to less bank-level capital structure costs than junior loans of the same size. A junior contract is more exposed to firm default risk than a senior contract, and therefore loses more value in bad states of the world. Those losses make junior debt more procyclical and create greater distress costs for a bank holding it. Lemma 2 formalizes this intuition.

**Lemma 2** A bank loan repayment that is senior (in the sense of Definition 1) produces lower bank-level capital structure costs than any other repayment with the same expectation.

For a similar reason, highly procyclical borrowers create higher capital structure costs than less procyclical borrowers. When the bank has a low cash flow, a highly procyclical borrower is more likely to have a low cash flow and be unable to repay its loans. Thus, a bank holding loans written by a highly procyclical borrower faces higher distress costs in bad states of the world. Conversely, a less procyclical borrower but equally volatile borrower defaults in both good and bad states and so is less likely to create losses in the bad states of the world where the bank faces financial distress. In the Diamond (1984) case where borrowers have only diversifiable idiosyncratic risk, the bank can take on very high leverage with little risk of distress. Lemma 3 states this relationship between procyclicality and bank-level capital structure cost more formally:

**Lemma 3** Consider two borrowers, $C$ and $D$, where

1. Borrower $C$ has more systematic risk than borrower $D$, $\beta^C_A > \beta^D_A$; and
2. Borrower $C$ has the same total risk as borrower $D$, $\sigma^2_A + \sigma^2_M \beta^2_A = \sigma^2_A + \sigma^2_M \beta^2_D$.

Any bank loan contract with a greater than zero repayment produces higher bank-level capital structure costs if written on borrower $C$’s cash flow, $R_B(A^C)$, than if written on borrower $D$’s cash flow, $R_B(A^D)$.

A bank with a large number of small loans does not face “concentration” or “single name” risk. Ignoring these risks dramatically simplifies the expression for the capital structure cost of a loan. As Lemma 4 shows, a large bank cares only about a loan’s systematic risk and ignores loan-specific idiosyncratic risk.\(^{11}\)

\(^{11}\)This contrasts with the illustrative example in Section 2, where an undiversified bank cares about all of the borrower’s risk.
Lemma 4 As the bank’s initial size, $B_0$, increases, the incremental bank-level capital structure cost created by a new bank loan, $\Delta (R_B (A))$, converges to a simple covariance expression:

$$
\Delta (R_B (A)) \rightarrow \mathbb{P} [B < \mathbb{E} [B]] \left( \mathbb{E} [R_B (A)] - \mathbb{E} [R_B (A) | B < \mathbb{E} [B]] \right)
$$

(11)

$$
= \text{COV} [R_B (A), \mathbb{I} [B \geq \mathbb{E} [B]]],
$$

(12)

where $\mathbb{I}$ is the indicator function.

Expression (11) has an intuitive interpretation. Capital structure costs arise from punishing the banker in bad states of the world. The amount of excess punishment created by making a new loan is equal to the probability of a punishment multiplied by the amount that the new loan increases the severity of that punishment. Loans that are likely to default in bad states of the world create high frictions; loans that are likely to repay create lower frictions.

Expression (12) is analogous to the covariance formulations in modern portfolio theory. There, an investor evaluating a small new investment does not care about that investment’s idiosyncratic risk and instead considers only its expected return and its covariance with the investor’s existing portfolio. Here, a bank with a large number of loans does not care about a new loan’s idiosyncratic risk, and instead considers only its expected repayment and systematic risk. What matters to the bank is the extent to which the new loan repays in the states of the world where the bank has low cash flows and faces distress costs.\(^{12}\)

3.4 Bank Lending Technology

The bank has a unique lending technology that creates value for its borrowers. Public debt markets cannot directly use this technology due either to diffuse ownership (as in Diamond (1984)) or confidentiality issues (as in Campbell (1979)). Thus, the only way a firm can get the benefits of this lending technology is by taking a bank loan.

Papers such as Diamond and Verrecchia (1991) and Holmstrom and Tirole (1997) argue that banks monitor borrowers and attenuate moral hazard. This section lays out a similar model, where banks

\(^{12}\)I assume that the bank cannot sell its in-place assets to reduce risk; however, an envelope theorem argument suggests that a new loan would not change the risk preferences of large bank that initially held an optimal mix of assets.
create value by preventing the firm’s managers from taking a value destroying action that confers private benefits. This value destroying action could be shirking, risk shifting, or simply stealing.\textsuperscript{13}

If the value destroying action is not taken, the firm’s cash flow is $A_1$, as in Expression (4). If the action is taken, the firm’s cash flow is the lower or riskier $A_0$ and the value of the firm’s debt is reduced:

$$\forall R_B, \; \mathbb{E}[R_B(A_1)] \geq \mathbb{E}[R_B(A_0)].$$

(13)

The bank can pay a cost $M$ to monitor the firm and prevent the value destroying action. However, the bank’s monitoring action is not observable and the bank will only monitor if it has sufficient skin in the game. If a bank has lent a firm a large amount of money, other investors can have confidence that the bank has blocked the value destroying action. That certification effect reduces the interest rate the firm pays on its other debt.\textsuperscript{14} The firm is fully aware of this effect and is willing to pay the bank a higher interest rate in order to reduce its total financing cost. The following section builds up a game where a bank with capital structure frictions must be provided incentives.

3.5 Timeline and Strategies

Firm debt structure arises from a game played by a firm, a bank, and a bond investor. The firm has to raise financing for an investment of $I$ from the bank and the bond investor. The bank has capital structure frictions and a monitoring technology, while the bond investor has no capital structure costs but cannot monitor. I model the process of raising this investment and the bank’s moral hazard about its monitoring action, $m$, as follows:

In step 1, the firm, the bank, and the bond investor engage in bargaining to select a financing contract $C = (V_B, R_B, V_P, R_P)$. This contract includes a bank loan (with proceeds $V_B$ and repayment $R_B$) and a bond (with proceeds $V_P$ and repayment $R_P$). The bargaining can take any form, as long as it selects

\textsuperscript{13}My results extend to other bank technologies. For example, Appendix A.3 explicitly looks at a screening technology that reduces asymmetric information.

\textsuperscript{14}Papers such as Ramakrishnan and Thakor (1984), Fama (1985), Diamond and Verrecchia (1991), Datta, Iskandar-Datta, and Patel (1999), Sufi (2007), and Ongena, Roscovian, Song, and Werker (2007) support this view that bank loans provide certification.
Figure 2: Timeline of Monitoring Game

Figure 2 shows a timeline for the monitoring game described in Section 3.5.

1. Efficient bank loan and bond contract, $C$, selected through bargaining.

2. Bank chooses whether to shirk or monitor, $m \in \{0, 1\}$.

3. Payoffs realized.

efficient contracts. For example, the parties could engage in Nash bargaining or the firm could make a take-it-or-leave-it offer.

In step 2, the firm invests $I$ into a project if sufficient financing was raised, $V_B + V_P \geq I$. If sufficient financing was not raised, the game ends and all agents get zero payoff. After the investment is made, the bank chooses whether to shirk or to pay $M$ to monitor and prevent the value destroying action. If the bank monitors, $m = 1$, the firm’s cash flow is $A_1$. If the bank shirks, $m = 0$, the firm’s management take the value destroying action and the firm’s cash flow is $A_0$.

In step 3, the firm’s cash flow $A_m$ is realized and is used to repay the bank, $R_B(A_m)$, and the bond investor, $R_P(A_m)$. Based on the bond and loan contract, $C = (V_B, R_B, V_P, R_P)$, and the bank’s action, $m$, the firm’s owners get an expected payoff of

$$
\pi_E(C, m) = \mathbb{E}\left[ A_m - I + V_P - R_P(A_m) + V_B - R_B(A_m) \right],
$$

(14)

the bank gets an expected payoff of

$$
\pi_B(C, m) = \mathbb{E}\left[ -V_B + R_B(A_m) - \Delta(R_B(A_m)) - mM \right],
$$

(15)

and the bond investor gets an expected payoff of

$$
\pi_P(C, m) = \mathbb{E}\left[ -V_P + R_P(A_m) \right].
$$

(16)

For simplicity, I set the risk-free interest rate to zero.
If the payoff to shirking is less than the payoff to monitoring, the bank monitors the firm. I call this the bank’s incentive compatibility condition:

$$\pi_B(C, 0) \leq \pi_B(C, 1) \iff \frac{M}{\text{Cost of monitoring}} \leq \mathbb{E}[R_B(A_1) - R_B(A_0)] - \Delta(R_B(A_1)) + \Delta(R_B(A_0)).$$

(17)

This expression has an intuitive interpretation. The bank monitors if the cost of monitoring is less than the costs the firm’s value destroying action creates for the bank.

A strategy profile is a financing contract and a monitoring action pair, \((C, m)\). I call a strategy profile incentive compatible if action \(m\) maximizes the bank’s expected payoff given financing contract \(C\), so that \(\pi_B(C, m) = \max\{\pi_B(C, 0), \pi_B(C, 1)\}\). I call an incentive compatible strategy profile \((C, m)\) efficient if no incentive compatible strategy profile generates a larger joint surplus, \(\Pi = \pi_E + \pi_B + \pi_P\).

**Lemma 5** All Pareto efficient strategy profiles that give the firm, bond investor, and bank non-negative payoffs are efficient.

As such, any bargaining process that produces Pareto efficient, individually rational contracts can be used in step 1 of the game, as by Lemma 5 any such bargaining leads to efficient contracts. Pareto efficiency and individual rationality are natural conditions for bargaining outcomes, and thus my model can accommodate a variety of bargaining games.

### 4 Borrower Procyclicality and Bank Seniority

This section presents my key results on seniority and procyclicality. Section 4.1 lays the groundwork by characterizing the efficient financing contracts. Section 4.2 shows that the bank is senior if firms that are not monitored repay nothing. Section 4.3 extends that seniority result to a setup where bank monitoring increases the mean or decreases the variance of firm cash flows. Section 4.4 looks at how procyclical cash flows lead firms to shift from bank loans to bonds or even to forgo investment.
4.1 Efficient Financing Contracts

Three types of equilibria are possible. First, monitored investment where the firm takes a bank loan and is monitored. Second, unmonitored investment where the firm funds its investment entirely by bond issuance, forgoing monitoring. Third, no investment where the firm simply does not invest. Each of these equilibria has distinct properties:

Theorem 1 The equilibrium is always one of three types:

1. **Monitored Investment:** The firm borrows from the bank and the bond market. The bank repayment, $R_B$, minimizes bank capital structure costs, $\Delta(R_B)$, while ensuring monitoring is incentive compatible for the bank, Expression (17). This contract leads to joint surplus of

   $$\Pi^M = \pi_E + \pi_B + \pi_P = E[A_1] - \Delta(R_B(A_1)) - M - I. \quad (18)$$

2. **Unmonitored Investment:** The firm issues a bond that finances its investment. The bank does not monitor and does not get any repayment. This contract leads to joint surplus of

   $$\Pi^U = E[A_0] - I.$$

3. **No Investment:** The project does not occur and so joint surplus is $\Pi^N = 0$.

Sections 4.2, 4.3, and 4.4 use these equilibria to look at firm debt structure and at procyclicality.

4.2 Banks Are Senior When Firms That Are Not Monitored Repay Nothing

To further analyze the seniority structure that motivates banks to monitor, in this section I impose a functional form on the impact of monitoring. For simplicity, first suppose that if the bank does not monitor then the firm’s management abscond with the financing proceeds and the firm’s cash flow is zero, $A_0 = 0$. In this case, the bank’s incentive compatibility condition, Expression (17), simplifies to

   $$\frac{M}{\Delta(R_B(A_1))} \leq \frac{E[R_B(A_1) - \Delta(R_B(A_1))]}{\pi_E + \pi_B + \pi_P}.$$

(19)
The bank’s monitoring decision depends on how the cost of monitoring compares with the value of the loan. A large loan gives the bank more skin in the game, which makes the bank more willing to monitor. Theorem 2 shows that making the bank senior is the optimal way to provide those incentives:

**Theorem 2** The bank is always senior if firms that are not monitored have a zero cash flow.

The intuition here follows directly from Lemma 2: seniority minimizes bank capital structure costs. To illustrate, consider a firm with senior, subordinated, and junior classes of debt, each with a promised repayment of $0.10. Figure 3 shows the bank-level capital structure frictions created for a bank that holds each of these classes and also a hypothetical risk-free claim. This figure shows that senior contracts (left) produce lower bank capital structure costs than more junior contracts (right).

**Figure 3: Impact of Seniority on Bank-Level Capital Structure Costs**

Figure 3 illustrates how different claims on a firm create different bank-level financing costs. The $x$-axis compares investments four claims with varying seniority: (1) a hypothetical risk-free investment, (2) a senior debt claim with a face value of $0.10$, (3) a subordinated debt claim with a face value of $0.10$ which is subordinated to the senior claim, (4) a junior debt claim with a face value of $0.10$ which is subordinated to both the senior and subordinated claims. The white bars show the capital structure cost created for a bank holding each claim. This chart assumes a large bank and firm risk parameters of $\sigma^2_A + \beta^2_A \sigma^2_M = 2$ and $\beta^2_A \sigma^2_M = 0.4$.

More junior contracts produce higher bank-level capital structure costs because they have more systematic risk. Junior claims pay a higher interest rate in good states of the world and are less likely to pay out in bad states of the world. That procyclicality makes it expensive for the bank to finance
these contracts, which causes the bank to charge a much higher interest rate than the public debt markets would. Seniority insulates loans from economic shocks and makes them less procyclical. This makes them cheaper for the bank to hold, which reduces the excess interest rate the bank charges. In the extreme case, a risk-free claim produces no capital structure costs as it holds its value all states of the world.

Theorem 2 can be extended to show that the bank is senior whenever a borrower needs a bank loan with a certain value. Thus, bank seniority is optimal whenever the benefit of a bank loan is dependent only on loan proceeds. For example, if a firm can borrow only through bank loans, it makes those loans senior in order to minimize lender-level frictions.

4.3 Banks Are Senior When Monitoring Makes Cash Flows Larger or Less Risky

In Section 4.2, bank shirking hurt senior creditors just as much as junior creditors. In practice, junior creditors often pay most of the costs of bad lending decisions. This section considers a model where bank shirking disproportionately impacts junior creditors. Perhaps surprisingly, bank seniority again emerges, even when it weakens bank incentives. Efficient contracts give the bank a large senior claim, which preserves bank incentives while minimizing capital structure costs.

Suppose that instead of having no cash flow, unmonitored firms have a lower or more risky cash flow:

\[
\log A_0 = \log A_1 - \mu_H + \sigma_H \varepsilon_H, \tag{20}
\]

where \( \mu_H \geq 0 \) controls how monitoring increases the cash flow, \( \sigma_H \) controls how monitoring reduces its risk, and \( \varepsilon_H \) is a standard normal and independent shock. The reduced mean is due to shirking, stealing, or diverting cash flows and reduces the value of all claims, debt and equity alike. The added variance is due to risk shifting or negligence and reduces the value of debt-like claims.

Going forward, I assume that the bank is large relative to the borrower, as in Lemma 4. This assumption eases calculation by removing idiosyncratic loan risk terms and is empirically reasonable as banks do, in practice, lend to a large number of borrowers. I also prohibit firms from issuing equity-like claims to creditors. Specifically, I assume that the firm cannot issue contracts to the bank or bond investor that have a greater than 50% chance of defaulting. This restricts the firm to debt-like contracts that reach
their highest payoff for firm cash flows below 1, and so is equivalent to imposing that $R_B(1) \geq R_B$ and $R_P(1) \geq R_P$. This follows naturally from a model where firm-level default costs make extremely high leverage suboptimal. This assumption ensures Expression (13) holds and that unmonitored firms are worse for creditors. Importantly, this assumption does not prevent the firm from making the bank junior to bondholders.

**Figure 4: Impact of Seniority on Bank Incentives**

Figure 4 illustrates how different claims on a firm create different bank incentives to monitor. The $x$-axis compares investments four claims with varying seniority: (1) a hypothetical risk-free investment, (2) a senior debt claim with a face value of $0.10$, (3) a subordinated debt claim with a face value of $0.10$ which is subordinated to the senior claim, (4) a junior debt claim with a face value of $0.10$ which is subordinated to both the senior and subordinated claims. The black bars show the amount that shirking reduces the payoff of each claim. The model of firm moral hazard in Section 4.3 is used for this chart with $\sigma_A^2 + \beta_A^2 \sigma_M^2 = 2$, $\beta_A^2 \sigma_M^2 = 0.4$, $\mu_H = 0$, and $\sigma_H^2 = 0.4$.

Under this setup, and in contrast to the previous section, junior claims lose more than senior claims if the bank fails to monitor. Figure 4 shows the degree to which monitoring increases the value of claims with the same repayment but varying seniority. I call this bank incentives, as it is the amount that the bank’s claim value is impaired if it shirks.

On the left of the figure, very senior claims generate weak bank incentives because these contracts will pay off with almost certainty regardless of whether the bank monitors. More junior claims produce stronger incentives, because the value of junior debt is more sensitive to an increase in variance or
decrease in mean, as junior claims lose the most when the firm defaults. However, seniority remains efficient even though it weakens bank incentives:

**Theorem 3** *The bank is always senior if monitoring increases the mean of firm cash flows or decreases the variance of firm cash flows or both.***

**Figure 5: A Large Senior Claim Versus a Small Junior Claim**

Figure 5 illustrates how varying the size and seniority of the bank loan impacts bank incentives and capital structure costs. The x-axis has four claims with varying seniority and varying size: (A) a senior debt claim with a face value of $0.10, (B) a subordinated debt claim with a face value of $0.10 that is subordinated to $0.10 of repayment, (C) a junior debt claim with a face value of $0.10 that is subordinated to $0.20 of repayment, and (A+B) a senior firm claim with a face value of $0.20, whose payoff is the sum of the payoffs of the $0.10 senior claim and the $0.10 subordinated claim. The black bar shows the amount that bank monitoring increases the value of each claim. The white bar shows the bank-level capital structure cost created for a bank holding each claim. The dashed line shows a cost of monitoring of $M = 0.0065$. The model in Section 4.3 is used for this chart with $\sigma^2_A + \beta^2_A \sigma^2_M = 2, \beta^2_A \sigma^2_M = 0.4, \mu_H = 0, \text{ and } \sigma^2_H = 0.4$.

To illustrate, consider again the example of a firm with three classes of debt, Figure 5 compares the capital structure cost and bank incentives created by each class. The first three claims have the same face value and varying seniority and the fourth claim has twice the face value. For each claim, the white bar shows the capital structure and the black bar shows the monitoring incentive. The dashed line denotes the monitoring cost – claims where the black bar crosses the dotted line produce sufficient
incentives for the bank to monitor. The first two claims are a $0.10 senior and a $0.10 subordinated claim, and although they produce little capital structure cost, neither makes monitoring incentive compatible for the bank. The third claim is a $0.10 junior claim which provides the right incentives but also creates high capital structure costs.

The fourth claim is larger and senior, it is a $0.20 senior claim, which has a payoff equal to the sum of the payoff of $0.10 the senior claim and the payoff of the $0.10 subordinated claim. The capital structure cost for this large senior claim is the sum of the capital structure costs of the two smaller claims, and it similarly provides incentives equal to the sum of the incentives produced by those two claims. This large senior claim produces stronger incentives than the smaller junior claim, while having lower capital structure cost. As in Theorem 3, a large senior claim can provide sufficient incentives with low capital structure cost.

This holds more generally because senior debt produces the most bank incentive per dollar of capital structure cost. A sufficiently large senior claim creates appropriate bank incentives while minimizing capital structure costs and so switching the bank from a small junior claim to a large senior claim preserves bank incentives while reducing capital structure costs. The intuition here is that the bank is punished when the loan contract denies it a repayment. This punishment encourages good behavior; however, it creates a deadweight loss of bank-level capital structure costs in states of the world where the bank has low capital. The most effective contract punishes in the states of the world where the agent clearly shirked. A large senior contract does that in my model by applying large losses when the bank is most likely to have shirked.

Figure 6 illustrates this by showing how the firm’s cash flow realization impacts both the probability the bank monitored and the amount of losses borne by senior and junior creditors. Senior loans punish the bank when the firm fails catastrophically and the bank is most likely to have shirked.\textsuperscript{15} Junior contracts punish the bank whenever the firm fails, which punishes a larger fraction of those banks that did shirk, but also punishes many banks that did not shirk. If the firm just barely defaults, it may be due to a bad lending decision or simply bad luck. Punishing banks from the first dollar of firm losses

\textsuperscript{15}This leads naturally to the question for whether the bank cares about states of the world where firms fail catastrophically. Appendix A.2 shows that adding bailouts or deposit insurance only strengthens my results, as there senior contracts maximize the subsidy the bank receives.
punishes many banks that did not shirk and creates a deadweight loss. A large senior loan is efficient because it delivers a large punishment in precisely the states where the bank is most likely to have shirked.

**Figure 6: Crime and Punishment**

Figure 6 illustrates how varying the firm’s cash flow realization impacts the conditional probability that the bank monitored and the amount of losses incurred on both a small junior and a large senior debt claim. The firm’s cash flow, \( A_m \), is plotted on the x-axis. On the left axis, a solid line plots the likelihood ratio, the probability of each firm cash flow given the bank monitored divided by the probability of that firm cash flow given the bank shirked. On the right axis, a dashed line plots the loss taken on a senior claim with a face value of $0.20. A dotted line plots the loss taken on a claim with a promised repayment of $0.10 that is junior to the $0.20 senior claim. The model in Section 4.3 is used for this chart with \( \sigma_A^2 + \beta_A^2 \sigma_M^2 = 2, \beta_A^2 \sigma_M^2 = 0.4, \mu_H = 0, \) and \( \sigma_H^2 = 0.4 \).

This relies on the fact that the probability that the bank shirked is decreasing in the firm’s realized cash flow. This likelihood ratio property is natural, and means that it is optimal to punish the bank in the states of the world where the firm value is lowest. Under a different model where monitoring increased firm risk, my results would not hold. For example, suppose that a monitored firm has a lognormal payout \( A_1 \), as before, but that an unmonitored firm has a cash flow that is always equal to half of the investment amount, \( A_0 = \frac{1}{2}I \). Under those assumptions, the bank is not senior in equilibrium. A senior claim would produce no incentives for the bank, because bank shirking never hurts senior creditors. As a result, the bank would take on a junior claim. This may parallel venture capital funds. Venture capital backed companies primarily issue convertible preferred equity, which gains most of its
value from upside scenarios. This matches a world where venture capital funds actively manage their investments to maximize their risk and their return.

Not shown on Figure 6, the probability that the bank is in financial distress is higher in states of the world where the firm does poorly. This reduces the efficiency of senior contracts, as they punish more in states of the world where the firm does most poorly and the bank is more likely to face capital structure costs. This is akin to an insurance effect in other contracting models with risk averse agents. Nevertheless, as Theorems 2 and 3 show, the likelihood ratio effect discussed previously dominates.

4.4 Procyclicality and the Choice of Bank Debt or Bonds

Theorem 1 showed that there were three types of equilibria: monitored investment, unmonitored investment, and no investment. This section looks at how the firm’s financing choice varies as the model parameters change. I show that as firm procyclicality increases, firms substitute from monitored investment to either unmonitored investment or no investment.

Both monitored and unmonitored investing create frictions. Bank loans create monitoring costs and bank-level financial frictions. Bond issuance without a bank loan creates moral hazard costs. The firm issues bank debt rather than solely bonds if the payoff from monitored investment is higher than the payoff from unmonitored investment. This happens when the moral hazard frictions are greater than the capital structure cost frictions:

$$\Pi^M \geq \Pi^U \iff M + \Delta (R_B(A)) \leq E[A_1 - A_0], \quad (21)$$

where $R_B$ is set according to Expression (17). A firm is locked out of the financing market when both sets of frictions are sufficiently severe.

Figure 7 shows how firm debt structure varies with firm cash flow procyclicality and investment cost. I vary firm procyclicality by changing the monitored firm’s beta, $\beta_A$, while holding the firm’s total cash flow volatility fixed. The chart shows the financing used in each region of parameter space.

Moving from left to right on Figure 7, firm procyclicality increases. This increases the bank-level capital structure cost created by a bank loan, which eats away the benefit of the bank’s technology. High procyclicality decreases the payoff to monitored investing, $\Pi^M$, while leaving the payoff to unmonitored
Figure 7: Procyclicality and Moral Hazard Impact Financing Choice

Figure 7 illustrates how varying borrower procyclicality, $\beta_A$, and the investment cost, $I$, impact the form of financing used. The $x$-axis varies firm procyclicality by varying the monitored firm’s beta, $\beta_A$, while adjusting the firm’s idiosyncratic volatility, $\sigma_A$, so that total firm cash flow volatility stays constant. The $y$-axis varies $I$, the firm’s investment cost. The labeled regions denote the type of financing used for the corresponding parameters.

- **Bank Financing**
- **Bond Financing**
- **No Investment**

If investment cost is low, more procyclical firms switch to exclusively issuing bonds. If investment cost is high, procyclical firms are shut out of the lending market completely. Theorem 4 states this procyclicality result more formally:

**Theorem 4**  Suppose the monitored firm’s cash flow, $A_1$, is changed to an identically distributed but more procyclical cash flow, $A_1^\star$, such that for all $a > 0$ and $b > 0$ we have $P[A_1^\star \leq a] = P[A_1 \leq a]$ and $P[A_1^\star \leq a|B \leq b] > P[A_1 \leq a|B \leq b]$, with all else held constant. The joint surplus of monitored investing, $\Pi^M$, is lower under $A_1^\star$, while the joint surplus of unmonitored investing, $\Pi^U$, is unchanged.

The above analysis fixes firm debt levels; however, similar results hold if firm leverage and bank effort intensity are set endogenously. Procyclicality increases a firm’s marginal cost of bank borrowing and the marginal cost of the bank’s technology. The firm responds by decreasing its bank loan size and forgoing certification. If public market borrowing depends on that certification, the firm also reduces its non-bank borrowing.
5 Empirical Predictions

This section develops my model’s empirical predictions. I focus on how bank seniority and procyclicality interact, as this interaction is central to my model but not considered in the existing debt structure literature. Section 5.1 shows that in the cross section, procyclical firms borrow less from banks. Section 5.2 discusses seniority assignment and securitization across bank lines of business. Section 5.3 applies my model to lending variation across the business cycle. Section 5.4 looks at non-bank investors that invest substantially in monitoring and screening, focusing on private equity and venture capital.

5.1 Systematic Risk and Debt Structure

My model predicts that highly procyclical borrowers substitute away from bank financing. I test this by matching Capital IQ debt structure data with accounting information from Compustat and returns from CRSP. This yields an unbalanced panel 2,247 U.S. firms over 1995–2014.

In my model, the bank-level capital structure cost created by a firm varies with the extent to which the firm’s value co-moves with the bank’s value. As a proxy for this, for each firm-quarter observation in Capital IQ, I calculate equity beta with respect to the CRSP NYSE / Amex / NASDAQ Value-Weighted Market Index. Let $R_{M,t}$ denote the day-$t$ market excess return and $R_{A,t}$ denote the day-$t$ firm equity excess return, both from with respect to the 3-month Treasury bill return. A firm equity beta at day $t$ is then

$$\beta = \sum_{j=0}^{4} \left( \sum_{s=t-251}^{t} R_{A,s} R_{M,s-j} / \sum_{s=t-251}^{t} R_{M,s-j} R_{M,s-j} \right),$$

with the lagged terms accounting for asynchronous trading (Scholes and Williams 1977). Similarly, the firm’s equity volatility is

$$\sigma = \sqrt{\frac{1}{252} \sum_{s=t-251}^{t} R_{A,s} R_{A,s}}.$$

I use $\beta$ in some regressions, but most of my specifications use unlevered beta. Asset beta is what drives my model. I use unlevered beta as a proxy for that. Using market value of equity ($csho \times prcc\_f$ from Compustat) and book value of debt ($debt$) I define unlevered beta as

$$\beta \times \frac{csho \times prcc\_f}{debt + csho \times prcc\_f}.$$
and similarly define unlevered volatility as

$$\sigma_U = \sigma \times \frac{csho \times prcc.f}{debt + csho \times prcc.f}.$$  

(25)

**Figure 8: Debt Composition and Unlevered Firm Beta**

Figure 8 shows how the composition of firm debt changes with equity beta. Capital IQ data from 1995–2014 with 1,288 firms and 45,900 firm-quarter observations is divided into 6 buckets based on unlevered beta, calculated from CRSP data. For each bucket, the black bar shows firm bank debt divided by total firm debt and the white bar shows firm bank debt divided by the quasi-market value of firm assets (book value of debt plus market value of equity). As the bank debt to total debt ratio is undefined for firms with very low leverage, firms with less than 20% leverage are excluded from this chart.

Figure 8 shows how firm debt composition varies with beta. Immediately apparent is that higher beta firms rely less on bank loans. As we move from firms with equity beta of less than 0.5 to firms with equity beta of more than 2, bank debt decreases from 42% to 27% of total debt or from 20% to 9% of assets. Highly procyclical firms use half as much bank debt as less procyclical firms.

Table 1 shows that the negative association between procyclicality and bank debt is statistically significant and robust to the inclusion of common controls. I run four specifications. Specification (1) shows that unlevered $\beta$ is negatively associated with bank debt as a fraction of debt, and that unlevered $\sigma$ is positively associated with it. Specification (2) confirms that this holds with the inclusion of common controls. Together, these suggest that more procyclical firms substitute away from bank
Table 1: Debt Composition and Unlevered Beta

Table 1 shows how firm bank borrowing varies with firm procyclicality, proxied by firm unlevered $\beta$, defined as $\beta \times \frac{csho \times prcc_f}{debt + csho \times prcc_f}$. Specifications (1) and (2) regress the ratio of a firm’s bank debt to its total debt on asset beta and other firm characteristics. This ratio is undefined for firms without debt and so I exclude firms with debt less than 10% of market value of assets. Specifications (3) and (4) repeat these regressions using the ratio of a firm’s bank debt to the quasi-market value of its assets (book value of debt plus market value of equity) as the dependent variable. Debt structure data from 1995–2014 are imported from Capital IQ and matched to Compustat accounting data and CRSP return data. I define unlevered $\sigma$ as $\sigma \times \frac{csho \times prcc_f}{debt + csho \times prcc_f}$; size as $csho \times prcc_f$; and leverage as $\text{debt}/(\text{debt} + csho \times prcc_f)$. Firm controls are tangibility, $ppentq/atq$; profitability, $oibdpq/atq$; operating leverage $xsgaq/(xsgaq + cogsq)$; and Tobin’s Q, $(csho \times prcc_f + \text{debt})/atq$. Standard errors are given in parentheses and are two-way clustered at the quarter (77 quarters) and two-digit SIC code levels (57 industries). Observations with missing information are excluded and variables are Winsorized at the 0.5% level. An asterisk (*) denotes significance at the 5% level; (**) the 1% level.

<table>
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<tr>
<th></th>
<th>Bank Debt / Debt</th>
<th>Bank Debt / Assets</th>
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<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
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<tr>
<td>Unlevered $\beta$</td>
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<td>$-0.057^{**}$</td>
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<tr>
<td></td>
<td>$(0.017)$</td>
<td>$(0.015)$</td>
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<tr>
<td>Unlevered $\sigma$</td>
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<td>$0.293^{*}$</td>
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<td>$(0.098)$</td>
<td>$(0.124)$</td>
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<td>Observations</td>
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<td>19,484</td>
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Table 2: Debt Composition and Equity Beta

Table 2 shows how firm bank debt varies with firm procyclicality, proxied by equity beta. Specifications (1) and (2) regress the ratio of a firm’s bank debt to its total debt on equity beta and other firm characteristics. This ratio is undefined for firms without debt and so I exclude firms with debt less than 10% of market value of assets. Specifications (3) and (4) repeat these regressions using the ratio of a firm’s bank debt to the quasi-market value of its assets (book value of debt plus market value of equity) as the dependent variable. Debt structure data from 1995–2014 are imported from Capital IQ and matched to Compustat accounting data and CRSP return data. From Compustat, I define size as $csho \times prcc_f$; leverage as $debt/(debt + csho \times prcc_f)$; tangibility as $ppentq/atq$; profitability as $oibdpq/atq$; operating leverage as $xsgaq/(xsgaq + cogsq)$; and Tobin’s Q as $(csho \times prcc_f + debt)/atq$. Standard errors are given in parentheses and are two-way clustered at the quarter (77 quarters) and two-digit SIC code levels (57 industries). Observations with missing information are excluded and variables are Winsorized at the 0.5% level. An asterisk (*) denotes significance at the 5% level; (**) the 1% level.

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<th>Bank Debt / Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>$\beta$</td>
<td>$-0.040**$</td>
<td>$-0.034**$</td>
<td>$-0.015**$</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.011)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.008</td>
<td>0.089</td>
<td>0.170**</td>
</tr>
<tr>
<td></td>
<td>(0.047)</td>
<td>(0.058)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>Log Size</td>
<td>$-0.094**$</td>
<td>$-0.103**$</td>
<td>$-0.043**$</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.008)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Leverage</td>
<td>$-0.094$</td>
<td>0.314**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.057)</td>
<td>(0.020)</td>
<td></td>
</tr>
<tr>
<td>Tangibility</td>
<td>$-0.174^*$</td>
<td>$-0.073**$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.068)</td>
<td>(0.024)</td>
<td></td>
</tr>
<tr>
<td>Profitability</td>
<td>$-0.380$</td>
<td>0.161</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.303)</td>
<td>(0.122)</td>
<td></td>
</tr>
<tr>
<td>Operating Leverage</td>
<td>$-0.050$</td>
<td>$-0.008$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.055)</td>
<td>(0.015)</td>
<td></td>
</tr>
<tr>
<td>Tobin’s Q</td>
<td>0.080**</td>
<td>0.011**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.003)</td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>16%</td>
<td>24%</td>
<td>29%</td>
</tr>
<tr>
<td>Two-digit SIC FE</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Quarter FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>21,732</td>
<td>19,484</td>
<td>27,434</td>
</tr>
</tbody>
</table>
debt toward public market debt. Specifications (3) and (4) repeat this analysis with bank debt over assets as the independent variable. In specification (3), total volatility has a large impact on overall debt levels, which carries through to a large impact on bank debt as a share of assets. Specification (4) removes this impact by controlling for leverage. Table 2 uses equity beta as a proxy for procyclicality and repeats the analysis of Table 1. In each of the eight specifications in these two tables, procyclicality is negatively associated with bank debt at the 1% confidence level.

A one standard deviation increase in equity or asset beta is associated with a 4–5% decrease in bank debt as a fraction of total debt. This effect is of comparable strength to the effects of a one standard deviation increase in size (6–7%) or tangibility (4%) and stronger than \( \sigma \), profitability, or operating leverage, which are not reliably significant. This correlation matches my predictions in Section 4.4. Highly procyclical firms create excessive bank-level capital structure frictions. This increases the cost they pay to access bank loans and reduces their use of these loans.

These results are similar to the work of Acharya, Almeida, and Campello (2013) who show that procyclical firms hold cash instead of using lines of credit. Note that I only find a correlation. I have controlled for factors known to influence debt structure; nevertheless, omitted-variable bias or other endogeneity may be driving these results. Beta is related to a host of other variables and to leverage itself, as shown by Schwert and Strebulaev (2014). An alternative explanation is that firms choose their financing source based on their expected financing needs. If banks have less lending capacity in bad states of the world, firms that will need financing primarily in bad states of the world have less to gain from banking relationships. Procyclical firms thus choose bonds over bank loans because the times when the firm needs financing are exactly the times the bank cannot provide it. Such an effect could lead procyclical borrowers to shift away from bank financing. Chen, Xu, and Yang (2012) argue that procyclical borrowers choose longer maturity debt for this reason. This effect is similar to the mechanism seen in my model.

5.2 Bank Seniority across Different Bank Lines of Business

Corporate Debt: My model explains why a firm’s bank loans are senior to its bonds. Bondholders absorb the first loss in default because they are better able to bear that risk. Banks hold senior, secured positions to reduce their capital structure costs.
A number of recent empirical papers provide direct evidence for my channel. Murfin (2012) shows that lower bank capitalization increases covenant tightness, providing direct evidence for the bank balance-sheet channel impacting their seniority. Berger, Makaew, and Roman (2015) use TARP funding as a natural experiment and similarly show that banks with better equity-capital positions make loans with less strict terms.

The idea that banks are afraid of borrower credit risk is unsurprising. The now massive credit default swap market originated from bank demands to manage their credit exposure. Credit protection is often sold to banks by insurance companies or institutional investors (Minton, Stulz, and Williamson 2009). In my model, banks are willing to pay for seniority over bond investors for the very reasons they have articulated for buying credit protection from some of those very same investors.

Capital regulation is unlikely to be the primary driver of the bank seniority seen in corporate debt structure. Although current capital regulation considers seniority when assessing the risk of corporate debt, that was not the case until very recently. Basel I was the dominant capital regulation paradigm until 2008 and it gave all corporate exposure the same risk treatment. Because of that, it would not have pushed banks to hold senior claims.

**Mortgages and Mortgage-Backed Securities:** Mortgage-backed securities (MBS) were a key contributor to the recent financial crisis. In the run up to the crisis, the banks issuing these MBS often sold the junior tranches and retained only some of the most senior tranches. The junior tranches of these MBS were purchased by hedge funds or other institutional investors. When the mortgage market deteriorated, these securities lost massive amounts of value. Chemla and Hennessy (2014) argue that these securitization structures weakened bank incentives.

In my model, junior tranches provide the best incentives but banks still sell them. Banks commit to retaining senior tranches in order to preserve their incentives while minimizing capital structure cost. Other investors buy the junior tranches of MBS because a bank with a large senior MBS claim or a large mortgage inventory will screen due to its own self-interest. The large ex-post losses on these securities are consistent with my model under three different stories. First, banks sold junior tranches

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16SEC v. Citigroup Inc. (2010) shows that Citigroup sold junior tranches and retained senior tranches: “We [Citigroup] typically have sold the lowest-rated tranches of the CDOs and held onto most of the highest rated tranches, which historically have enjoyed more stable valuations.”
to mitigate risk and kept senior trances to preserve incentives, but were hit by a large negative shock (an explanation that matches the empirical evidence of Erel, Nadauld, and Stulz (2011)). Second, banks shirked and were punished by losses on their senior claims. Third, banks expected government assistance through deposit insurance or bailouts and held large senior positions to maximize their tail risk exposure and the expected value of those government transfers.17 Outside of my model, the favorable treatment capital regulation gave to senior MBS tranches provides a compelling forth explanation for this phenomenon.

The U.S. Dodd-Frank Wall Street Reform and Consumer Protection Act contains a risk retention provision. The current proposal requires originators to retain 5% of the credit risk on some types of MBS, either by holding a large junior claim or by holding proportional amounts of each tranche. Under my model, this is inefficient as it increases bank risk by forcing banks to hold difficult-to-hedge assets. Further, it is ineffective if banks expect bailouts in the states of the world where they suffer losses. My model shows that the incentive problems that exist are not created by banks that retain the wrong tranches, but rather by government bailouts and deposit insurance. A better policy would be to dramatically limit bank leverage and leave securitization up to the market. That would reduce the risk of bank distress and restore bank incentives. The buyers of MBS tranches should be the ones disciplining the bank to hold a stake that efficiently trades off bank incentives with bank capital structure costs. These buyers certainly have an incentive to do so.

My model provides a potential justification of the much maligned government-sponsored enterprises, such as Fannie Mae and Freddie Mac.18 These agencies guaranteed large parts of the mortgage market. In my model, such guarantees would remove bank screening effort but could potentially create value by moving risk away from distress-prone financial intermediaries.

**Consumer Credit:** The corporate credit and mortgage markets both feature extensive risk transfer. Banks are protected in corporate credit markets through their seniority to the massive corporate bond markets and protected in mortgage markets through government guarantees and extensive securitization. Consumer credit has seen comparatively little risk transfer. Although credit card

17Refer to Appendix A.3 for a more detailed analysis.

18See, for example, Acharya, Richardson, Van Nieuwerburgh, and White (2011) for an overview of the systemic risk and moral hazard problems Fannie Mae and Freddie Mac created.
receivable securitization is used by a small number of banks, these securitizations involve little real risk transfer (Calomiris and Mason 2004; Levitin 2013). My model provides a natural explanation for this lack of risk transfer. Consumer credit has higher default rates but is less procyclical than corporate debt or mortgage debt.\textsuperscript{19} This suggests consumer credit requires relatively more monitoring intensity and produces relatively less capital structure costs. Both of these reduce incentives to transfer risk.

**Derivatives and Repurchase Agreements:** The exemption of derivatives and repurchase agreements from bankruptcy’s automatic stay is a contentious subject. That exemption makes those claims exceptionally protected in bankruptcy, at the expense of other creditors. Although my model does not directly target those transactions, its core intuition may again apply. If banks face high capital structure costs, contracts that shift credit losses from banks to bondholders or other creditors create value. The automatic stay may accomplish this by protecting banks from credit losses.

5.3 **Bank Loans versus Bonds across the Business Cycle**

Corporate borrowing swings from bank financing to bond financing during recessions (Erel, Julio, Kim, and Weisbach 2011; Contessi, Li, and Russ 2013). My model provides an explanation for part of this dramatic shift: increases in distress costs ($\alpha$) or procyclicality ($\beta_A$ or $\beta_B$) would both reduce bank lending.\textsuperscript{20} Empirical evidence suggests that these parameters do increase in downturns. Campbell, Lettau, Malkiel, and Xu (2001), Ang and Chen (2002), and Forbes and Rigobon (2002) show that equity prices are more correlated in periods of economic turmoil. Mason (2005) shows bank recoveries are much lower in periods when the banking industry is under strain. Bankruptcy costs tend to be higher during recessions, see for example the study of airlines by Pulvino (1998), and bank recoveries in default much lower, as shown by Mason (2005). In my model, this would cause firms to substitute from bank borrowing to public market debt in recessions, as the price of bank loans would increase.

\textsuperscript{19}Lamb and Perraudin (2008) find a correlation between retail exposures of 1%, as compared to 5–7% for corporate exposures and 8–11% for residential mortgages. Rösch and Schaeule (2007) and Crook and Bellotti (2012) similarly find low correlations between retail exposures. Recognizing this pattern, the Basel Committee on Banking Supervision (2004, 2013) assumes a 4% correlation between qualifying retail exposures, dramatically less than the 8–24% correlation used for corporate loans or the 15% correlation used for residential mortgages.

\textsuperscript{20}My model is a single period model, which makes time-series predictions tenuous. However, the following predictions are straightforward and would emerge from natural multi-period versions of my model.
Importantly, these effects would apply to even banks with financial slack. Increased bank-level financial frictions make risky loans less profitable and lead to tightened credit standards.

5.4 Non-bank Lenders

Like banks, private equity funds and venture capital funds provide active monitoring. However, unlike banks, these funds take on junior positions. Venture capital funds make highly speculative investments and plan on large gains on a few equity investments outweighing the losses on the majority. Private equity funds take many forms, but most invest in either debt (junior to banks) or in the equity of highly leveraged portfolio companies.

My model links that difference in claim structure to taxes. Like mutual funds or pension funds, private equity and venture capital funds do not face fund-level taxation. Because of this, these intermediaries do not take on leverage at the fund level (although private equity funds often investment in highly leveraged companies). With low fund-level leverage, they are less worried about fund-level distress costs. That allows them to take advantage of the high powered incentives junior contracts offer.

Additionally, for investors in the business of risk maximization, senior claims may provide the wrong incentives. Good venture capital investments may be those with the highest variance and the highest mean. If good investments are riskier than bad investments, my model results may be reversed and more junior claims may produce the best incentives.

The differential taxation of bank debt and equity is a distortionary government policy in my model. This differential distorts not only bank leverage decisions, it also reduces bank monitoring and starves procyclical firms of credit. Treating banks like private equity funds and removing bank-level taxation reduces this distortion leads to safer banks that monitor and lend more.

6 Conclusion

Bank claims are senior across a variety of contracts, despite this seniority arguably weakening bank incentives. Bank-level financial frictions provide a natural and previously unexplored explanation.
I argue that bank lending technologies are tied to bank-level financial frictions. Banks that face double taxation will pursue high leverage to mitigate their tax costs. That leverage makes them fragile and willing to pay more for senior claims. Firms set their debt structure in response to the clientele effects created by these fragile intermediaries. Highly leveraged intermediaries have difficulty holding volatile instruments, so borrowers create safe, senior instruments for them. The residual risk is sold to less levered public debt market participants.

This bank seniority result persists even when junior contracts give banks better incentives. Making a bank more junior may give it more skin in the game and stronger incentives to screen or monitor. Nevertheless, banks are senior because a large senior claim produces the same incentives as a smaller junior claim while creating lower capital structure cost.

Bank-level capital structure frictions can also explain cross-sectional and time-series firm debt structure variation. In the cross section, more procyclical firms borrow less from banks, a pattern that I document and explain. These borrowers impose high capital structure costs on their lenders and, as a result, borrow less. Across time, firms shift from bank borrowing to public market borrowing and reduced investment during recessions. Even well capitalized banks forego lending as higher procyclicality and distress costs make bank lending less profitable.
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A Alternative Financial Frictions and Bank Technologies

This appendix extends my model to different lending technologies and different bank-level frictions. Appendix A.1 extends my results to a model that uses bank-level distress and tax costs in place of Diamond (1984) financing frictions. Appendix A.2 shows bailouts can act as a complementary mechanism. Appendix A.3 shows that seniority also emerges from a model where the bank screens against low quality borrowers. I consider capital structure costs for a large, diversified bank for each of these extensions as this eases calculation by removing the impact of idiosyncratic loan risk.

A.1 Taxes and Distress Costs as Bank Capital Structure Frictions

My results extend to the trade-off theory frictions of tax benefits of debt and financial distress costs. These frictions produce the same results as the Diamond (1984)-style frictions I use in the main paper.

A stylized empirical fact is that banks overwhelmingly prefer debt financing. I use a tax benefit of debt to make bank equity privately expensive and to drive high bank leverage. Trading off tax benefits against distress costs is in line with an expansive capital structure literature. As applied to banks, Gornall and Strebulaev (2014) argue that tax costs can explain high bank leverage and Schandlbauer (2013) and Schepens (2013) show empirically that financial institutions vary their leverage in response to tax changes. Nevertheless, other debt benefits could equally well motivate bank leverage. For example, a liquidity provision benefit (such as DeAngelo and Stulz (2013)) or a clientele effect (such as Baker and Wurgler (2013)) could lead to similar formulations. Any of these frictions give banks an incentive to increase leverage and become fragile.

The bank’s gross tax cost is \( \tau B \), where \( \tau > 0 \) is a linear tax rate applied to the bank’s cash flow of \( B \). Issuing debt can shield the bank from this tax burden. If the bank issues debt with a promised repayment of \( S \), it receives an interest tax shield equal to the lesser of \( \tau S \) and its total tax bill. Taking into account both the bank’s gross tax bill and its interest tax shield, the bank’s net tax cost is \( \tau B - \tau \min\{B, S\} \).

Debt provides a tax shield; however, it makes the bank vulnerable to financial distress. I model this cost either as proportional to the bank’s debt repayment shortfall or of fixed size.
First, I model bank financial distress as a costly fire sale to raise liquidity. If a bank’s cash flow is low, it meets its debt repayment by selling illiquid assets for less than the value these assets would have if held to maturity. The bank’s monitoring technology provides a natural motivation of such costs. If the bank sells a loan, the associated firm takes a value destroying action. Thus when the bank sells loans, value is destroyed though increased borrower moral hazard. Alternatively, this friction could be viewed as the cost of raising equity at an inopportune time.

If the bank’s cash flow is less than its promised debt repayment, the bank must raise $S - B$ by selling illiquid assets. In order to raise $\$1$ for debt repayment, the bank must sell assets that would be worth $\$(1 + \alpha)$ if held to maturity. The cost of this fire sale is equal to $\alpha \max\{S - B, 0\}$ for some linear fire sale cost $\alpha > 0$. When the promised debt repayment is set optimally, the bank’s value after taxes and these distress costs, $W^\alpha(B)$, is

$$W^\alpha(B) = \sup_S \left\{ \frac{\mathbb{E}[B]}{\text{Cash flow}} - \frac{\tau \mathbb{E}[B]}{\text{Gross tax}} + \frac{\tau \mathbb{E}[\min\{B, S\}]}{\text{Tax shield}} - \frac{\alpha \mathbb{E}[\max\{S - B, 0\}]}{\text{Distress cost}} \right\}.$$  

(A.1)

Second, I consider a distress cost of a fixed size that is incurred if the bank’s cash flow is less than its debt repayment. This cost is either a direct bankruptcy cost or the cost of the loss of customers, employees, and suppliers associated with financial distress. Managerial incentives offer an alternative explanation for distress costs. If managers face a penalty for poor performance (for example, suppose they get fired), a self-interested manager would seek to minimize the probability of financial distress.

Suppose that if $B < S$, the bank incurs a distress cost of $\gamma B_0$ for some $\gamma > 0$. The bank’s value, $W^\gamma(B)$, for the optimal promised debt repayment, $S$, is

$$W^\gamma(B) = \sup_S \left\{ \frac{\mathbb{E}[B]}{\text{Cash flow}} - \frac{\tau \mathbb{E}[B]}{\text{Gross tax}} + \frac{\tau \mathbb{E}[\min\{B, S\}]}{\text{Tax shield}} - \gamma B_0 \mathbb{P}\{B < S\} \right\}.$$  

(A.2)

With either form of distress cost, I define the bank capital structure cost created by a new loan, $\Delta$, as before using Expression (9). The game in Section 3.5 can be easily updated to this form of distress cost, with similar equilibria holding. Under a model where unmonitored borrowers abscond with the cash flow, as in Section 4.2, the bank is always senior:

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21 Bank distress would then have a knock-on effect on public debt market participants. This effect could be priced into public debt offerings and bank seniority would persist.
Theorem 5 If unmonitored borrowers repay nothing and the bank has either fixed or proportional distress costs, the bank is senior in all equilibria.

As before, making the bank senior minimizes portfolio risk, which minimizes bank-level distress costs. Junior securities produce more tax costs in good states of the world and more distress costs in bad states of the world. Senior securities are less procyclical and thus less costly for the bank to hold.

If, as in Section 4.3, bank monitoring increases borrower quality or decreases borrower risk, the bank is senior for reasonable model parameters. To illustrate, I use a baseline parameter set motivated by empirical proxies and vary parameters from that baseline one by one.

My baseline uses a one-year loan and a firm volatility of 40%, consistent with Choi and Richardson (2008) and Schaefer and Strebulaev (2008). I set the correlation between the bank and firm to 45%, in line with the Basel Committee on Banking Supervision (2004, 2013) which uses values ranging from 28% to 49%. I use a bank asset volatility of 3%, in line with Ronn and Verma (1986) and Hassan, Karels, and Peterson (1994). Finally, I use a tax rate of 20% to model the effect of double taxation, in line with Djankov, Ganser, McLiesh, Ramalho, and Shleifer (2010).

The remaining parameters lack empirical proxies. In the proportional distress cost model, I assume the bank incurs a cost of one dollar to raise one dollar of liquidity. In the fixed distress cost model, a defaulting bank suffers a loss equal to 20% of its initial value, similar to the costs observed by James (1991) and Bennett and Unal (2008). Finally, I assume that monitoring reduces firm cash flow standard deviation by 20% and increases firm cash flow mean by 20%.

Varying parameters from that baseline one at a time, the bank is always senior for reasonable parameter values in both the fixed and proportional distress cost models. The bank is senior if either firm or bank volatility is less than 250%, the correlation between the bank and the firm is less than 73%, or tax costs are set to any level greater than 0.025%. Similarly, bank seniority persists as long as the fixed

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22 Basel correlation parameters are usually given as the correlation between two firms and range from 8% to 24%. I take the square root of these to get the correlation between the bank and the firm.

23 A correlation of 73% between bank and firm returns is much higher than both the levels proposed by the Basel Committee on Banking Supervision (2004, 2013) and empirical estimates of the correlation between banks and non-banks. For example, the correlations between S&P 500 non-financial corporations and S&P 500 banks are all below that level. Looking at equity return correlations over the past ten years between pairs of banks and non-banks, the median correlation
distress cost is less than the bank’s initial value or the proportional distress cost incurred when raising one dollar of liquidity is less than twenty dollars. Finally, seniority remains optimal if monitoring reduces firm cash flow volatility or increases firm cash flow mean by any amount.

For some extreme parameter sets, the bank is not senior. To get the intuition for this, consider a firm with a massive amount of systematic risk and a value that is always very close to zero when the bank is in distress. That firm’s senior debt produces about the same bank-level capital structure costs as its junior debt: both securities have close to zero value when the bank is in distress and so both are equally costly for the bank to hold. However, the junior security may generate stronger monitoring incentives. If that is the case, efficient contracts do not always make the bank senior. This exception occurs for low bank leverage and highly procyclical firms, which together mean that almost all classes of firm debt are nearly worthless when the bank is near default.

I have modeled distress costs as applying to the bank and not to the bond investor. However, my results depend only on banks having higher leverage or greater capital structure frictions than bond investors. Tax costs are the driver of bank leverage in my model, and thus the driver of bank distress costs. Typical public debt market investors do not get these tax benefits, which means they do not need such high leverage. Further, these bond investors, such as mutual funds and pension funds, are often barred from taking high leverage in the first place.

A.2 Bailouts and Deposit Insurance

Any discussion of bank distress costs is incomplete without considering the impact of government interventions such as bailouts or deposit insurance. This appendix shows that these interventions offer an alternative and complementary channel for my results. The intuition is simple: bailouts and deposit insurance subsidize tail risk and large senior loans have more tail risk than small junior loans. Bailouts and deposit insurance payouts occur in the states of the world where bank values are very low. These

is 38% and the 99th percentile correlation is 57%. The maximum correlation observed is 65% and occurs between the bank-like General Electric and the bank JPMorgan Chase.

24As discussed in Section 2, individual investors are the largest holders of corporate debt. Whether held in mutual funds, pension funds, or directly (in fully taxable or tax advantaged accounts), these investors avoid double taxation and have less leverage than banks.
payouts reduce the amount that banks care about losses in those very bad states of the world. A large senior contract imposes heavy losses in precisely those states of the world where the bank is most likely to be bailed out. Thus, giving the bank a large senior contract creates private value for the firm, bank, and bond investor by maximizing bank losses in bad states of the world and maximizing the government subsidy.

I show this intuition using a simple model of a bank that faces distress costs, but whose losses are backstopped by the government. Suppose that the bank suffers a cost of $\gamma > 0$ in a bank run. These runs occur whenever the bank’s after-run cash flow is insufficient to repay its creditors, $B - \gamma < S$. The bank’s creditors are insured depositors with a repayment $S$ and are always repaid in full, even if the bank defaults. The bank sets its capital structure to balance the tax benefits of debt against the cost of bank runs, subject to the presence of this deposit insurance.\(^{25}\) The bank’s value is thus

$$W^{\text{Bailout}}(B) = \sup_{S < \mathbb{E}[B]} \left\{ (1 - \tau)\mathbb{E}[B] + \tau S - \mathbb{E}[((1 - \tau)B + \tau S)\mathbb{I}[B - \gamma < S]] + S\mathbb{P}[B - \gamma < S] \right\}. \quad (A.3)$$

Suppose the losses equity holders face in a bank run, $\gamma$, are 1%, 5%, or 20% of the bank’s initial size, $B_0$. Under all of the parameter variations tested in Appendix A.2 and each of these loss scenarios, the bank is always senior. Importantly, bank capital structure and firm debt structure are set based on private efficiency, without considering the losses the government bears. Self-interested banks and borrowers do not consider these bank-risk externalities.

Large senior claims have more tail risk than small junior claims, which means they receive a greater subsidy from bailouts. As a simplified example, suppose that a bailout occurs with certainty if the firm’s value is less than $0.10 and never occur otherwise. For firm cash flows above $0.10, the intuition in Section 4.3 continues to apply: banks are senior because large senior contracts deliver punishment to shirking banks with a minimum of collateral damage. Bailouts change nothing over this range of firm cash flows.

For firm cash flows below $0.10, the bank’s creditors are made whole by the government and their payoff does not depend on the loan contract payoff. However, the bond market still cares about payoffs.

\(^{25}\) I have limited the bank’s promised repayment, $S$, to $\mathbb{E}[B]$ in order to prevent the bank promising infinite repayments to its creditors.
in this range, as it does not have a government bailout. Therefore, from the view of the bank, the
bond investor, and the firm, it is more effective to shift losses onto the bank in this bad state of the
world. Giving the bank low repayments here has no effect on agents’ payoffs and means that the bond
market can be given higher repayments in other states of the world. Thus, a large senior contract is
the most effective way to exploit government bailouts. Because the bank owners are walking away in
some states, bank incentives are weakened, as in Fender and Mitchell (2009). However, increasing the
size of the senior contract overwhelms that and seniority remains optimal. The value of this subsidy is
independent of monitoring: if the bank was subject to bailouts but had no monitoring ability, it would
hold a smaller senior claims in order to exploit government bailouts.

A.3 Screening in Place of Monitoring

Bank seniority is also optimal under a screening model. Suppose that instead of monitoring against a
value destroying action, the bank can create value by separating good firms ($\theta = 1$) from bad firms
($\theta = 0$). Good firms have a cash flow $A_1$, as in Expression (4), and the descriptively named bad firms
have the lower or riskier cash flow $A_0$ given in Expression (20). The unconditional probability that a
firm is bad is $p$ with $0 < p < 1$. The bad firm is sufficiently “bad” that it could not raise funding if its
type were known:

$$\forall R_D, \ E[R_D(A_0)] < I. \quad (A.4)$$

Further, as in Section 4.3, I prohibit the bank from holding equity-like claims.

The bank can pay cost $M$ to screen the firm and verify its type. If the bank screens, it lends only to
good firms and so it lends to a good firm with probability $1 - p$ and rejects a bad firm without lending
with probability $1 - p$. If the bank shirks and still lends, it again lends to a good firm with probability
$1 - p$ and this time lends to a bad firm with probability $p$, instead of turning that firm away.

Firm debt structure arises from a game the firm plays with a competitive bank and a competitive bond
investor. The bank has capital structure frictions and a screening technology while the bond investor
has no capital structure costs and cannot screen. This game involves asymmetric information about
the firm’s type, $\theta$, and moral hazard about the bank’s screening action, $m$.

In step 1, the firm’s type, $\theta$, is drawn.
Figure A.1: Timeline of Screening Game

Figure A.1 shows a timeline for the screening game described in Appendix A.3.

1. Firm’s type $\theta$ drawn.
2. Bank has the option of paying $M$ to learn the firm’s type.
3. Bank can pay $h$ to offer its choice of loan to the firm $(V_B, R_B)$.
4. Bond investor chooses a bond to offer the firm $(V_P, R_P)$.
5. Payoffs realized.

In step 2, the bank chooses whether to pay $M$ to invest in a screening technology, $m = 1$, or whether instead to shirk and pay nothing, $m = 0$. If the bank invests in the screening technology, the bank learns the firm’s type, $\theta$. Otherwise, the firm’s type is the firm’s private information.

In step 3, the bank can pay a cost, $h > 0$, to offer the firm a bank loan. The bank can choose the proceeds, $V_B$, and repayment, $R_B$, of this loan. If the bank invested in the screening technology, the bank knows the firm’s type. Otherwise, the bank makes the offer without knowing the firm’s type. If the bank does not offer a loan, the game ends with zero payoff for the firm and bond investor and a payoff to the bank of $-M$ if the bank invested in the screening technology and zero if it did not invest.

In step 4, the bond investor observes the bank loan offer and can make its own bond offer with proceeds $V_P$ and repayment $R_P$.

In step 5, the payoffs are realized. If the loan and bond offered are insufficient to fund the project, $V_B + V_P < I$, the game ends with zero payoff for the firm and the bond investor, and $-h - M$ for the bank if it invested in the screening technology and $-h$ if it did not invest.

If at least $I$ financing was raised, the firm invests $I$ into a project. This project yields a cash flow $A_\theta$, with $A_\theta = A_1$ for a good firm and $A_\theta = A_0$ for a bad firm and shirking bank. This cash flow is used to repay the bank, $R_B(A_\theta)$, and the bond investor, $R_P(A_\theta)$. I again use $C = (V_B, R_B, V_P, R_P)$ to represent the bond and loan contracts. Given the project has been financed, the firm gets an expected
payoff of

$$\pi_E(C, \theta, m) = \mathbb{E}\left[ A_\theta - I + V_P - R_P(A_\theta) + V_B - R_B(A_\theta) \right],$$  \hspace{1cm} (A.5)$$

the bond investor gets an expected payoff of

$$\pi_P(C, \theta, m) = \mathbb{E}\left[ -V_P + R_P(A_\theta) \right],$$  \hspace{1cm} (A.6)$$

and the bank gets an expected payoff of

$$\pi_B(C, \theta, m) = \mathbb{E}\left[ -V_B + R_B(A_\theta) - \Delta(R_B(A_\theta)) - m M - h \right].$$  \hspace{1cm} (A.7)$$

The bank’s strategy is a choice of whether to invest in screening, $m$, and a loan to offer the firm, $(V_B, R_B)$. The bond investor’s strategy is a bond to offer the firm, $(V_P, R_P)$, based on the loan the bank offered. The bond investor makes an offer with imperfect information about the bank’s screening investment, so let $\lambda$ denote the bond investor’s belief about the firm’s type at the time it makes a bond offer.

Given these strategies, beliefs, and payoffs, I consider perfect Bayesian equilibria. As a further refinement, I consider only those equilibria that satisfy the Cho and Kreps (1987) intuitive criterion. The only equilibria that survive the intuitive criterion are those that make the bank senior:

**Theorem 6** *If the bank can screen against bad firms that have cash flows with lower mean or higher variance or both, the bank is senior in all perfect Bayesian equilibria that satisfy the intuitive criterion.*

The intuition behind this result is the same as that behind Theorem 3. Giving the bank a large senior claim gives the bank the right incentives while minimizing bank-level capital structure costs.