Litigation or Foreclosure? The Effects of Judicial Efficiency on Lending Markets

Tianhao Wang*

March 26, 2026

Abstract

The efficiency of judicial enforcement significantly influences credit market outcomes. We examine a bilateral lending relationship with opportunistic borrowers and imperfectly efficient courts, where lenders choose between costly legal proceedings and non-judicial foreclosure to enforce debt contracts. We show that lenders' enforcement preferences depend on the relative effectiveness of courts versus non-judicial recovery. More efficient courts allow lower upfront interest rates while increasing expected recovery on each loan. While improvements in judicial efficiency reduce credit rationing, they can adversely affect credit access, disproportionately benefit wealth-constrained borrowers, while tightening credit availability for asset-rich borrowers. We further show that informal enforcement mechanisms, such as reputational penalties, complement judicial enforcement in deterring defaults, but greater reliance on penalties lowers both contractual interest rates and lenders' expected returns. Collateral is most relevant for lower-quality investments and serves as an effective repayment incentive only when its value exceeds the outstanding debt.

JEL Classification: D86, G21, K41.

Keywords: enforcement, judicial efficiency, contest, credit market, collateral, interest rates.

*University of California, Irvine. Email: tianhw15@uci.edu

1 Introduction

Why would a borrower, with a promising project but insufficient liquid wealth to finance it, struggle to secure funding? A borrower may default on a loan either as a consequence of a genuine inability to repay or because they are unwilling to repay if the gain from defaulting outweighs the perceived cost of sanctions. The cost of sanctions depends not only on the lender's willingness to impose them but also on institutional factors, such as the quality of laws and the legal system supporting the lender's claims. Given the costly nature of loan recovery in cases of default, this raises the question of whether the lender is willing to lend ex-ante, and consequently, the extent to which the borrower faces the risk of being credit-constrained.

The primary function of courts in lending relationships is, therefore, to force solvent borrowers to repay when they fail to do so. Institutional factors, such as laws governing foreclosure and the protection of creditor-borrower rights, can create significant asymmetries in legal strength between lenders and borrowers. Our focus is on the broader distinction between *judicial enforcement* and *non-judicial recovery* — specifically, whether lenders recover delinquent debts through the court system or rely on direct asset repossession. Judicial procedures are more costly than power-of-sale alternatives, as they require legal professionals and extended court proceedings. Non-judicial foreclosure, in contrast, often involves minimal legal intervention and can expedite loan recovery. When these frameworks disproportionately favor one party, they influence the choice of dispute resolution, especially when one party perceives a substantial advantage in court due to these legal imbalances (Schaller and Skaperdas 2020).

This power asymmetry is often determined by *judicial efficiency*, which influences creditors' willingness to lend and the terms they offer. Recent surveys examine how variations in creditor and borrower rights affect loan structures (e.g., Esty and Megginson 2003; Bae and Goyal 2009; Dagher and Sun 2016; Moro et al. 2018). They found that borrower-friendly judicial requirements increase costs and risks for lenders, reducing their willingness to extend credit. In contrast, stronger creditor rights protection is often associated with higher willingness to lend and lower loan spreads. Judicial efficiency plays a pivotal role in shaping the lender's decision to extend loans and recover debts, as it affects the relative strength of creditor and borrower protections.

In this paper, we examine a bilateral lending relationship to explore the impact of judicial enforcement of debt contracts on ex-ante contracting, interest rates, credit access, and the choice of dispute resolution methods. We are particularly interested in how the prospects of judicial recovery and non-judicial foreclosure impact the lending relationship when collateral is involved.

We present a model of opportunistic borrowers and courts with varying degrees of judicial efficiency. The borrower and the lender engage in ex-ante contract negotiation, with the lender determining the terms of the contract. The borrower, while lacking liquidity, holds collateralizable wealth that can be pledged as collateral. Once the loan agreement is made, the borrower decides whether to repay based on the project's outcome. If the project succeeds, the borrower chooses between fulfilling their contractual obligations or defaulting. If the project fails, the borrower has no liquid assets and must default. The lender then selects an enforcement mechanism—either legal action through the courts or non-judicial recovery via collateral repossession. A contest game characterizes the litigation process, while repossession serves as an alternative means of enforcement. Judicial efficiency is measured by how practices of law favor the lender when the lender has the claim at the contract's formation, which in turn determines the lender's winning probability in court if legal action is pursued.

According to the model, relative judicial efficiency is critical in determining whether the lender resorts to non-judicial foreclosure mechanisms such as repossession of the collateral. One of the central findings is that higher judicial efficiency does not simply increase the likelihood of court enforcement; rather, it alters the lender's trade-off between collateralization and legal action. When legal institutions function effectively, lenders may either require full collateral coverage or none at all, with this choice determined by the effectiveness of collateral recovery. Borrowers strategically default whenever their expected payoff, even after accounting for potential legal disputes, exceeds the cost of repayment. The contract terms adjust in response: if collateral recovery is high, lenders rely more on collateral and accept a lower interest rate; conversely, when collateral recovery is costly, lenders forego collateral to extract a higher surplus by raising the interest rate. We also find that, in these cases, lenders' expected interest rates unambiguously increase with judicial efficiency, while the interest rates specified in the contract decline as judicial efficiency improves. Better courts allow lenders to charge less up-front while increasing the expected recovery on each loan.

Another key finding concerns the role of collateralizable wealth in enforcement decisions. When borrowers have limited collateralizable wealth, lenders have no choice but to rely on judicial enforcement. However, when collateral is sufficient, lenders favor non-judicial foreclosure when judicial efficiency is moderate, regardless of the project's outcome. In this setting, the lender requires collateral equal to the net return of the project. A trade-off exists between judicial efficiency and the collateral recovery rate: when collateral recovery is low, judicial efficiency must be sufficiently high for court actions to remain attractive. We also find that while improvements in judicial efficiency reduce credit rationing, their effects on borrowers' access to credit can be ambiguous. An improvement in judicial efficiency decreases the marginal contribution of collateral to the lender's expected payoff and relaxes the minimum collateralizable wealth requirement, expanding credit access for wealth-constrained borrowers, while narrowing the set of feasible contracts for asset-rich borrowers.

These findings have broader implications for credit access and financial markets. Judicial reforms, although welfare-improving overall, may have distributional consequences. Better courts disproportionately benefit wealth-constrained borrowers while tightening the credit availability for wealthier borrowers, who may be excluded from the credit market. In addition, an improvement in the quality of the project reduces credit-rationing. Collateral is often used to finance low-quality investments, and improvements in judicial efficiency or collateral recovery rate unambiguously increase the likelihood of lending in such bilateral lending relationships.

Lastly, we extend our analysis to include informal enforcement mechanisms (e.g., reputational damage, exclusion from future lending, etc.). In particular, borrowers face a penalty in the event of default. We find that while judicial efficiency and default penalty are substitutes in deterring opportunistic behaviors, formal and informal enforcement are complementary. Such penalties, however, are not without cost. An increase in the default penalty leaves less room for mutually beneficial contracts, and reduces both contractual and lenders' expected interest rates.

Our technical and substantive contributions to the literature are: i) we endogenize the legal enforcement process in debt contracts and show that the choice of enforcement mechanism, contract terms, and credit availability critically depend on relative judicial efficiency; ii) we integrate legal institutions into a lending model with collateral and show that institutional factors are key determinants of equilibrium collateral requirements and interest rates. This approach allows us

to combine the intuitions of previous research and provide a coherent framework to discuss policy tradeoffs such as debtor protections versus creditor enforcement.

2 Related Literature

Securing title to assets involves significant costs, and debt contracts are particularly costly to enforce in lending scenarios. The World Bank "Doing Business" database documents that judicial procedures to enforce debt are costly even when lenders have secured claims. In 91 out of 198 countries, the estimated recovery rate on a secured loan is less than one-third of the claim[1]. Failures of debt enforcement discourage lending, and costly debt enforcement negatively impacts credit market development in emerging economies (Djankov et al. 2008). Recovery rates remain low even in high-income countries, and enforcing rights in assets like real estate or intellectual property can be prohibitively expensive in developed economies as well. This difficulty in debt enforcement is often rooted in the legal system's origins, where more formalistic legal systems tend to yield greater inefficiency and a lower quality of legal systems (Djankov et al. 2003, 2008). Structural aspects of debt enforcement, such as ineffective collateral systems and poorly structured appeals, also contribute to this inefficiency. Our work examines these structural factors in the context of legal institutions and relates to three main strands of literature.

First, extensive literature has focused on the role of collateral in loan contracts and credit-rationing under informational asymmetry. Although bilateral lending arrangements often incorporate mechanisms to mitigate default risk, standard contractual features alone do not necessarily incentivize repayment or guarantee efficient contract enforcement. Loan collateral—an asset pledged by the borrower to secure a loan—provides lenders with a legal avenue to recover losses and increases the punishment for default. Barro (1976), Benjamin (1978), and Stiglitz and Weiss (1981) highlighted the role of collateral in providing a disincentive for the borrower to default. Chan and Kanatas (1985) emphasized collateral's signaling role when lender and borrower have asymmetric

[1]The World Bank Doing Business database documents the costs involved in a bank enforcing a secured claim on a non-financial firm which enters bankruptcy procedures. For data see http://www.doingbusiness.org/data/exploretopics/resolving-insolvency

valuations based on information or belief. Bester (1994) proposed a model of debt renegotiation – an alternative mechanism for recovering debt – in which the extent of the entrepreneur's liabilities in the optimal loan contract depends on the creditor's commitment to impose bankruptcy. However, collateral's effectiveness can be compromised when its recovery is costly, possibly failing to assure full recovery of the lent value (Carroll and McCann 2017).

Much of this research abstracts from the judicial institution that enforces debt contracts and collateral. They typically assume that, upon default, lenders can seize the pledged collateral (up to some fixed value), and beyond that, the borrower cannot be forced to repay. For example, Kiyotaki and Moore (1997) assumed borrowers cannot be forced to repay their debts beyond surrendering collateral. This assumption effectively treats enforcement as a constraint rather than an endogenous process. We follow Bester (1994) in incorporating a loss of value during enforcement (e.g. due to transaction costs), but extends this framework by explicitly modeling enforcement institutions. In particular, we examine the role of collateral in the context of legal institutions, where lenders have the choice between foreclosing on the collateral and suing in court for the debts.

A second line of research focuses on the role of judicial institutions and their performance in understanding behavioral variations in debt repayment and credit availability. While theoretical literature often acknowledges that a well-functioning judiciary lowers financial intermediation costs and enhances investment climates, many models either overlook legal enforcement altogether or impose a single, exogenously determined mechanism without accounting for strategic enforcement decisions. Our model is closely related to Jappelli et al. (2005) and Zazzaro (2005), who examine the effects of legal system efficiency on the functioning of the credit market. Jappelli et al. (2005) showed that improvements in judicial efficiency reduce credit constraints, lower the cost of bank credit, and increase lending. However, they operationalize the court's effect only through the fraction of collateral recoverable. Zazzaro (2005) employed a banking model with borrower heterogeneity and showed that stronger contract enforcement reduces default risk but may also weaken lenders' incentive to screen borrowers. This framework assumes courts always enforce with a given efficiency. Our model differs from previous works in that we explicitly model court proceedings through a contest game and allow lenders to optimize enforcement strategies under different conditions.

Empirically, judicial efficiency is often measured through the length of trials and bankruptcy case load (Müller 2022). Longer trials typically result in increased resource expenditures and lower recovery rates. Empirical evidence suggests that judicial efficiency and institutional frameworks explain cross-country differences in how households respond to adverse income or health shocks. Duygan-Bump and Grant (2009) used data from the European Community Household Panel to show that households are strategic in their repayment decisions when legal institutions are less effective at punishing default. Many studies have consistently shown that institutional factors influencing the punishment of defaults are critical in explaining credit availability – improvements in judicial efficiency lower the cost of bank credits (see, for example, Laeven and Majnoni 2005; Moro et al. 2018). Even within a single country, regional disparities in judicial efficiency influence both the volume of lending and loan terms (Pinheiro and Cabral 1999). In principle, more efficient judicial enforcement systems not only reduce the probability of borrowers being partially or totally denied credit but also decrease the likelihood of strategic default. In this context, our model provides a coherent framework for understanding how variations in judicial efficiency influence interest rates, enforcement, and credit supply.

A third, closely related line of literature studies the protection of creditor rights and its implications for lending markets. Higher creditor and property rights are positively associated with the size and development of financial sectors (Bae and Goyal 2009; Qian and Strahan 2007; Djankov et al. 2008; La Porta et al. 1998). While the literature often emphasizes creditor rights and the legal enforcement of property rights, the protection of debtor rights is relatively less discussed. La Porta et al. (1998) showed that common-law countries generally have stronger legal rules for creditor rights protection than civil-law countries. However, even in common-law countries like the United States, there are strong protections for debtor rights aimed at benefiting less well-off borrowers. For example, many personal assets can be exempted from the bankruptcy process under Chapters 7 or 13 in various states. Many U.S. households might find themselves in situations where filing for bankruptcy could financially benefit them, as the legal system provides incentives for filing bankruptcy rather than repaying debts (Gropp et al. 1997; White 1998). Similar concerns exist

for corporate borrowers, who may transfer assets out of companies through tunneling [2](Johnson et al. 2000). Hence, the balance between debtor rights and creditor rights could be an important determinant of credit supply, loan recovery, and debt structures.

3 The Framework

We consider a framework that is partly based on Bester (1994), where a risk-neutral borrower (B) is endowed with a project. This project necessitates an investment, represented by I, and yields a random return. If the project is successful, X_s is realized with probability p. A failed project yields zero. The setup simplifies Bester (1994) in the sense that the borrower and the lender both observe the return realization at no cost.

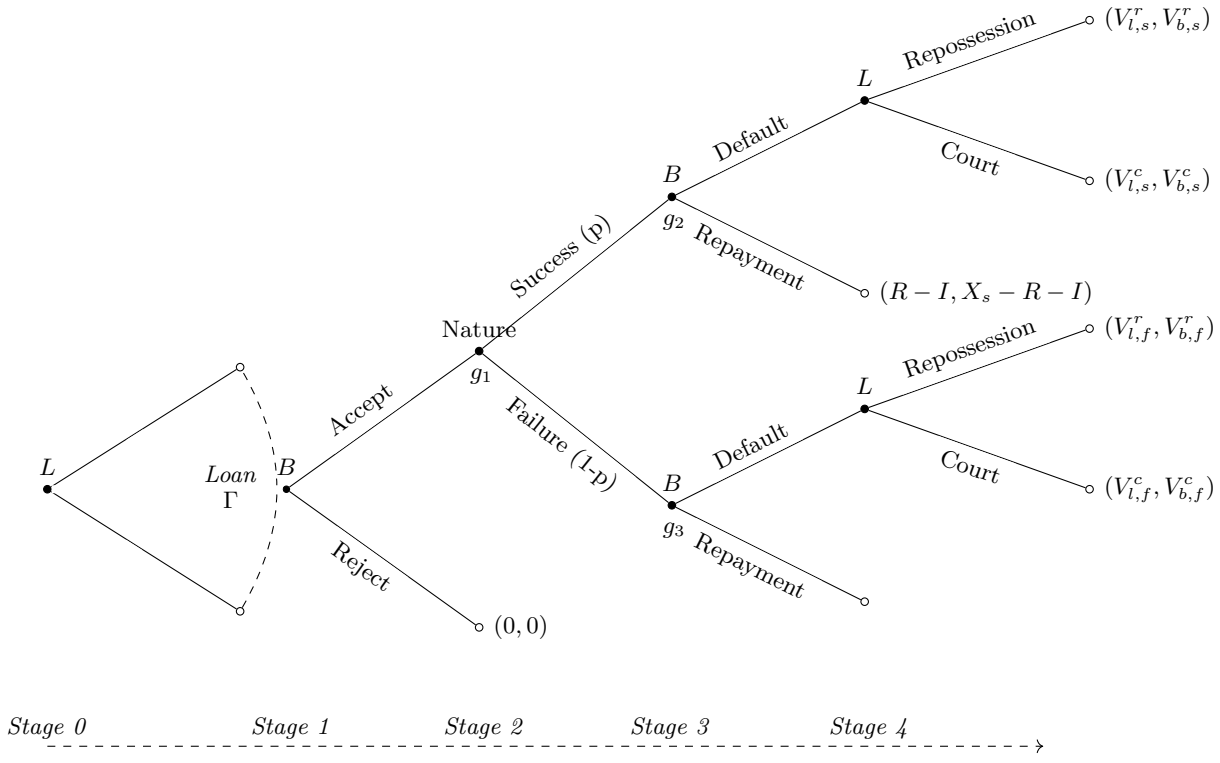


Figure 1: The Investment Game.

[2]Johnson et al. (2000) defines 'tunneling' as a term that describes the transfer of assets and profits out of firms for the benefit of those who control them.

The borrower lacks liquid assets to fund the investment and can put down only I for the project but possesses collateralizable wealth amounting to W. The collateralizable wealth W cannot be directly utilized for investment purposes. Instead, the borrower can secure the loan from the lender (L) by using a fraction of W as collateral C for the loan. Assume the risk (or quality, distribution) of the project is common knowledge, such that

$$pX_s > I. \tag{1}$$

The lender values the collateral C differently from the borrower, quantified as βC, with $0 < \beta < 1$. The costs $(1-\beta)C$ arise because taking possession of and liquidating C involves transaction costs, such as the fees to file for a lien and the costs to conduct an appraisal.

The loan contract between the lender and the borrower specifies a repayment amount of R, defined as $R \equiv (1+\rho)I$, where ρ represents the interest rate stipulated in the contract. The lender's right to foreclose on the project assets becomes essential to induce the borrower's incentive of repayment. If the borrower refuses to pay R, the lender has the enforcement option of i) foreclosure on collateral, provided that the loan contract includes collateral as security; ii) suing in court to recover R in cases where the project succeeds. The latter option requires $X_s > R$ such that the borrower has sufficient funds to cover the repayment.

In summary, the obligations specified in the debt contract are $\Gamma = (R, C)$, requiring the borrower to pay the amount R; failure to do so, whether due to a genuine inability to repay or strategic behavior, entitles the lender to enforce the contract through available means.

The model's structure can be interpreted in at least two ways:

- A typical business lending environment, where the project can be viewed as a business venture, and the borrower is a firm seeking capital for investment. An example of this is the Small Business Administration (SBA) disaster loan program, which provides secured loans to firms without requiring collateral to fully cover the loan.
- Mortgage loan relationships. The borrower's employment status or income-generating ability determines repayment capacity — with a steady stream of income, the borrower is capable

of repaying their mortgage. When the borrower is unemployed or experiences a significant income shock, the project fails, and the borrower is less able to meet mortgage obligations.

To analyze lender and borrower behaviors in this scenario, we adopt the stylized game of contest and bargaining to analyze borrower and lender behavior. The lender offers contracts of the form $\Gamma = (R, C)$. Assume an exogenous prevailing interest rate $\bar{r}$. The lender decides to invest if their expected payoffs $V_l \geq \bar{r}I$. Here, a successful project yields the lender a return of R, which can be expressed as $(1 + \rho)I$, where $\rho \geq 0$ is the loan's profitability. If the lender finds no profitable contract to offer, the game ends. Otherwise, the borrower decides whether to accept the contract offer and undertake the investment. Figure 1 summarizes the investment game under complete information. We study the subgame-perfect equilibrium of this game and proceed by backward induction from the final stage.

The timing of moves is as follows:

- In stage zero, the lender extends a loan package to the borrower.
- In stage one of the borrower-lender relationship, the borrower decides whether to accept the lender's offer and invest and fund the project.
- In stage two, X_s is realized with probability p and zero is realized with probability $1 - p$. This is observed by both the lender and the borrower.
- In stage three, the entrepreneur decides whether to fulfill the repayment and pay R. If the repayment occurs and the project is successful, the game concludes with payoffs of $X_s - R - I$ for the borrower and $R - I$ for the lender. If the project fails, the entrepreneur is forced to default.
- In stage four, upon default, the lender either repossesses the collateral and incurs a fixed cost or takes legal action against the borrower.

3.1 Going to Court

In the event of a default, the lender intends to recover the agreed-upon repayment. Our stylized model gives the lender the option to force a trial and seize the repayment R in the event of default. The court's ruling is not purely an objective assessment of facts; institutional biases, legal

protections, and procedural rules can influence it (e.g., courts rely on presented evidence and legal frameworks).

Both parties, the lender and the borrower, can influence their respective probabilities of winning by expending efforts, such as hiring counsel and collecting evidence. These effort choices are strategic and impact the outcomes of the contest. They are represented through a CSF as in Skaperdas and Vaidya (2012). Specifically, let e_l and e_b be the efforts expended by the lender and the borrower, respectively. The winning probability of the lender is given by $q(e_l, e_b)$, expressed as:

$$q(e_l, e_b) = \frac{\varphi e_l}{\varphi e_l + (1-\varphi)e_b}. \tag{2}$$

Here, $\varphi \in (0, 1)$ represents the judicial efficiency or the degree of property rights security and describes the pre-trial legal environment. Assuming $\varphi \to 1$ indicates that preexisting legal norms, legislation, or the practices of law completely favor the lender. This scenario aligns closely with Shapiro (1986)'s idealized universal court, where a dispute between two neighbors is resolved by a third party guided by common sense and custom. If the contract clearly outlines an agreement that includes all necessary elements, given that the nature of the contract favors the lender in case of default, the lender should be assigned the legal rights. On the contrary, assuming $\varphi \to 0$ indicates that the legal or factual situation completely favors the borrower, indicating low judicial efficiency. Given a fixed effort level e_b, the lender's winning probability $q(e_l, e_b)$ increases with e_l. The converse is true for the borrower.

Assume both parties are risk neutral and the 'American' rule is in place, that is, each party pays their own legal costs, the expected payoffs when the project is successful are:

$$\begin{aligned} V_{l,s}^{\prime c} &= q(R-I) + (1-q)(-I) - (1+\delta)e_l \\ V_{b,s}^{\prime c} &= q(X_s - R - I) + (1-q)(X_s - I) - (1+\delta)e_b \end{aligned} \tag{3}$$

where δ is the additional cost of actually going to court as opposed to just preparing to go to court.

Equating the two first-order conditions for the equilibrium efforts e_l^c and e_b^c yields the equilibrium condition and thus the expected payoffs (see Appendix A.1). Equilibrium efforts are closely related

to judicial efficiency φ.

$$\begin{aligned} e_b^c = e_l^c &= \frac{\varphi(1-\varphi)R}{(1+\delta)}; \\ V_{l,s}^c &= -I + \varphi^2 R, \\ V_{b,s}^c &= X_s - I - \varphi(2-\varphi)R. \end{aligned} \tag{4}$$

3.2 The Decision to Repossess

Alternatively, the lender may choose to repossess the collateral if the borrower defaults, incurring a fixed cost. In the case of repossession, the lender recovers βC minus the fixed cost.

Creditors could bring suit on the underlying debt, but this remedy is infrequently utilized due to its time-consuming and costly nature. Instead, many creditors prefer non-judicial foreclosure, as it is typically faster and less expensive than judicial foreclosure. In practice, lenders favor repossessing the collateral, either selling it or retaining possession to satisfy the debt.

Consider a scenario where, in the event of a default, the lender repossesses the collateral pledged by the borrower directly, without obtaining a court judgment beforehand.

We assume no fixed cost is incurred in this process so that the lender recovers βC. Introducing a positive fixed cost does not alter our main results. In Appendix A.2, we extend the model to allow for a positive fixed cost and examine the implications of judicial foreclosure. The expected payoffs are

$$\begin{aligned} V_{l,s}^r = V_{l,f}^r &= -I + \beta C, \\ V_{b,s}^r = X_s - C - I, &\quad V_{b,f}^r = -C - I. \end{aligned} \tag{5}$$

In cases where the debtor defaulted on their loans, 'self-help' repossession is usually permissible. This is predicated on the security agreement's provision that allows repossession, provided it can be carried out without breaching the peace.

4 Debt Recovery and Contract Enforcement

We want to take a look at the contracting problem by studying the subgame-perfect equilibrium condition of the game described in Section 3. In this scenario, the borrower has no assets other than the collateralizable wealth W. As we shall see, a successful borrower will always default if they anticipate that the lender will go to court. If the borrower expect the lender to exercise their right to foreclose on their assets in the event of default, the successful borrower is better off paying the debt as long as the collateral covers the repayment obligation, i.e., $C \geq R$.

4.1 Default and Enforcement Decisions

We now solve for the optimal decisions in stages three and four. The project fails with probability $1-p$. In the final stage, the lender always chooses to repossess the collateral, provided that it is included in the loan contract[3]. In stage three, regardless of the lender's decision in the final stage, the borrower lacks liquid assets to repay and is thus forced to default.

With probability p, the project succeeds, and the borrower's realized project return is X_s. In the event of default, the lender decides to take legal action against the borrower if and only if $V^c_{l,s} > V^r_{l,s}$, which occurs when $\varphi^2 R > \beta C$.

Therefore, the lender repossesses if and only if $\varphi \leq \hat{\varphi} = \sqrt{\frac{\beta C}{R}}$, and goes to court otherwise.

In stage three, knowing that the lender favors court actions, the borrower will always default since $\varphi < 1$ implies $\varphi(2-\varphi) < 1$. Thus, the borrower is better off defaulting given $V^c_{b,s} > X_s + C - R$, the payoff received when fulfilling contractual obligations and repaying.

Given the lender's decision to repossess, the borrower's optimal strategy is to default when $C - R \leq 0$, and to repay otherwise.

[3]We could extend the model to incorporate judicial foreclosure, a court-ordered process that allows the lender to foreclose on the collateral. The equilibrium choice of enforcement remains unchanged even when the fixed cost of repossession is positive, as long as the fixed cost is sufficiently small relative to βC. See Appendix A.2 for details.

To summarize, the optimal strategies for the lender and the borrower, respectively, in the subgame g_2 are

$$s = \begin{cases} \{\text{repossess, repay}\} & \varphi^2 R \leq \beta C, C > R \\ \{\text{repossess, default}\} & \varphi^2 R \leq \beta C, C \leq R \\ \{\text{court, default}\} & \varphi^2 R > \beta C \end{cases}$$

4.2 Equilibrium Characterizations

In stage one, the lender invests if and only if the lender's effective return from the project exceeds $\bar{r}I$, where $\bar{r}$ is the prevailing interest rate, or the opportunity cost of investment. The effective return is determined by the lender's expected payoff from the project relative to their initial investment, factoring in both the probability of repayment and the potential for collateral recovery.

There are five possible equilibrium outcomes that depend on the collateral, judicial efficiency, and project quality. Table 1 provides an overview of the outcomes and the conditions under which they occur.

Enforcement		C^*	ρ^*	Key driver
Success (p)	Failure ($1-p$)			
Court	Repossession	W	Low	High φ, high β; collateral supplements litigation
Court	Default (no collateral)	0	High	High φ, low β; collateral recovery too costly, lender forgoes it
Repossession	Repossession	$pX_s - \bar{u}$	High	Low φ, $C < R$; borrower defaults, lender seizes collateral
Repay	Repossession	$pX_s - \bar{u}$	Low	Low φ, $C \geq R$; collateral threat induces repayment
No Lending	No Lending	/	/	Lender's expected return below opportunity cost $\bar{r}I$

Table 1: Summary of Equilibrium Outcomes

Lending occurs if and only if the lender's expected payoff V_l exceeds the opportunity cost $\bar{r}I$. If lending proceeds, borrowers—aware of the difficulties creditors face in recovering loans easily and cheaply through the courts—may be tempted to default strategically.

To mitigate the risk of default, the lender adjusts the interest rate and collateral requirements based on the collateral recovery rate (β) and judicial efficiency (φ). When judicial efficiency is above the threshold $\hat{\varphi}$, if the collateral recovery rate is low (i.e., β is small), the lender responds by increasing the interest rate, since recovering loans through collateral is less effective. The lender recognizes that a portion of the repayment is dissipated by the judicial process itself. On the other hand, when the collateral recovery rate is high (i.e., β is large), the lender focuses more on requiring collateral and accepts a lower interest rate, relying on the collateral to punish default. In a sense, collateralization also becomes attractive for high-risk entrepreneurs.

If judicial efficiency φ is below the threshold $\hat{\varphi}$, the lender optimally chooses to repossess the collateral in the event of default regardless of the status of the project, and thus, the borrower's repayment behavior depends on the amount of the collateral specified in the contract. The borrower repays their loan only if the value of the collateral exceeds their debt $(1+\rho)I$. Regardless of the borrower's default decision, the lender takes nearly all the surplus from the project ($pX_s - I$) minus the reservation utility of the borrower ($\bar{u}$): The collateral equals the gross return of the project to the borrower. Of course, this solution works only when W is sufficiently large.

We next present the equilibrium characteristics of the model and examine how the parameters discussed above influence the lending decisions, interest rates, and collateral requirements.

4.2.1 Default and Litigation in Successful Projects ($\varphi > \hat{\varphi}$)

This is the case where $\varphi > \hat{\varphi}$ when the project is successful. The lender's expected payoff is given by

$$V_l = p\varphi^2 R + (1-p)(\beta C) - I. \tag{6}$$

When equality holds, the subgame-perfect equilibrium is achieved when the expected interest rate

$$\iota = \frac{p\varphi^2 R + (1-p)\beta C - I}{I} \geq \bar{r}. \tag{7}$$

The borrower's expected payoff is given by

$$V_b = p(X_s - \varphi(2-\varphi)R) + (1-p)(-C) \geq \bar{u}, \tag{8}$$

where the parameter $\bar{u}$ denotes the expected utility demanded by the borrower.

Equation 8 will always be binding and hence can be rewritten to express the interest rate specified in the contract

$$\rho = \frac{pX_s - (1-p)C - \bar{u}}{p\varphi(2-\varphi)I} - 1. \tag{9}$$

The interest rate ρ decreases in φ. Hence, as the legal or factual situations increasingly favor the lender, the lower the interest rate required by the lender.

We now examine the set of feasible contracts and the equilibrium choice of collateral.

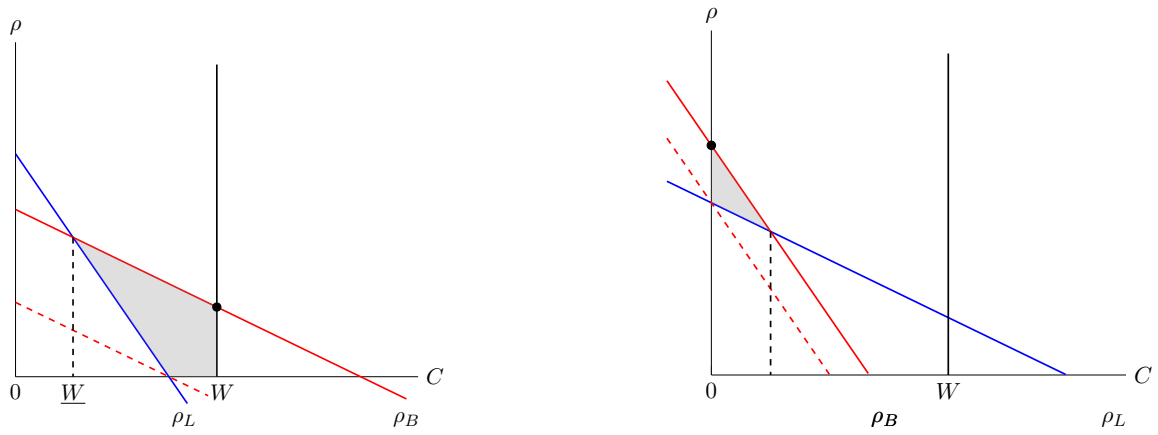
Lemma 1. *A feasible contract $\Gamma = (R, C)$ always exists when pX_s is sufficiently large.*

Proof. See Appendix A.3. □

The relative judicial efficiency (φ) and collateral recoverability (β) determine the set of feasible contracts. Figure 2 provides a graphical representation. The interest rate ρ can be expressed as a function of C by solving for ρ in the lender's and borrower's expected payoff conditions given in Equations (6) and (8). These constraints define the set of contract terms that satisfy both parties' participation conditions. The lender prefers any combination of (ρ, C) northeast to the ρ_L curve, and the borrower prefers anything southwest to the ρ_B curve. The shaded areas represent the set of contracts the lender and the borrower could agree upon. φ and β determine the relative slopes of the ρ_L and ρ_B curves, the feasible set of contracts, and ultimately the optimal contract signed in equilibrium.

By setting the slopes of ρ_L and ρ_B curves equal, we identify the threshold judicial efficiency φ at which the relative impact of legal enforcement versus collateral recovery on contract feasibility is balanced. This threshold allows us to extract pX_s for comparison, as stated in Lemma 1.

For the scenario illustrated in Figure 2a to hold, the condition $\hat{\varphi} < \varphi < \frac{2\beta}{\beta+1}$ must be satisfied. This condition can also be expressed as $\frac{\varphi}{2-\varphi} < \beta < \varphi^2(1+\rho)\frac{I}{C}$, which simplifies to $\varphi^2(1+\rho)\frac{I}{C} > \frac{\varphi}{2-\varphi}$.



(a) $\varphi < \frac{2\beta}{\beta+1}$ (b) $\varphi > \frac{2\beta}{\beta+1}$

Figure 2: The ρ-C space.

Hence we have $\varphi(2-\varphi)(1+\rho)\frac{I}{C} > 1$. Under this scenario, the interest rate ρ specified in the contract is likely high or the legal system operates with high efficiency. With a relatively high discount factor β, it is reasonable that the lender would rely more heavily on a higher amount of collateral.

For the scenario depicted in Figure 2b, the condition $\varphi > \hat{\varphi}$ and $\varphi > \frac{2\beta}{\beta+1}$. This translates to the condition $\beta < \min\{\frac{\varphi}{2-\varphi}, \varphi^2(1+\rho)\frac{I}{C}\}$. Given that $\varphi \in (0,1)$, unless the legal system is highly efficient and strongly favors the lender, the discount factor β will remain relatively low.

Assuming Equation 7 holds, the following result deals with the optimality of collateralization in this situation.

Proposition 1. *If judicial efficiency is relatively low (i.e., $\varphi < \frac{2\beta}{\beta+1}$) and collateralizable wealth W is limited, satisfying $pX_s - \bar{u} > W \geq W_{\min}$, then in equilibrium a contract Γ^* is signed such that $C^* = W$. The minimum collateralizable wealth required for lending, W_{min}, is given by $W_{\min} \equiv \frac{(\bar{r}+1)I + \frac{\varphi}{2-\varphi}\bar{u} - \frac{\varphi}{2-\varphi}pX_s}{(1-p)(\beta - \frac{\varphi}{2-\varphi})}$). If judicial efficiency is sufficiently high (i.e., $\varphi \geq \frac{2\beta}{\beta+1}$), it is optimal to set $C^* = 0$.*

Proof. See Appendix A.3. □

The lender's expected payoff in equilibrium when the borrower pledges full collateral $C^* = W$ is given by

$$V_l^* = \frac{\varphi}{2-\varphi}(pX_s - \bar{u}) + (1-p)(\beta - \frac{\varphi}{2-\varphi})W - I,$$

When the discount factor β is relatively high, i.e., $\beta > \frac{\varphi}{2-\varphi}$, the lender demands full collateral coverage and requires the borrower to pledge W. Despite requiring full collateral coverage, this condition can only be met if the borrower's collateralizable wealth W is sufficiently small ($W^{\min} \leq W < pX_s - \bar{u}$).

On the other hand, the lender's expected payoff in equilibrium when no collateral is pledged ($C^* = 0$) is

$$V_l^* = \frac{\varphi}{2-\varphi}(pX_s - \bar{u}) - I.$$

In this case, the lender chooses to go to court in response to a default, requiring the borrower to pledge no collateral and charges the interest rate ρ_0^* when $\beta < \frac{\varphi}{2-\varphi}$. Here, the discount factor β is relatively small since $\varphi^2(1 + \rho_0^* \frac{I}{C^*}) > \frac{\varphi}{2-\varphi}$ is always satisfied.

To flesh out the intuition, we discuss the mortgage loan interpretation of the model. During the subprime mortgage crisis, falling prices, combined with rising unemployment and resetting interest rates for adjustable mortgages, led to very high foreclosure rates. Foreclosures skyrocketed in 2007, peaked around 2010, and remained high in the years that followed.

We have a case of underwater collateral here. Mortgages were still given out even though there was essentially no recovery ($C^* = 0$) when the borrower experienced a significant income shock. Borrowers defaulted strategically even when they had kept their jobs (i.e., high income).[4] Investors still agreed to fund these mortgages even though the subprime-prime mortgage spread fell to historic lows during this period, which suggests that investors were not compensated for the additional ex-post risk. More broadly, lending in the absence of effective collateral recovery is consistent with the equilibrium outcome in Proposition 1: when judicial efficiency is sufficiently high, lending can be sustained without collateral, as the lender relies on judicial recovery rather than repossession.

In favorable economic conditions, for example, in many states, a lender may seek a deficiency judgement following judicial foreclosure, such that if the property sells for less than the outstanding loan balance, the borrower may still be liable for the remaining debt. The deficiency judgment

[4] Zingales (2010) suggests that strategic defaults accounted for a significant share of loan delinquencies during this period.

represents a form of judicial recovery beyond collateral repossession. During economic downturns, even as loan quality deteriorated, judicial oversight of foreclosures may have mitigated some of the predatory lending practices of the subprime era, such as issuing high-rate mortgages with a higher likelihood of default to lower-income and minority borrowers.

In both scenarios, stronger creditor protection improves the lender's welfare.

Corollary 1. *As judicial efficiency approaches full creditor protection (i.e., $\varphi \to 1$):*

(i) If the lender requires full collateral ($C^* = W$), the lender's expected payoff is given by:

$$V_l^* = \frac{\varphi}{2-\varphi}(pX_s - \bar{u}) - (1-p)(1-\beta)W.$$

(ii) If no collateral is required ($C^* = 0$), the lender's expected payoff is:

$$V_l^* = (pX_s - \bar{u}) - I.$$

Thus when judicial efficiency fully favors the lender, i.e., $\varphi \to 1$, the lender increasingly appropriates the surplus from lending and captures (nearly) all of the surpluses when lending occurs.

4.2.2 Repayment in Successful Projects ($\varphi \leq \hat{\varphi}$, $C \geq R$)

The borrower repays the loan only if the value of the collateral exceeds the debt when the lender decides to repossess the collateral. In this case, when the incentive constraint $C \geq R$ holds, a successful entrepreneur is better off paying R rather than defaulting. The expected payoff for the lender is

$$V_l = p(1+\rho)I + (1-p)\beta C - I \geq \bar{r}I. \tag{10}$$

The borrower's expected payoff V_b is expressed as

$$V_b = pX_s - p(1+\rho)I + (1-p)(-C) \geq \bar{u}. \tag{11}$$

Suppose the lender maximizes their expected payoff V_l subject to the conditions $C \leq W$ and $C \geq (1+\rho)I$, while also considering the borrower's individual rationality constraint $V_b \geq \bar{u}$. The optimal interest rate ρ^* and collateral C^* that maximize the lender's expected payoff are given by:

$$\rho^* = \frac{pX_s - \bar{u} - I}{I},$$
$$C^* = pX_s - \bar{u},$$

assuming $pX_s - u > W$. Here, the collateral C is set equal to the net return of the project to the borrower to incentivize repayment when the project succeeds. The lender's expected payoff in equilibrium is therefore

$$V_l^* = [p + (1-p)\beta](pX_s - \bar{u}) - I. \tag{12}$$

A high collateral requirement and the threat of repossession constitute a strong enforcement mechanism, inducing the borrower to fulfill contractual obligations. The lender's equilibrium return equals the gross return of the borrower, adjusted for the project's risk of failure and the collateral's enforcement, minus the cost of the project.

4.2.3 Default and Repossession in Successful Projects ($\varphi \leq \hat{\varphi}$, $C < R$)

When the value of the collateral is below R and the lender decides to repossess the collateral in the event of default ($\varphi \leq \hat{\varphi}$), the borrower responds by defaulting. The lender's expected payoff is thus

$$V_l = \beta C - I \geq \bar{r}I. \tag{13}$$

The borrower's expected payoff is

$$V_b = pX_s - C \geq \bar{u}. \tag{14}$$

The break-even level of collateral for the borrower, which maximizes the lender's expected payoffs, is therefore

$$C^* = pX_s - \bar{u}. \tag{15}$$

The collateral C^* in Equation 15 strictly increases in the expected return from the project pX_s. Substituting C^* into Equation 13 yields

$$V_l^* = \beta(pX_s - \bar{u}) - I \tag{16}$$

Hence, the lender's investment decision depends on the expected return from the project. The lender invests if and only if $pX_s \geq \frac{(1+\bar{r})I}{\beta}$.

Using the equilibrium collateral level C^*, the condition $C^* < (1+\rho)I$ must hold for this scenario to occur. This implies that:

$$pX_s - \bar{u} < (1+\rho)I,$$

meaning that the interest rate ρ^* in equilibrium satisfies:

$$\rho^* > \frac{pX_s - I}{I} - \frac{\bar{u}}{I}.$$

4.3 Expected Interest Rates for Lenders

Now that we have characterized the possible equilibrium outcomes, we are interested in how the lender's expected interest rate, $E(\rho)$, defined as $\frac{E(\rho)I-I}{I} = \frac{V_l^*}{I}$, varies with different parameters. In doing so, we introduce the general quality, or the profitability of the project with the ratio $\theta = \frac{pX_s-\bar{u}}{I}$, where $pX_s - \bar{u}$ represents the net return of the project for the entrepreneur. The following proposition summarizes the equilibrium behaviors of both parties and characterizes the lender's expected interest rate in equilibrium.

Proposition 2. *Suppose that the borrower's participation conditions in Equations 8, 11, and 14 hold. Then a failed project forces the borrower to default, and the lender forecloses on the collateral.*

(i) If the lender seeks to recover defaulted debt through the court system following a successful project and $C^* = 0$, then $E(\rho) = \frac{\varphi}{2-\varphi}\theta$, which increases in φ and θ;

(ii) If the lender enforces repayment through the court system following a successful project and $C^* = W$, then $E(\rho) = [\frac{\varphi}{2-\varphi}[\theta I - (1-p)W] + (1-p)\beta W]/I$, which increases with an improvement in φ, β, or θ;

(iii) If the borrower repays following a successful project, i.e., $C \geq R$, $E(\rho) = [p + (1-p)\beta]\theta$ *increases in either* β *or* θ*;*

(iv) If the borrower defaults following a successful project and the lender recovers the debt through repossession, i.e., $C < R$*, then* $E(\rho) = \beta\theta$ *increases in either* β *or* θ*.*

Proof. See Appendix A.3. □

This result is similar to what occurs in Jappelli et al. (2005), where under monopoly, an improvement in judicial efficiency raises average interest rates. In our setting, two mechanisms drive this effect: an increase in φ effectively increases the recoverable portion of debts in court, whereas an increase in β raises the pledgable portion of collateral. Both mechanisms allow the lender to extract a higher surplus by raising the expected interest rate $E(\rho)$.

Interestingly, the contractual interest rate ρ decreases as judicial efficiency improves when the lender enforces repayment through the courts. There exists a clear trade-off: the lender accepts a lower promised interest rate because a stronger legal system raises the odds of collecting that interest and imposes stronger punishment for default. More efficient courts effectively substitute legal protections for some of the interest rates that would otherwise compensate for default risk. This allows lower contract rates but higher effective returns.

5 Discussion: Equilibrium Lending and Credit Constraints

Figure 4 offers a graphical representation of the subgame-perfect equilibria discussed earlier, partitioning the (β, φ) space into regions that indicate the potential equilibrium outcomes, conditional on lending taking place. To ensure a meaningful context and economic relevance, we construct two representative levels of project quality, which we denote as low ($\theta = 0.25$) and high ($\theta = 1.25$). Lower-quality (riskier) projects generate lower expected interest rate and returns for the lender.

We first consider the case when the collateralizable wealth W is insufficient, i.e., $W < pX_s - \bar{u}$, where only court-based equilibria arise, as shown in Figures 4c and 4d. In these cases, the curve $\beta = \frac{\varphi}{2-\varphi}$ determines whether the lender demands full or zero collateral when resorting to legal actions. The lender requires full collateral coverage ($C^* = W$) when the judicial efficiency φ is sufficiently large while the collateral recovery rate β could be moderate. This results in a balance

between the expected returns from litigation when the project succeeds and the outcomes of non-judicial foreclosure when the project fails. On the other hand, if the collateral recovery rate is low enough, the lender foregoes any recovery through collateral and instead compensates by charging a higher interest rate.

Remark 1. *An improvement in either judicial efficiency (φ) or collateral recovery rate (β) reduces credit rationing.*

While improvements in judicial efficiency reduce credit rationing by expanding the set of profitable lending opportunities, the effect on borrowers' access to credit is less straightforward. To formalize this, we consider the minimum collateralizable wealth W_{min} required for the loan to be extended in Proposition 1.

Lemma 2. *Suppose $\varphi < \hat{\varphi} < \frac{2\beta}{\beta+1}$ and $C^* = W$, the effect of judicial efficiency on the minimum collateralizable wealth $W_{\min}$ satisfies:*

$$\frac{\partial W_{\min}}{\partial \varphi} \gtreqless 0 \quad \Longleftrightarrow \quad \beta\theta \lesseqgtr \bar{r} + 1.$$

Proof. See Appendix A.4. □

Lemma 2 says that improving judicial efficiency raises the minimum wealth requirement for credit access when $\beta\theta < \bar{r} + 1$, and lowers it otherwise. Recall that $\beta\theta$ is the gross return the lender would earn if lending were sustained entirely through collateral recovery, since β captures the fraction of collateral value the lender recovers and θ measures the project's quality. When $\beta\theta < \bar{r} + 1$, collateral recovery alone is insufficient to sustain lending, and no feasible contract with a non-negative contractual interest rate exists. When $\beta\theta > \bar{r} + 1$, collateral recovery on its own could sustain lending. An improvement in judicial efficiency more than compensates for the declining marginal contribution of collateral. Better courts expand the set of feasible contracts without requiring additional collateral, and $W_{\min}$ falls. We next examine how the feasible set of contracts changes overall as judicial efficiency improves.

Proposition 3. *Suppose* $\hat{\varphi} < \varphi < \frac{2\beta}{\beta+1}$ *and* $\beta\theta > \bar{r} + 1$. *For a borrower with collateralizable wealth* $W \geq W_{\min}(\varphi)$, *define the size of feasible contract as*

$$F = \int_{W_{\min}(\varphi)}^{W} \left[\rho_B(C, \varphi) - \rho_L(C, \varphi)\right] dC.$$

There exists a unique threshold $\hat{W(\varphi)} > W_{\min}(\varphi)$ *such that*

$$\frac{\partial F}{\partial \varphi} \gtrless 0 \iff W \lessgtr \hat{W}.$$

That is, an improvement in judicial efficiency expands the feasible set for wealth-constrained borrowers and contracts it for wealthy borrowers.

Proof. See Appendix A.4. □

The finding that better judicial efficiency may tighten the credit available to some borrowers is, at first glance, counterintuitive: one might expect better courts to relax borrowing constraints and expand lending. An improvement in judicial efficiency relaxes the minimum wealth requirement for credit access, bringing previously excluded borrowers into the market. At the same time, the range of contract terms that both parties can agree upon narrows. For wealthier borrowers, who already had comfortable access to credit, the narrowing of feasible contract terms dominates. Judicial reform makes courts a better substitute for collateral. Borrowers who relied on collateral (high W) lose their relative advantages, as the lender no longer needs as much collateral. Therefore, an improvement in judicial efficiency may disproportionately benefit more wealth-constrained borrowers, while wealthier borrowers might be excluded. In other words, judicial reform (an exogenous shock to judicial efficiency) can have unintended adverse effects on credit markets. Our result is consistent with Vig (2013), who finds that improvements in judicial efficiency (through improved creditor rights) led to reductions in secured debt, total debt, and debt maturity, with effects more pronounced for firms with a higher proportion of tangible assets.

Figure 3 provides a graphical example of the effect of an exogenous improvement in judicial efficiency on the $\rho - C$ space. The solid lines represent the ρ_L and ρ_B curves at the initial level of judicial efficiency φ_0. The dashed lines represent the corresponding ρ'_L and ρ'_B curves after

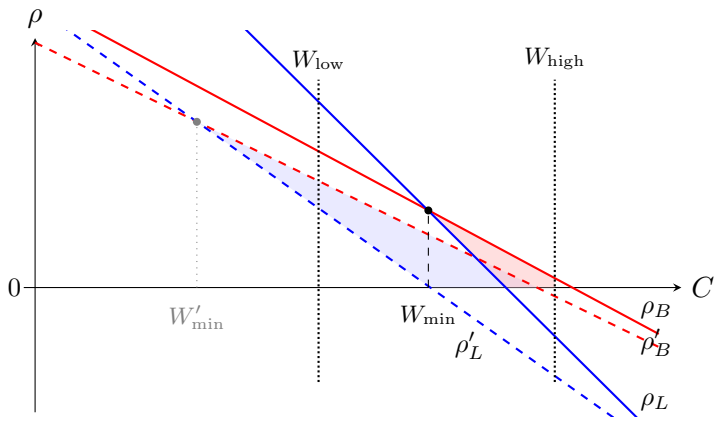
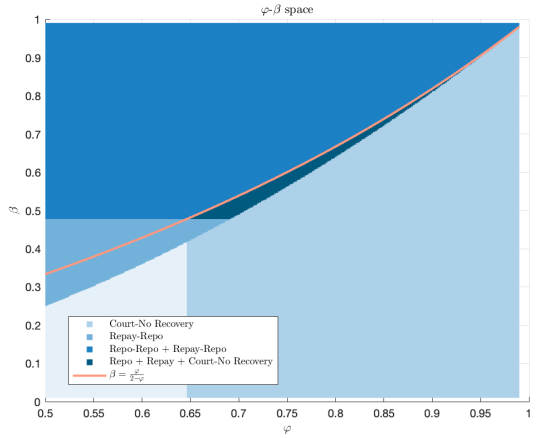


Figure 3: Example of an Exogenous Shock to Judicial Efficiency

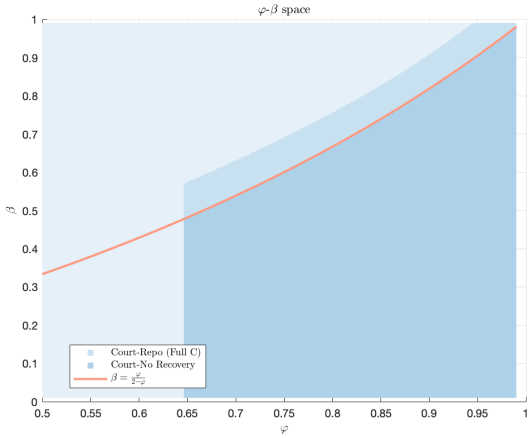
the improvement to φ', where $\varphi' > \varphi_0$. An increase in judicial efficiency shifts both ρ_L and ρ_B curves inwards, and the minimum collateralizable wealth requirement decreases from W_{min} to W'_{min}, expanding credit access to wealth-constrained borrowers. The blue-shaded area represents the set of feasible contracts under post-shock judicial efficiency φ'. A borrower at W_{low} was previously excluded from the credit market, but now has access to some contracts. A borrower at W_{high}, with a pre-shock feasible set shown in red, is now excluded from the credit market.

Next, we examine the case when W is sufficiently large ($W \geq pX_s - \bar{u}$), where different types of equilibrium outcomes—repossession, repayment, and court action—are possible, as depicted in Figures 4a and 4b. In this case, the equilibrium involving full collateral coverage is excluded, as W is constrained between W_{min} and $p(X_s - \bar{u})$ and must remain relatively modest.

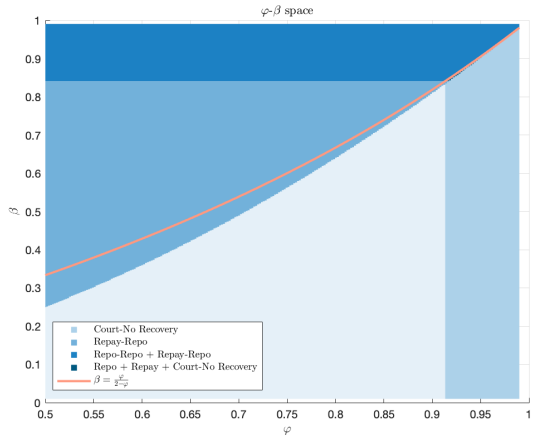
The intuition is as follows. If the borrower must pledge too much collateral, they are more likely to repay the loan rather than default. In the case of repossession following a successful project, the minimum collateral recovery rate β increases as judicial efficiency φ rises. When the borrower defaults and disputes the lender's claim, a higher judicial efficiency – and thus a greater winning probability in court for the lender – requires the collateral recovery to be low enough for the option of non-judicial foreclosure to be unattractive. Hence, the relative judicial inefficiency drives the lender's preference for repossession in the case of success. This scenario only happens, of course, when the required amount of the collateral does not exceed the borrower's debt. As long as $C \geq (1 + \rho)I$, the lender's threat of resorting to non-judicial foreclosure effectively induces the successful entrepreneur to pay their debts.



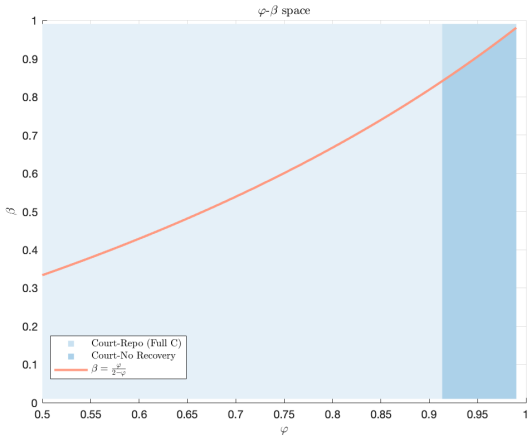
(a) High Quality, Sufficient W



(c) High Quality, Insufficient W



(b) Low Quality, Sufficient W



(d) Low Quality, Insufficient W

Figure 4: Equilibrium Outcome Regions: φ-β space

Note: The profitability or quality of the project is measured by $\theta = \frac{pX_s - \bar{u}}{I}$. A sufficiently high collateralizable wealth W implies that $W > pX_s - \bar{u}$, ensuring the borrower has enough assets to cover the required collateral in equilibrium.
Source: Author's calculation.

Lastly, we consider the effects of project quality. As project quality θ increases, the regions in which lending does not occur and credit is constrained shrink. For lower-quality projects, improvements in judicial efficiency can convert otherwise loss-making loans into viable ones, given that the lender decides to take legal action against defaulting borrowers. Since the portion of the payment dissipated by the judicial process—due to legal fees, bribes, and other costs—diminishes, the borrower's ability to exploit costly enforcement mechanisms is weakened. Indeed, less costly judicial foreclosure or easier collateral repossession likely enables the provision of riskier loans (Milonas 2017). Instead, if the lender optimally chooses to repossess the collateral when the successful entrepreneur defaults, a more efficient collateral recovery increases the likelihood of lending.

Remark 2. *Higher project quality* (θ) *reduces credit constraint. However, repayment following a successful project remains a stable equilibrium outcome whenever the collateral pledged by the borrower exceeds the repayment obligation* ($C > R$)*, regardless of project quality.*

The only equilibrium outcome unaffected by project quality θ is when the borrower repays the loan following a successful project. Collateralization remains a stable repayment incentive, provided the collateral exceeds the outstanding debt.

When θ is low, non-judicial foreclosure becomes a more important mechanism for enforcing contracts. As project quality decreases, it becomes difficult for the lender to rely on judicial recovery to protect their claims, though equilibria involving repossession after a successful project are less affected by the declining quality. In such cases, lenders mitigate risk through collateral, shielding themselves from losses if the borrowers default.

6 The Role of Reputation in Strategic Defaults

We extend the court equilibrium in Section 4.2.1 by introducing a simple default penalty $d \geq 0$. The parameter d is commonly known at the time of contracting and can be interpreted as an informal, social, or market-based enforcement mechanism that represents reputational damage, credit score deterioration, or exclusion from future lending.

The penalty is incurred upon default, regardless of the lender's choice of enforcement mechanisms and project outcome. In the event of default following a successful project, the equilibrium

efforts in litigation and the lender's payoff following default remain as in Equation 4. The borrower's equilibrium payoff becomes

$$V_{b,s}^{c} = X_s - I - \varphi(2-\varphi)R - d. \tag{17}$$

The borrower compares the payoff from repayment, $X_s - R - I$, with the payoff from defaulting and subsequent litigation, and repays if and only if

$$d \geq R\big[1-\varphi(2-\varphi)\big] = R(1-\varphi)^2. \tag{18}$$

Lemma 3. *Let $\hat{d}(\varphi) \equiv R(1-\varphi)^2$. The borrower defaults if $d < \hat{d}(\varphi)$ and repays if $d \geq \hat{d}(\varphi)$, and*

(i) $\hat{d}(\varphi)$ is strictly decreasing and convex in φ;

(ii) For any $d \in [R(1-\varphi)^2, R)$, neither the threat of litigation alone nor the default penalty alone is sufficient to deter default.

Lemma 3 establishes that while judicial efficiency and default penalty are *substitutes*, formal legal enforcement and reputation are *partial complements* in sustaining repayments. For intermediate values of d, the penalty deters default only because judicial enforcement makes default sufficiently costly. More broadly, this complementarity resembles institutional settings such as debt restructuring, where informal coordination among creditors similarly depends on the shadow of formal legal enforcement to bind strategic holdouts.

We focus on the case where $d \geq \hat{d}(\varphi)$, in which the borrower repays upon a successful project, and the penalty is incurred only if the project fails. The lender's expected payoff remains as in Equation 11. The borrower's expected payoff is given by

$$V_b = pX_s - p(1+\rho)I + (1-p)(-C-d) \geq \bar{u}. \tag{19}$$

Lending occurs if the lender's expected payoff exceeds the opportunity cost of investment, $V_l^* \geq \bar{r}I$. The following proposition characterizes the equilibrium contract.

Proposition 4. *Suppose $\phi > \hat{\phi}$ and $d \geq \hat{d}(\varphi)$. Then a equilibrium contract Γ^* is signed such that $C^* = 0$, with optimal interest rate $\rho^* = \frac{pX_s - (1-p)d - \bar{u}}{pI} - 1$.*

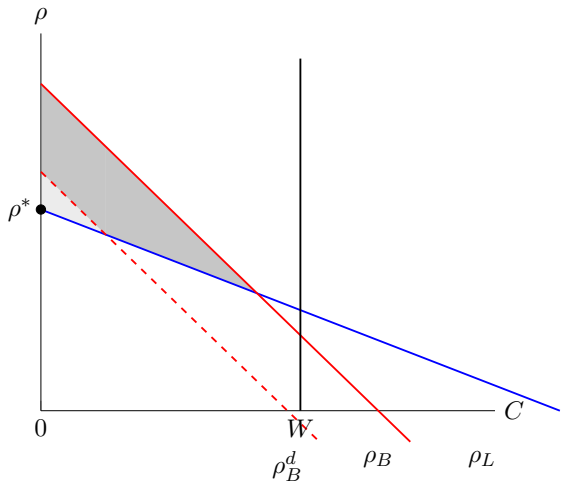


Figure 5: The ρ-C space with default penalty d.

The lender's expected payoff in equilibrium is therefore

$$V_l^* = pX_s - \bar{u} - (1-p)d - I, \tag{20}$$

The equilibrium collateral $C^* = 0$ holds regardless of judicial efficiency, φ, and collateral recovery, β. Once the default penalty is sufficient to deter strategic default, collateral serves only as partial insurance against project failure. However, collateral is often inefficient because liquidation is costly, with the lender recovering only a fraction $\beta < 1$ of the pledged value. As a result, the lender forgoes collateral and instead charges a higher interest rate.

Reliance on informal enforcement mechanisms, however, has its own cost. When the project fails and the borrower defaults involuntarily, the penalty d is still incurred; that is, the borrower's reputation is damaged even in the absence of strategic default. The borrower prices in this expected loss and, at the contracting stage, requires more favorable loan terms to compensate for it. Figure 5 illustrates the set of feasible contracts when a default penalty is present. The penalty shifts the borrower's participation constraint inward from ρ_B to ρ_B^d. The slope of the ρ_L curve is $-\frac{(1-p)\beta}{pI}$ and the slope of ρ_B^d is $-\frac{(1-p)}{pI}$. Thus, the slope of p_B^d is necessarily steeper than that of ρ_L. The set of feasible contracts shrinks as the default penalty gets larger. The darker-shaded area represents the loss of surplus resulting from the penalty.

Proposition 5. *Suppose $\phi > \hat{\phi}$ and the borrower's participation constraint in Equation 19 holds. An increase in the default penalty d strictly decreases the contractual interest rate ρ^*, and the lender's expected interest rate $E(\rho)$.*

The default penalty d reduces both the contractual interest rate and the lender's expected interest rate. This result contrasts with the effect of judicial efficiency, where a higher φ lowers the contractual rate but raises the expected rate by improving the lender's recovery in court. The difference is that judicial efficiency increases the lender's recovery, whereas a higher default penalty does not. Instead, once repayment is already induced, a further increase in d only tightens the borrower's participation constraint and forces the lender to offer better terms. This creates a tension in the lender's preferences over the default penalty. The lender benefits from the penalty insofar as it deters strategic default and avoids costly dissipation in litigation. Any further increase in d reduces the lender's payoff without any additional benefit. The lender thus prefers the penalty to be just large enough to sustain repayment.

7 Concluding Remarks

We propose a model of bilateral lending and show how judicial efficiency and collateral recoverability can affect the choice between judicial recovery and non-judicial foreclosure by explicitly modeling these two enforcement mechanisms. We find that when collateralizable wealth is limited, lenders may prefer court-based recovery, especially if judicial efficiency is high. However, when collateral is sufficient, multiple outcomes are possible, and lenders' preferences for repossession or legal action are based on the balance between the collateral recovery rate and judicial efficiency. Higher judicial efficiency and more efficient collateral recovery increase lenders' expected interest rates. Improvements in judicial efficiency, however, have uneven effects on credit availability. This result implies that judicial reforms could risk excluding borrowers with high collateralizable wealth, while benefiting less well-off borrowers. We further examine the role of informal enforcement mechanisms and find that formal and informal enforcement are complementary in deterring opportunistic defaults. These results have broader implications for the design of legal and institutional frameworks, and emphasize the interdependence between formal and informal enforcement, between judicial reform

and collateral recovery, and between aggregate lending efficiency and distributional equity in credit access.

Our analysis also highlights that environments with pronounced institutional biases in contract enforcement may see increased conflict through court actions, while more balanced systems can foster smoother interactions, where legal conflicts are less frequent. While rational litigants with complete information would avoid the costs and risks of trial by settling out of court, there are many circumstances where litigation may be preferable (Priest and Klein 1984; Reinganum and Wilde 1986; Kiser et al. 2008; McBride et al. 2018). One significant reason for the breakdown of ex-post bargaining is when one party perceives a substantial advantage in court due to asymmetries in bargaining power or legal strength (Schaller and Skaperdas 2020). More broadly, institutional frameworks that strongly favor either creditors or borrowers — particularly through foreclosure laws and creditor-borrower protection rules — can substantially influence dispute resolution outcomes.

We recognize that the model is missing some important features that affect both borrowers and lenders. For example, the borrower has no equity in the project, which increases the likelihood of strategic default. The structure of debt arrangements plays a crucial role in mitigating the risks associated with lending. In syndicated loan markets, lenders form larger and more diffuse syndicates as a strategy to deter strategic defaults when legal enforcement mechanisms are insufficient to protect their claims (Esty and Megginson 2003). For bilateral loans, although the debt structure can be much simpler, the underlying principle should remain consistent: stronger protection of creditor rights and dependable legal enforcement should incentivize lenders to maintain smaller equity positions. This confidence stems from reduced fears of strategic default and the associated costly disputes.

References

Acemoglu, Daron and Simon Johnson (2005) "Unbundling Institutions," *Journal of Political Economy*, Vol. 113, No. 5, pp. 949–995.

Apergis, Nicholas and Dimitris Voliotis (2016) "Mood effects in optimal debt contracts," *Journal of Behavioral and Experimental Finance*, Vol. 10, pp. 50–53.

Argenton, C. and X. Wang (2023) "Litigation and settlement under loss aversion," *European Journal of Law and Economics*, Vol. 56, pp. 369–402.

Bae, Kee-Hong and Vidhan K. Goyal (2009) "Creditor Rights, Enforcement, and Bank Loans," *The Journal of Finance*, Vol. 64, No. 2, pp. 823–860.

Barro, Robert J. (1976) "The Loan Market, Collateral, and Rates of Interest," *Journal of Money, Credit and Banking*, Vol. 8, No. 4, pp. 439–456.

Battigalli, Pierpaolo and Martin Dufwenberg (2007) "Guilt in Games," *American Economic Review*, Vol. 97, No. 2, pp. 170–176.

Benczúr, Péter and Cosmin L. Ilut (2016) "Evidence for Relational Contracts in Sovereign Bank Lending," *Journal of the European Economic Association*, Vol. 14, No. 2, pp. 375–404.

Benjamin, Daniel K. (1978) "The Use of Collateral to Enforce Debt Contracts," *Economic Inquiry*, Vol. 16, No. 3, pp. 333–359.

Berger, A.N., M.A. Espinosa-Vega, W.S. Frame, and N.H. Miller (2010) "Why do borrowers pledge collateral? New empirical evidence on the role of asymmetric information," *Journal of Financial Intermediation*, Vol. 19, No. 3, pp. 308–332.

Bester, Helmut (1994) "The Role of Collateral in a Model of Debt Renegotiation," *Journal of Money, Credit and Banking*, Vol. 26, No. 1, pp. 72–86.

Brown, Martin and Marta Serra-Garcia (2017) "The Threat of Exclusion and Implicit Contracting," *Management Science*, Vol. 63, No. 12, pp. 4081–4100.

Carroll, James and Fergal McCann (2017) "SME Collateral: Risky Borrowers or Risky Behaviour?" Research Technical Papers 06/RT/17, Central Bank of Ireland.

Chan, Yuk-Shee and George Kanatas (1985) "Asymmetric Valuations and the Role of Collateral in Loan Agreements," *Journal of Money, Credit and Banking*, Vol. 17, No. 1, pp. 84–95.

Chang, Yun-chien and Daniel Klerman (2022) "Settlement around the World: Settlement Rates in the Largest Economies," *Journal of Legal Analysis*, Vol. 14, No. 1, pp. 80–175.

Dagher, Jihad and Yangfan Sun (2016) "Borrower Protection and the Supply of Credit: Evidence from Foreclosure Laws," *Journal of Financial Economics*, Vol. 121, No. 1, pp. 195–209.

Delrossi, Alison F. and Owen R. Phillips (1999) "Pretrial Bargaining in the Face of a Random Court Decision: Evidence from Laboratory Games," *Journal of Risk and Uncertainty*, Vol. 18, No. 3, pp. 271–293.

Djankov, Simeon, Oliver Hart, Caralee McLiesh, and Andrei Shleifer (2008) "Debt Enforcement around the World," *Journal of Political Economy*, Vol. 116, pp. 1105–1149.

Djankov, Simeon, Rafael La Porta, Florencio Lopez-de Silanes, and Andrei Shleifer (2003) "Courts," *The Quarterly Journal of Economics*, Vol. 118, No. 2, pp. 453–517, DOI: 10.1162/003355303321675437.

Djankov, Simeon, Caralee McLiesh, and Andrei Shleifer (2007) "Private Credit in 129 Countries," *Journal of Financial Economics*, Vol. 84, No. 2, pp. 299–329.

Duygan-Bump, Burcu and Charles Grant (2009) "Household Debt Repayment Behaviour: What Role Do Institutions Play?" *Economic Policy*, Vol. 24, No. 57, pp. 108–140.

Esty, Benjamin C and William L Megginson (2003) "Creditor Rights, Enforcement, and Debt Ownership Structure: Evidence from the Global Syndicated Loan Market," *Journal of Financial and Quantitative Analysis*, Vol. 38, No. 1, pp. 37–60.

Feinstein, Brian D. (2018) "Judging Judicial Foreclosure," *Journal of Empirical Legal Studies*, Vol. 15, No. 2, pp. 406–451.

Gerardi, Kristopher, Lauren Lambie-Hanson, and Paul S. Willen (2013) "Do Borrower Rights Improve Borrower Outcomes? Evidence from the Foreclosure Process," *Journal of Urban Economics*, Vol. 73, No. 1, pp. 1–17.

Gropp, Reint, John Karl Scholz, and Michelle J White (1997) "Personal Bankruptcy and Credit Supply and Demand," *The Quarterly Journal of Economics*, Vol. 112, No. 1, pp. 217–251.

Hart, Oliver and John Moore (1998) "Default and Renegotiation: A Dynamic Model of Debt," *The Quarterly Journal of Economics*, Vol. 113, No. 1, pp. 1–41.

Haselmann, Rainer, Katharina Pistor, and Vikrant Vig (2010) "How Law Affects Lending," *The Review of Financial Studies*, Vol. 23, No. 2, pp. 549–580, DOI: 10.1093/rfs/hhp073.

Hvide, Hans K. and Tore E. Leite (2010) "Optimal debt contracts under costly enforcement," *Economic Theory*, Vol. 44, pp. 149–165.

Jappelli, Tullio, Marco Pagano, and Magda Bianco (2005) "Courts and banks: Effects of judicial enforcement on credit markets," *Journal of Money, Credit and Banking*, pp. 223–244.

Johnson, Simon, Rafael La Porta, Florencio Lopez-de Silanes, and Andrei Shleifer (2000) "Tunneling," *American Economic Review*, Vol. 90, No. 2, pp. 22–27.

Kahn, Charles M. and Abdullah Yavaş (1994) "The Economic Role of Foreclosures," *The Journal of Real Estate Finance and Economics*, Vol. 8, pp. 35–51.

Karlan, Dean S. (2005) "Using Experimental Economics to Measure Social Capital and Predict Financial Decisions," *American Economic Review*, Vol. 95, No. 5, pp. 1688–1699.

Kiser, R. L., M. A. Asher, and B. B. McShane (2008) "Let's Not Make a Deal: An Empirical Study of Decision Making in Unsuccessful Settlement Negotiations," *Journal of Empirical Legal Studies*, Vol. 5, No. 3, pp. 551–591.

Kiyotaki, Nobuhiro and John Moore (1997) "Credit Cycles," *Journal of Political Economy*, Vol. 105, No. 2, pp. 211–248.

La Porta, Rafael, Florencio Lopez-de Silanes, Andrei Shleifer, and Robert W Vishny (1998) "Law and Finance," *Journal of Political Economy*, Vol. 106, No. 6, pp. 1113–1155.

Laeven, Luc and Giovanni Majnoni (2005) "Does Judicial Efficiency Lower the Cost of Credit?" *Journal of Banking & Finance*, Vol. 29, No. 7, pp. 1791–1812.

McBride, Michael, Stergios Skaperdas, and Pi-Han Tsai (2018) "Why go to court? Bargaining failure under the shadow of trial with complete information," *European Journal of Political Economy*, Vol. 55, No. C, pp. 151–168.

Milonas, Kristoffer (2017) "The Effect of Foreclosure Laws on Securitization: Evidence from US States," *Journal of Financial Stability*, Vol. 33, pp. 1–22.

Moro, Andrea, Daniela Maresch, and Annalisa Ferrando (2018) "Creditor Protection, Judicial Enforcement and Credit Access," *The European Journal of Finance*, Vol. 24, No. 3, pp. 250–281.

Müller, Karsten (2022) "Busy Bankruptcy Courts and the Cost of Credit," *Journal of Financial Economics*, Vol. 143, No. 2, pp. 824–845.

Niblett, A. and A.H. Yoon (2017) "Unintended Consequences: The Regressive Effects of Increased Access to Courts," *Journal of Empirical Legal Studies*, Vol. 14, pp. 5–30.

Pew Research Center, Washington D.C. (2020) "How Debt Collectors Are Transforming the Business of State Courts," URL: https://www.pewtrusts.org/en/research-and-analysis/reports/2020/05/how-debt-collectors-are-transforming-the-business-of-state-courts.

Pinheiro, Armando Castelar and Celia Cabral (1999) "Credit Markets in Brazil: The Role of Judicial Enforcement and Other Institutions," Working Paper.

Priest, George L. and Benjamin Klein (1984) "The Selection of Disputes for Litigation," *Journal of Legal Studies*, Vol. 13, pp. 1–55.

Qian, Jun and Philip E. Strahan (2007) "How Laws and Institutions Shape Financial Contracts: The Case of Bank Loans," *The Journal of Finance*, Vol. 62, No. 6, pp. 2803–2834.

Reinganum, Jennifer and Louis Wilde (1986) "Settlement, Litigation, and the Allocation of Litigation Costs," *Rand Journal of Economics*, Vol. 17, pp. 557–568.

Robson, Alex and Stergios Skaperdas (2008) "Costly Enforcement of Property Rights and the Coase Theorem," *Economic Theory*, Vol. 36, pp. 109–128.

Schaller, Zachary and Stergios Skaperdas (2020) "Bargaining and Conflict with Up-Front Investments: How Power Asymmetries Matter," *Journal of Economic Behavior & Organization*, Vol. 176, pp. 212–225.

Serra-Garcia, Marta (2010) "Moral Hazard in Credit Markets: The Incentive Effect of Collateral," Economics Workshop in Tilburg University, Netherlands.

Shapiro, Martin (1986) *Courts: A Comparative and Political Analysis*: University of Chicago Press.

Skaperdas, Stergios and Samarth Vaidya (2012) "Persuasion as a Contest," *Economic Theory*, Vol. 51, No. 2, pp. 465–486.

Stiglitz, Joseph E. and Andrew Weiss (1981) "Credit Rationing in Markets with Imperfect Information," *The American Economic Review*, Vol. 71, No. 3, pp. 393–410.

Vig, Vikrant (2013) "Access to Collateral and Corporate Debt Structure: Evidence from a Natural Experiment," *The Journal of Finance*, Vol. 68, No. 3, pp. 881–928.

White, Michelle J (1998) "Why it Pays to File for Bankruptcy: A Critical Look at the Incentives under US Personal Bankruptcy Law and a Proposal for Change," *The University of Chicago Law Review*, Vol. 65, No. 3, pp. 685–732.

Yang, Erya (2020) "Optimism and pessimism in bargaining and contests," *International Review of Law and Economics*, Vol. 64, p. 105935.

Zazzaro, Alberto (2005) "Should Courts Enforce Credit Contracts Strictly?" *The Economic Journal*, Vol. 115, No. 500, pp. 166–184.

Zingales, Luigi (2010) "The Menace of Strategic Default," *City Journal*, Vol. 20, No. 2, pp. 47–51.

A Appendix

A.1 Materials for Section 3

When the lender decides to go to court, the risky prospect for the lender in a successful project scenario is represented as $Y_L^s = (R-(1-\alpha)I, -(1-\alpha)I; q, 1-q)$, and in the event of project failure, as $Y_L^f = (\beta C-(1-\alpha)I, -(1-\alpha)I; q, 1-q)$. For the borrower, the prospects in a successful project are denoted as $Y_B^s = (X_s - R - \alpha I, X_s - \alpha I; q, 1-q)$ and in a failed project as $Y_B^f = (-C-\alpha I, -\alpha I; q, 1-q)$, respectively.

Assume both parties have to pay their own legal costs. Let δ be the fraction of the additional cost of actually going to court, then the expected payoffs when the project is a success are:

$$\begin{aligned} V_{l,s}^{\prime c} &= q[R-I] + (1-q)[-I] - (1+\delta)e_l \\ V_{b,s}^{\prime c} &= q(X_s - R - I) + (1-q)(X_s - I) - (1+\delta)e_b \end{aligned} \tag{A1}$$

The first-order conditions (FOC) implies

$$\begin{aligned} \frac{e_b(\varphi(1-\varphi))}{(\varphi e_l + (1-\varphi)e_b)^2}(R) - (1+\delta) = 0, \\ -\frac{e_l(\varphi(1-\varphi))}{(\varphi e_l + (1-\varphi)e_b)^2}(-R) - (1+\delta) = 0, \end{aligned} \tag{A2}$$

and gives the equilibrium condition of efforts

$$\frac{e_b}{e_l} = 1. \tag{A3}$$

Let e_l^c and e_b^c represent the equilibrium efforts of the lender and the borrower, respectively, when opting for court litigation. The efforts and expected payoffs are as follows:

$$
\begin{aligned}
e_b^c = e_l^c &= \frac{\varphi(1-\varphi)R}{(1+\delta)};\\
V_{l,s}^c &= -I + \varphi^2 R,\\
V_{b,s}^c &= X_s - I - \varphi(2-\varphi)R.
\end{aligned}
\tag{A4}
$$

A.2 The Case of Judicial Foreclosure

In the event of a project failure, the borrower is forced to default on the specified repayment of R. If the borrower voluntarily surrenders the collateral, the lender receives βC. The borrower is left with no assets. If the lender resorts to judicial foreclosure, the expected payoffs in court are:

$$
\begin{aligned}
V_{l,f}^c &= q(\beta C - I) + (1-q)(-I) - (1+\delta)e_l,\\
V_{b,f}^c &= q(-C - I) + (1-q)I - (1+\delta)e_b.
\end{aligned}
\tag{A5}
$$

Equating the two FOCs for the equilibrium efforts gives the equilibrium condition

$$
\frac{e_b}{e_l} = \frac{C}{\beta C} = \frac{1}{\beta} > 1. \tag{A6}
$$

A borrower who chooses to default must exert greater effort than the lender, in an attempt to secure a payoff exceeding their entitled share as outlined in the contract. This is equivalent to a winner-take-all contest with asymmetric valuations. The efforts and expected payoffs are as follows:

$$
\begin{aligned}
e_{l,f}^c &= \frac{\varphi(1-\varphi)C}{[\varphi + (1-\varphi)\frac{1}{\beta}]^2(1+\delta)},\ \ e_{b,f}^c = \frac{\varphi(1-\varphi)\frac{C}{\beta}}{[\varphi + (1-\varphi)\frac{1}{\beta}]^2(1+\delta)};\\
V_{l,f}^c &= -I + \frac{\varphi^2}{[\varphi + (1-\varphi)\frac{1}{\beta}]^2}\beta C,\\
V_{b,f}^c &= -I - \frac{\varphi^2 + 2\varphi(1-\varphi)\frac{1}{\beta}}{[\varphi + (1-\varphi)\frac{1}{\beta}]^2}C.
\end{aligned}
\tag{A7}
$$

In the final stage, the lender must choose between repossession and judicial foreclosure when facing a defaulting borrower. For the lender to prefer repossession over court action, the following conditions must be satisfied:

$$\frac{\varphi^2}{[\varphi+(1-\varphi)\frac{1}{\beta}]^2}\beta C \leq \beta C$$

It is straightforward to show that $\frac{\varphi^2}{[\varphi+(1-\varphi)\frac{1}{\beta}]^2}\beta C \in (0, \beta C)$ is monotonically increasing and convex in φ. Therefore, the lender repossesses the collateral C when the borrower defaults.

In fact, given any fixed cost of repossession $f > 0$ that is sufficiently small relative to βC, the lender always favors repossession in the event of a default when the project fails. Note that a sufficiently small f can be interpreted as the cost associated with obtaining a court order granting access to the collateral, which occurs when $\varphi \to 1$.

In stage three, regardless of the lender's decision in the final stage, the borrower lacks liquid assets to repay and is thus forced to default.

A.3 Materials for Section 4

Proof for Lemma 1. We can derive the interest rate ρ as a function of C, given the values of other parameters, from the expected payoffs V_l and V_b, respectively:

$$\rho_L = \frac{(\bar{r}+1)I - (1-p)(\beta C)}{p\varphi^2 I} - 1,$$
$$\rho_B = \frac{pX_s - (1-p)C - \bar{u}}{p\varphi(2-\varphi)I} - 1.$$

For any $\rho(C)$ to be acceptable to both parties, it must satisfy $0 < \rho_L < \rho(C) < \rho_B$.

If $\varphi = \frac{2\beta}{\beta+1}$, a feasible contract $\Gamma = (R, C)$ exists when

$$pX_s \geq \frac{(1+\bar{r})I}{\beta} + \bar{u}.$$

When $\varphi < \frac{2\beta}{\beta+1}$, the slope of ρ_L is larger than the slope of ρ_B. Setting $\rho = 0$ yields $C_b(0) = \frac{pX_s - \bar{u} - p\varphi(2-\varphi)I}{1-p}$ and $C_l(0) = \frac{(1+\bar{r}-p\varphi^2)I}{(1-p)\beta}$.

As seen in Figure 2a, the lender prefers any combination of (ρ, C) northeast to the ρ_L curve, and the borrower prefers anything southwest to the ρ_B curve. A feasible set of $\Gamma = (R, C)$ exists if and only if $C_b(0) \geq C_l(0)$, that is,

$$pX_s \geq (\frac{(1+\bar{r}-p\varphi^2)I}{\beta} + \bar{u} + \varphi(2-\varphi)pI.$$

When $\varphi > \frac{2\beta}{\beta+1}$, the slope of ρ_l is smaller than the slope of ρ_b. A feasible set of $\Gamma = (R, C)$ exists if and only if the intercept of ρ_b is larger than that of ρ_l, as shown in Figure 2b. This condition can be rewritten as

$$pX_s \geq \frac{2-\varphi}{\varphi}(\bar{r}+1)I + \bar{u}.$$

□

Proof for Proposition 1. As a result of competition, Γ^* maximizes the lender's expected payoff, subject to the borrower's break-even constraints. Equation 9 defines the break-even interest rate ρ charged to the borrower. Substituting ρ in Equation 6 yields

$$V_l = \frac{\varphi}{2-\varphi}(pX_s - \bar{u}) + (1-p)(\beta - \frac{\varphi}{2-\varphi})C - I \geq \bar{r}I. \tag{A8}$$

As a result, maximizing the lender's payoff with respect to C implies $C^* = W$ given that $\varphi < \dfrac{2\beta}{\beta+1}$ and the corresponding interest rate

$$\rho_W^* = \frac{pX_s - (1-p)W - \bar{u}}{p\varphi(2-\varphi)I} - 1. \tag{A9}$$

When the lender requires the borrower's entire collateralizable wealth W as collateral, the borrower will be credit-rationed if the collateral is insufficient to fully shield the lender against losses in the event of project failure. As a result, when $\dfrac{\varphi}{2-\varphi} < \beta$ and ρ_W is charged to the borrower, it must hold that $\frac{\varphi}{2-\varphi}(pX_s - \bar{u}) + (1-p)(\beta - \frac{\varphi}{2-\varphi})W - I \geq \bar{r}I$. The inequality implies that

$$W \geq \frac{(\bar{r}+1)I + \frac{\varphi}{2-\varphi}\bar{u} - \frac{\varphi}{2-\varphi}pX_s}{(1-p)(\beta - \frac{\varphi}{2-\varphi})} \equiv W_{\min}. \tag{A10}$$

From Lemma 1, this equilibrium scenario holds if and only if $\hat{\varphi} < \varphi < \frac{2\beta}{\beta+1}$. Rewriting this condition, we obtain $\frac{\varphi}{2-\varphi} < \beta < \frac{\varphi^2(1+\rho)I}{C}$. For this condition to hold, it must be that $\frac{\varphi}{2-\varphi} < \frac{\varphi^2(1+\rho)I}{C}$. Substituting the equilibrium collateral $C^* = W$ and the corresponding equilibrium interest rate ρ^*_W in Equation A9, we obtain:

$$W > pX_s - \bar{u}.$$

If instead $\varphi \geq \dfrac{2\beta}{\beta+1}$, then maximizing the lender's payoff with respect to C gives $C^* = 0$ with the corresponding interest rate

$$\rho^*_0 = \frac{pX_s - \bar{u}}{p\varphi(2-\varphi)I} - 1. \tag{A11}$$

□

Proof for Proposition 2. We first consider the case where the lender recovers debts through the court system. When $C^* = 0$, the expected interest rate $E(\rho)$ is defined to be

$$E(\rho) = \frac{\varphi}{2-\varphi}\frac{pX_s - \bar{u}}{I} = \frac{\varphi}{2-\varphi}\theta. \tag{A12}$$

Taking derivatives with respect to φ and θ:

$$\begin{aligned}
\frac{\partial E(\rho)}{\partial \varphi} &= \frac{2}{(2-\varphi)^2}\frac{pX_s - \bar{u}}{I} > 0, \\
\frac{\partial E(\rho)}{\partial \theta} &= \frac{2}{2-\varphi} > 0.
\end{aligned}$$

The first derivative is positive as a direct result of the borrower's individually rational constraint in Equation 8.

For part (ii) of Propositon 2, let $C^* = W$, then the expected interest rate $E(\rho)$ becomes

$$\begin{aligned}
E(\rho) &= \frac{\varphi}{2-\varphi}[(pX_s - \bar{u}) - (1-p)(\beta - \frac{\varphi}{2-\varphi})W]/I \\
&= [\frac{\varphi}{2-\varphi}[\theta I - (1-p)W] + (1-p)\beta W]/I
\end{aligned} \tag{A13}$$

This is straightforwardly increasing in β and θ.

Differentiating with respect to φ:

$$\frac{\partial E(\rho)}{\partial \varphi} = \frac{2}{(2-\varphi)^2}[\theta I - (1-p)W]/I.$$

The sign of this derivative depends on the term $[\theta I - (1-p)W]$. Recall that in Proposition 1, W must satisfy the constraint $W \in [W_{min}, pX_S - \bar{u})$. Setting W to its upper bound ($W = pX_s - \bar{u}$), we obtain

$$\frac{\partial E(\rho)}{\partial \varphi} = \frac{2}{(2-\varphi)^2}[\theta - (1-p)\theta]. \tag{A14}$$

which is strictly positive.

To prove part (iii) of Proposition 2, we use V_l^* in Equation 12 to obtain the expression of the expected interest rate

$$\begin{aligned} E(\rho) &= [p + (1-p)\beta](pX_s - \bar{u})/I \\ &= [p + (1-p)\beta]\theta. \end{aligned} \tag{A15}$$

It is straightforward from the above expression that $E(\rho)$ increases in β and θ.

Similarly, to prove part (iv) of Proposition 2, we use V_l^* in Equation 16 and the definition of θ to get

$$E(\rho) = \beta \frac{(pX_s - \bar{u})}{I} = \beta\theta. \tag{A16}$$

It is apparent that the above expression increases in both β and θ. □

A.4 Materials for Section 5

Proof for Lemma 2. Using the project quality $\theta \equiv \frac{pX_s - \bar{u}}{I}$, the minimum collateralizable wealth in Equation A10 can be written as

$$W_{\min} = \frac{I\left[(\bar{r}+1) - \dfrac{\varphi\,\theta}{2-\varphi}\right]}{(1-p)\left(\beta - \dfrac{\varphi}{2-\varphi}\right)} \tag{A17}$$

The equilibrium condition $\beta > \frac{\varphi}{2-\varphi}$ implies that the denominator is positive. Noting that $\frac{d}{d\varphi}\left(\frac{\varphi}{2-\varphi}\right) = \frac{2}{(2-\varphi)^2}$, we have

$$\frac{\partial}{\partial\varphi}\left\{I\left[(\bar{r}+1) - \frac{\varphi\theta}{2-\varphi}\right]\right\} = -\frac{2I\theta}{(2-\varphi)^2}, \qquad \frac{\partial}{\partial\varphi}\left\{(1-p)\left(\beta - \frac{\varphi}{2-\varphi}\right)\right\} = -\frac{2(1-p)}{(2-\varphi)^2}.$$

Applying the quotient rule:

$$\begin{aligned}\frac{\partial W_{\min}}{\partial\varphi} &= \frac{(1-p)\left(\beta - \frac{\varphi}{2-\varphi}\right)\left(-\frac{2I\theta}{(2-\varphi)^2}\right) - I\left[(\bar{r}+1) - \frac{\varphi\theta}{2-\varphi}\right]\left(-\frac{2(1-p)}{(2-\varphi)^2}\right)}{\left[(1-p)\left(\beta - \frac{\varphi}{2-\varphi}\right)\right]^2} \\ &= \frac{2}{(2-\varphi)^2\left[(1-p)\left(\beta - \frac{\varphi}{2-\varphi}\right)\right]^2}\left[(1-p)\,I\left((\bar{r}+1) - \frac{\varphi\theta}{2-\varphi}\right) - I\theta(1-p)\left(\beta - \frac{\varphi}{2-\varphi}\right)\right].\end{aligned}$$

After some algebra,

$$\frac{\partial W_{\min}}{\partial\varphi} = \frac{2\,I\left[(\bar{r}+1) - \beta\theta\right]}{(2-\varphi)^2\,(1-p)\left(\beta - \frac{\varphi}{2-\varphi}\right)^2}. \tag{A18}$$

The sign of the expression in equation A18 depends on $(\bar{r}+1) - \beta\theta$. □

Proof for Proposition 3. From Equations (6) and (8), we have

$$\rho_B(C,\varphi) - \rho_L(C,\varphi) = \frac{(1-p)\left[\beta(2-\varphi) - \varphi\right]}{pI\varphi^2(2-\varphi)}\left(C - W_{\min}(\varphi)\right)$$

For notational simplicity, define

$$\alpha(\varphi) \equiv \frac{(1-p)\left[\beta(2-\varphi) - \varphi\right]}{pI\varphi^2(2-\varphi)}.$$

Since the equilibrium condition implies $\beta > \frac{\varphi}{2-\varphi}$, we have $\beta(2-\varphi) - \varphi > 0$, and therefore $\alpha(\varphi) > 0$.

The area of feasible contracts is therefore

$$
\begin{aligned}
F(\varphi) &= \int_{W_{\min}(\varphi)}^{W} \alpha(\varphi)\big(C - W_{\min}(\varphi)\big)\, dC \\
&= \frac{1}{2}\,\alpha(\varphi)\big(W - W_{\min}(\varphi)\big)^2.
\end{aligned}
\tag{A19}
$$

Differentiating with respect to φ, we have

$$
\frac{\partial F}{\partial \varphi} = \big(W - W_{\min}\big)\left[\tfrac{1}{2}\,a'(\varphi)\big(W - W_{\min}\big) - \alpha(\varphi)\frac{\partial W_{\min}}{\partial \varphi}\right]
$$

We first show $\alpha'(\varphi) < 0$. Differentiating $\alpha(\varphi)$ with respect to φ and apply the quotient rule, we get

$$
\alpha'(\varphi) = \frac{(1-p)}{pI} \cdot \frac{-(\beta+1)\varphi^2(2-\varphi) - [\beta(2-\varphi) - \varphi]\,\varphi(4-3\varphi)}{\varphi^4(2-\varphi)^2}.
$$

The sign of α' depends on the numerator. The first term is negative since $\beta + 1 > 0$. The second term is negative since $\beta(2-\varphi) - \varphi > 0$ and $4 - 3\varphi > 0$ for $\varphi < 1$. Hence $\alpha' < 0$.

Now, given $\beta\theta > \bar{r} + 1$. By Lemma 2, $\frac{\partial W_{\min}}{\partial \varphi} < 0$. Hence, for $W > W_{\min}$, the sign of $\frac{\partial F}{\partial \varphi}$ is determined by

$$
G(W) \equiv \frac{1}{2}\alpha'(\varphi)\big(W - W_{\min}\big) - \alpha(\varphi)\frac{\partial W_{\min}}{\partial \varphi}.
$$

Because $\alpha'(\varphi) < 0$, $G(W)$ is linear and strictly decreasing in W. We also note that $G(W_{\min}) = -\alpha(\varphi)\frac{\partial W_{\min}}{\partial \varphi} > 0$, and $\alpha(\varphi) > 0$ and $\frac{\partial W_{\min}}{\partial \varphi} < 0$. On the other hand, $G(W) \to \infty$ as $W \to \infty$.

Therefore, there exists a unique $\hat{W} > W_{\min}$ such that $G(\hat{W}) = 0$.

It follows that

$$
\frac{\partial F}{\partial \varphi} > 0 \quad \text{for } W \in (W_{\min}, \hat{W}), \qquad \frac{\partial F}{\partial \varphi} < 0 \quad \text{for } W > \hat{W}.
$$

□