Abstract

This is a theoretical investigation of “creditor rights” and “information sharing” in the sense of La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998, hereafter LLSV). In recent years, empirical finance scholars have begun studying these two intermediation arrangements using individual firm, or bank, cross-country panel data that have become available since publication of LLSV. Unfortunately, much of this new work has reached varying conclusions, disagreeing with one another and frequently with LLSV. Arguably, one reason is that the research has had little or nothing in the way of theoretical priors to guide the empirics. Filling that gap is the main purpose of this study. Our theoretical results tend (mostly) to support the empirical findings of Houston, Lin, Lin, and Ma (2010). Both our theory and their empirics suggest that stronger creditor rights are associated with greater bank risk taking. Interestingly, both studies find that information sharing and creditor rights are importantly interactive. Thus, if the empirical researcher studies one mechanism without carefully controlling for the other, there may be a significant omitted variables issue. This problem potentially affects a number of studies.

Keywords: Creditor rights, information sharing, bank risk taking.

JEL-Classification: G21, L15.
1 Introduction

Two financial market mechanisms have been studied for their role in economic development. The first is known as “creditor rights” and refers to efficient contracting between borrowers and lenders. The second is sharing of information among lenders about the creditworthiness of loan customers and applicants. This may involve a formal organization known as a “credit bureau” or it may be informal communication between lenders. The seminal work on both issues is La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998, hereafter LLSV) who constructed indices of creditor rights that are still widely used by researchers. LLSV employed aggregate panel data at the country level and concluded that both creditor rights and information sharing contributed to ceteris paribus growth in real per capita GDP.

In recent years, finance scholars have begun studying these same mechanisms employing cross-country individual firm or bank panel data that have become available. In principle, this is an excellent idea because of the greater statistical power of the individual firm/bank data. However, as we shall discuss, the results obtained in this line of research have been varying – often differing from those of LLSV and/or differing from one another.

Our Model. We construct a model with two banks, competing for borrowers on a differentiated market. By exerting effort, they can single out bad borrowers. A structure à la Broecker (1990) emerges, but due to the competition structure, we can get rid of the mixed strategy pricing equilibria. We are then especially interested in two comparative statics. First, how do prices and loan qualities react if creditor rights improve, thus if the loss given defaults (LGD) decrease from the banks’ perspective. Second, what is the reaction if the banks are forced to share information?

Empirical Literature. As noted earlier, LLSV found that both creditor rights and information sharing are associated with faster output growth. A more recent study that reaches the same conclusion is Houston, Lin, Lin, and Ma (2010, hereafter HLLM). However, Acharya, Amihud, and Litov (2011) find that stronger creditor rights decrease corporate risk taking, which might be expected to be positively correlated with real output growth.
Further, Acharya, Amihud, and Litov (2011) find that stronger creditor rights reduce the value of the corporation. HLLM find that creditor rights increase bank risk of failure and the likelihood of banking crises. Djankov, McLiesh, and Shleifer (2007) find that creditor rights are relatively more important to lending in developed economies, whereas information sharing is relatively more important in less developed countries. Michalopoulos, Laeven, and Levine (2011) find that information sharing contributes importantly to real economic growth, but only if information bureaus are privately organized and operated. This finding appears to conflict with those of HLLM.

Why are the results of these empirical studies so different? We believe there are three reasons. First, the work is data-driven in a way that did not trouble LLSV who employed aggregate national data. If the micro researcher has bank data he naturally studies the banking side of the loan market. If he has borrower data, he naturally studies the borrower (firm) side of the market. But, equilibrium outcomes in financial markets are generally affected by actions of both borrowers and lenders. Second, to our knowledge there is little existing theoretical work on the effects of information sharing among lenders; and little theoretical work on the effects of arrangements to improve creditor rights. We believe this is the first theoretical treatment of the two issues simultaneously. In essence, this empirical literature has had a paucity of theoretical frameworks to test, or to impose priors on the expected findings. Providing such a theoretical framework is the objective of this paper.

A third problem with this literature only becomes apparent after we have constructed and analyzed our theoretical model. We shall show that creditor rights and information sharing are importantly interactive. The magnitude of one affects the other (including even the sign of certain economic effects). Thus, if the empirical researcher studies creditor rights (information sharing) without carefully controlling for information sharing (creditor rights), there is an important omitted variable problem.

In sum, there are burgeoning numbers of empirical papers in this area and a considerable amount of disagreement in their findings. For our purpose, which is to link theory with empirics, it is helpful to focus on a single empirical study, HLLM. We choose this paper because it is very carefully done, and extremely broad in coverage. It studies the effects of both creditor rights and information sharing. It investigates real economic growth, bank risk, bank profitability, and the probability of having a banking crisis. Below, we briefly
summarize the main findings of HLLM (in italics), and then discuss what our theory says on the same issue.

1. **Stronger creditor rights are associated with greater bank risk-taking.**
   
   Our model reproduces this result. The probability of default of a single loan increases in creditor rights (Figure 2-3).

2. **Stronger creditor rights increase the probability of a financial crisis.**
   
   We do not study systemic issues explicitly. However, in our model, the screening choices of banks are strategic complements. If, hypothetically, the creditor right increased for one bank only, then this bank would screen less, and so would the other bank. In that sense, the risks of the banks are related.

3. **Information sharing results in higher bank profitability, lower bank risk, less risk of a financial crisis and higher economic growth.**
   
   Our model reproduces the higher bank profitability (Figure 3-2), it reproduces the lower bank risk (Figure 2-3). The model does not focus on systemic effects, but because of the strategic complementarity of screening efforts, both banks would tend to take similar levels of risk (even in an asymmetric version of our model). Hence, with a grain of salt, the model reproduces the lower risk of financial crises. The model itself is static, but if we identify growth with aggregate output in the model, then Figure 4-3 documents that information sharing stimulates growth.

4. **Information sharing has an interactive effect that mitigates the unwanted effect of creditor rights increasing bank risk taking. In many of their tests this effect is reduced to essentially zero.**
   
   Our model implies that creditor rights lead to increased risk taking, but information sharing goes into the opposite direction. The cross derivative (PD with respect to information sharing and to creditor rights) is positive, however.

5. **Both creditor rights and information sharing are correlated with higher industrial growth. These tests are at the industry level and use the methods as Rajan and Zingales (1998).**
Our model reproduces these findings, see Figure 4-3. In our model, growth would then have to be identified with aggregate output.

6. Stronger creditor rights are associated with lower loan rates, ceteris paribus.

Our model reproduces this result, see Figure 3-1. For little information sharing and substantial creditor rights, the comparative static goes into the opposite direction, however. Typically, stronger creditor rights do lead to lower loan rates.

7. Stronger creditor rights are associated with a lower rate of return on assets for banks.

Our paper produces the opposite result. Figure 3-2 shows that bank profits increase with creditor rights. However, the effect gets smaller if there is information sharing.

2 The Model

Consider an economy with one period and two dates, 1 and 2, and three types of agents: entrepreneurs, banks, and investors. Entrepreneurs have access to real investment projects, but have no funds. Investors are endowed with funds, but do not have direct access to projects. Banks are endowed with neither funds nor projects, but have access to a screening technology that they can use to evaluate projects. Hence in the financial system, investors need to use banks as intermediaries in order to lend to entrepreneurs. We now define the exact endowments and preferences of agents.

Entrepreneurs. There is a continuum of entrepreneurs of mass 1. Each entrepreneur needs to borrow $1 in order to invest into a project. There are two types of entrepreneurs, good (fraction $\gamma$) and bad (fraction $1 - \gamma$). Projects of good entrepreneurs return some $Y > 1$ with probability 1. Projects of bad entrepreneurs return $y < 1$. Entrepreneurs have no initial endowment, they are risk neutral and protected by limited liability, and they want to consume only at the later date 2.
Banks. There are two banks in the economy. However, an alternative model with more banks positioned on a Salop circle would yield identical results. On the liability side, the two banks have access to investors’ deposits at rate \( r \geq 1 \) (including the repayment of the principal). On the asset side, banks compete for loans by setting interest rates. For concreteness, given loan rates of \( R_1 \) and \( R_2 \) (including the repayment of the principal), bank 1 initially attracts

\[ L_1 = \frac{1}{2} + \phi (R_2 - R_1), \]

of entrepreneurs, and banks 2 attracts \( L_2 = 1 - L_1 = 1/2 + \phi (R_1 - R_2) \). This specific loan demand function is micro-founded in the appendix. The parameter \( \phi > 0 \) is the sensitivity of entrepreneurs to loan rates, and thus measures the degree of competition between banks. Furthermore, banks have access to a screening technology that allows them to screen out bad entrepreneurs. Exerting a non-monetary cost of

\[ C(q) = -c \log(1 - q) > 0, \]

they get a negative signal for a fraction \( q \) of bad entrepreneurs. This cost function has some micro-foundation, which is given in the appendix. However, for the model predictions, the important property is that \( C(q) \) is increasing and convex. To assure an interior solution of the banks’ optimization problem, one could assume some Inada conditions like \( C'(0) = 0 \) and \( C''(1) = \infty \), but these conditions are too strict; they are not necessary for an inner optimum of \( q \).

Because \( y < 1 \), banks will reject entrepreneurs after a negative signal. The more effort a bank spends, the fewer bad entrepreneurs it will have in the pool of applicants. The absolute number of good entrepreneurs in the pool is unchanged, hence the relative number of good entrepreneurs increases.

The screening results of the two banks are assumed to be stochastically independent. Because entrepreneurs are screened out after a negative signal, they will then apply for a loan at the other bank. Because \( L_1 \) measures the fraction of entrepreneurs that first apply at bank 1, the total number of applicants is larger; it also includes the rejected applicants from bank 2. Consequently, also the aggregate loan volume of bank 1 can potentially exceed \( L_1 \); it will consist of the non-rejected fraction of \( L_1 \) plus the fraction of \( L_2 \) rejected by bank 2, but then accepted by bank 1. Like entrepreneurs, banks have no
initial endowment, they are risk neutral and protected by limited liability, and they want
to consume only at the later date $2$.

**Investors.** There is a continuum of investors of mass $\geq 1$, each holding an initial en-
dowment of $w \geq 1$. Investors have a utility function $u(c_1, c_2) = c_1 + c_2/(1 + r)$, hence
they are willing to invest their money into the bank if the expected return is at least $r$.

**Creditor Rights.** Those bad entrepreneurs who have not been rejected will invest at date
1. The investment project returns $y$, which is never sufficient to repay the debt, so bad en-
trepreneurs default with certainty. The liquidation value is $y$. We assume that bankruptcy
law determines how this liquidation value is distributed between the lender-bank and the
borrower-entrepreneur. Assume that the bank gets $\lambda \leq y$, so the entrepreneur keeps the
remaining $y - \lambda$, which is thus non-pledgeable for legal reasons. The entrepreneur keeps
$y - \lambda$, this is the reason why he carries out a project with negative NPV in the first place.
Bankruptcy costs are largely shifted to the bank.

Because $\lambda \leq y < 1 \leq r$, the net profit $\lambda - r$ for the bank will always be negative. Hence, $\lambda$
measures the strength of creditor rights. The variable $\lambda$ is exogenous to the model, so we
can use it for comparative statics. If it were not, $\lambda$ could be used by banks for screening,
or by entrepreneurs to signal their type. $\lambda$ should thus be interpreted as a parameter for
the legal environment, not for a specific contract.

**Information Sharing.** Banks can share information about rejected entrepreneurs. Let
$s \in [0; 1]$ be the probability that a bank informs its competitor when an entrepreneur has
been rejected. Hence for $s = 1$, banks share information about applicants, for example
by entering the rejection into a credit registry. For $s = 0$, banks do not let out any
information. Also $s$ is exogenous to the model; banks must report the correct information
(rejection) with probability $s$, and they cannot report anything with probability $1 - s$.\footnote{Alternatively, one could also assume that banks report garbled information, with $s$ measuring the quality of the signal. Another alternative is to interpret $s$ as the probability that negative information just leaks out.}
**Time Structure.** The time and information structure of the game are illustrated in Figure 1. Importantly, banks do not know whether they are at node (iii) or (v). Hence, they do not know whether they are the first bank to screen the applicant, or the second. Banks decide upon screening at the time when the entrepreneur demands the loan.\(^2\)

![Figure 1: Time and Information Structure](image)

Creditor rights \(\lambda\) and information sharing \(s\) are fixed exogenously. Nature draws the type of entrepreneurs.

**Date 1**

(i) Banks announce loan rates \(R_1\) and \(R_2\).

(ii) Entrepreneurs decide at which bank first to apply for a loan.

(iii) The bank decides whether to screen the applicant. With probability \(s\), it must communicate the information to its competitor.

(iv) If an entrepreneur is screened out, he applies at the other bank.

(v) The other bank decides whether to screen the applicant.

(vi) Entrepreneurs who obtain a loan invest into the project.

**Date 2**

If the project is good, it returns \(Y\), of which the entrepreneur passes on \(R_1\) or \(R_2\) to the bank. If the project is bad, the project returns \(y\), of which the entrepreneur passes on \(\lambda\) to the bank.

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**Related Theory Models.** Our modeling choice is related to the influential paper by Broecker (1990). However, in Broecker’s paper, banks first simultaneously choose how much information to gather, and then set loan rates. The unique equilibrium exhibits a mixed pricing strategy by banks. In our model, entrepreneurs successively apply at banks. Our resulting equilibrium is in pure strategies. Still, information plays an important competitive role. Offering low loan rates, banks try to be the first to attract entrepreneurs. If they fail, only the lemons that are rejected from their competitor will apply. Also, we can discuss the role of competition. In Broecker’s model, the number of banks would increase. In our paper, the entrepreneur’s reactivity to an individual bank’s interest rate would increase. Summing up, we believe we use a more tractable version of Broecker’s model. Of course, we are not the first to have modified this model, others including Ruckes (2004), Hauswald and Marquez (2006), Dell’Ariccia and Marquez (2006), Gehrig and Stenbacka (2007), or Heider and Inderst (2011).
3 Equilibrium

We now derive the volume of loan applicants and that of borrowers at each bank. If a share of $L_1$ of entrepreneurs applies at bank 1 first, and bank 1 has a screening intensity of $q_1$, then $\gamma L_1$ good borrowers and $(1 - \gamma) L_1 (1 - q_1)$ bad borrowers are accepted; the according screening costs are $L_1 C(q_1)$. Now bank 2 accepts all good applicants, and rejects $(1 - \gamma) L_2 q_2$ entrepreneurs, who then apply at bank 1. With probability $s$, bank 1 learns that these applicants have been rejected before, hence it infers they are bad borrower, and rejects them right away. With probability $1 - s$, bank 1 learns nothing, hence it treats the applicant like a first-time applicant. As a result, it accepts another $(1 - \gamma) L_2 q_2 (1 - s) (1 - q_1)$ bad entrepreneurs, and incurs screening costs of $(1 - \gamma) L_2 q_2 (1 - s) C(q_1)$. Consequently, expected profits for bank 1 are

$$\Pi_1 = \gamma L_1 (R_1 - r) + (1 - \gamma) (1 - q_1) (\lambda - r) \left[ L_1 + (1 - s) q_2 L_2 \right] - \left[ L_1 + (1 - s) q_2 L_2 (1 - \gamma) \right] C(q_1).$$

(3)

Analogous arguments apply for bank 2. In a symmetric equilibrium, the first order condition with respect to $q$ yields

$$q^* = \sqrt{\Psi^2 + \frac{1}{1 - s} \left( 1 - \frac{c}{1 - \gamma} \frac{r - \lambda}{r - \lambda} \right)} - \Psi,$$

where

$$\Psi = \frac{1}{2} \left( \frac{c}{r - \lambda} + \frac{s}{1 - s} \right)$$

is an auxiliary variable. For $q^* \to 1$, screening costs become infinite. Together with the fact that the inner solution of the FOC is unique, this implies that the FOC describes the global maximum. The solution for $q^*$ is positive if and only if

$$c < c_{\text{max}} = (1 - \gamma)(r - \lambda), \quad \text{or equivalently}$$

$$\lambda < \lambda_{\text{max}} = r - \frac{c}{1 - \gamma}.$$  

(5)

If information costs $c$ are too high, or if there are too few bad applicants to be screened out (high $\gamma$), or if a bank does not lose much by accepting a bad entrepreneur (low $r - \lambda$), it is possible that the bank does not screen at all.\textsuperscript{3}

\textsuperscript{3}This result is not surprising. For the first marginal unit of $q \approx 0$, the cost is $C'(0) = c q$, the number of screened out loans is $(1 - \gamma) q$, with an avoided loss of $(r - \lambda)$ per screened out loan.
The optimal $q^*$ does not depend on loan rates. This is due to a modeling choice and simplifies the subsequent analysis. Screening means sorting out bad loans, and bad entrepreneurs do not pay the interest rate, they fail instead and pay the $\lambda$ (thus $q^*$ does depend on $\lambda$). Now because the optimal $q^*$ is independent of loan rates, we can treat it as a constant when considering the first order conditions with respect to $R_1$ and $R_2$. In a symmetric equilibrium, we get

$$R^* = r + \frac{1}{2} \phi + \frac{1 - \gamma}{\gamma} \left( (1 - q) (1 - q (1 - s)) (r - \lambda) - c \log(1 - q) \left( \frac{1}{1 - \gamma} - q (1 - s) \right) \right).$$

These variables $q^*$ and $R^*$ completely describe the symmetric equilibrium. The solution for the FOC is unique. Together with the fact that both for small $R$ and for large $R$, expected profits are negative, this implies that the FOC describes the global maximum.

### 4 Comparative Statics

#### 4.1 Screening, Loan Volumes, and Default Probabilities

In the following, we analyze a number of endogenous variables, especially depending on the degree of creditor rights $\lambda$ and information sharing $s$. The structure is always the same: we show plots of a numerical example, we give economic intuition, and we derive propositions. In the plots, the parameter constellation never changes: the investors’ sensitivity to differences in interest rates is $\phi = 0.5$, the cost parameter is $c = 0.25$, the fraction of good entrepreneurs is $\gamma = 0.5$, and the expected interest rate is zero, thus $r = 1$.

We start with the most fundamental variable, the screening intensity $q$ chosen by the banks. The higher this $q$, the more loans will be rejected, hence there is a direct consequence on loan volume. The more bad loans are rejected, the higher the average loan quality, hence there is also a direct effect on the probability of default (PD).

Figure 2-1 shows how the banks’ screening intensity depends on creditor rights $\lambda$. The black curve stands for zero information sharing ($s = 0$), the lighter curve stands for
full information sharing \((s = 1, \text{discussed in section 4.4})\). Some intermediate level of information sharing would be in between. From a failing loan, the bank can seize between \(\lambda = 0\) and \(\lambda = 0.5\). For larger values of \(\lambda\), the screening intensity just drops to zero.

In the picture, better creditor rights \(\lambda\) reduce the screening intensity, with the following intuition. With better creditor rights, knowing they will have a better grasp on bad entrepreneurs’ assets in the case of default, banks have less of an incentive to screen out bad entrepreneurs. In addition, there is a competitive effect. Rejected entrepreneurs try again at the other bank. Hence, the pool of applying entrepreneurs deteriorates. However, the direct effect dominates the indirect one, such that \(dq^*/d\lambda < 0\).

As a direct consequence, with stronger creditor rights, banks grant more loans in total. They screen less, hence they will screen out fewer bad loans. Also, the expected PD increases, because the absolute volume of good loans remains unchanged, but the volume of bad loans increases.

These comparative statics have important consequences on economic growth. The volume variable is equivalent to aggregate investment in the model, so high volume could be associated with high growth. In that sense, creditor rights would be good for growth.

**Proposition 1a** Better creditor rights reduce the equilibrium level of bank screening, \(dq^*/d\lambda < 0\). They increase the aggregate loan volume, \(d(\text{Loan Volume})/d\lambda > 0\), and they increase the average entrepreneur’s default probability, \(d\text{PD}/d\lambda > 0\).
4.2 Loan Rates and Bank Profits

Figure 3 shows loan rates and bank profits for the same set of parameters. The role or creditor rights is ambiguous, especially if there is no information sharing. There are two channels. First, as creditor rights increase, each single loan becomes more profitable for a bank. Hence, banks compete harder, and the loan rate falls. But second, as creditor rights increase, the incentives to screen applicants deteriorate. There are hence more bad loans (see Figure 2), thus the loan rates must increase in order to compensate banks. The second picture shows a surprising result. If there is full information sharing, profits are independent from creditor rights. This is a standard result under competition à la Hotelling. Banks pass on the benefits due to creditor rights completely to borrowers. But with less than full information sharing, banks’ profits increase with creditor rights. With better creditor rights, banks have less to lose, hence competing hard in order not to get a negative selection (after the other bank has picked the cherries) becomes less profitable. Hence endogenously, the degree competition is relaxed with better creditor rights, and bank profits increase. In fact, one can show that

**Proposition 2a** Without information sharing and for high creditor rights, more rights entail an increase in loan rates, $dR^*/d\lambda > 0$ for $\lambda = \lambda_{\text{max}}$ and $s = 0$. For worse creditor rights, loan rates can decrease. With full information sharing and for good creditor rights, more rights entail a decrease in loan rates, $dR^*/d\lambda < 0$ for $\lambda = \lambda_{\text{max}}$ and $s = 1$. 
Figure 4: Borrowers’ Profits and Aggregate Welfare

4.3 Borrowers’ Profits, Aggregate Welfare, and Aggregate Output

We discuss three more pictures (see Figure 4). The first shows the borrowers’ profits, net of application costs. For good borrowers, profits are $Y - R$ minus application costs, where $R$ is endogenous. For bad borrowers, the profits are $y - \lambda$. Hence we still need to fix $Y$ and $y$, parameters that have not yet played a role. We set $Y = 3.2$ and $y = 0.5$ for the figures. Aggregate profits are

$$
\Pi_B = \gamma(Y - R) + (1 - \gamma)(1 - q)(y - \lambda) - 2 \int_0^{1/2} \frac{\gamma}{2\phi} x^2 \, dx \\
+ (1 - \gamma)q (1 - s)(1 - q)(y - \lambda) - 2 (1 - \gamma)q \int_0^{1/2} \frac{\gamma}{2\phi} (1 - x)^2 \, dx.
$$

(7)

Here, the integrals sum up the borrowers’ applications costs that are consistent with micro-foundation of the bank-individual loan-demand function (1). The first integral are costs stemming from the first application, the second integral are costs for bad borrowers, stemming from the second application after having been rejected once. Aggregate application costs depend on the screening intensity, because the more banks screen, the more borrowers have to apply twice (see the discussion in the appendix).

Now better creditor rights can have ambiguous effects on borrowers’ profits. Of course, bad borrowers must pass on more to banks due to stricter creditor rights. But as a result, the loan rate $R$ for good borrowers decreases, offsetting the direct effect. Under full information sharing, there is just one more effect. Banks screen less with better creditor rights. Screening costs are ultimately passed on to borrowers. Profits increase. With the exception of full information sharing, there is one additional channel. With little creditor rights, banks compete hard in order to be the first bank to attract an borrower, and to avoid
the lemons problem they would face otherwise. With better creditor rights, this effect is mitigated. Abstracting from other channels, borrowers pay higher interest rates, and their profits decrease.

Figure 4-2 shows aggregate welfare, defined as the sum of banks’, borrowers’, and investor’s profits. Only the first two are positive, investor’s profits are zero. In the picture, better creditor rights improve welfare. However, for full information sharing, the additional welfare improvement becomes negligible when creditor rights \( \lambda \) reach the maximum. Above this point, there is no screening, and all applicants obtain loans. Creditor rights are then irrelevant for welfare.

Figure 4-3 shows aggregate output. This is similar to welfare, only that non-monetary application costs of entrepreneurs are not taken into account. Comparative statics are, however, identical to those of welfare. The following proposition sums up our results.

**Proposition 3a** For low information sharing, borrowers’ profits decrease in increasing creditor rights, \( d\Pi_B/d\lambda < 0 \) for \( s = 0 \). For high information sharing, borrowers’ profits increase in increasing creditor rights, \( d\Pi_B/d\lambda > 0 \) for \( s = 1 \). Welfare and growth both increase with creditor rights.

### 4.4 More About Information Sharing

We now discuss the role of information sharing for the equilibrium. The above figures already contain the effect of information sharing, because the black curves mark the case of no information sharing, and the dashed curves mark the case of full information sharing. The case of partial sharing is in between.

In Figure 2, we see that information sharing reduces the screening intensity \( q \). This is intuitive: a single bank knows more about the applicant ex ante, hence the incentives to screen decrease. Now information sharing means that banks need to screen less applicants, but they accept more of them. Figure 2-2 shows that the second, indirect effect can never dominate the first. Information sharing leads to a drop in aggregate loan volume. This implies that, if economic growth is associated with the mere number of firms, then information sharing leads to a drop in growth. On the other hand, as visible in the
third picture, information sharing decreases the PD of loans. The following proposition collects the results.

**Proposition 1b** Information sharing reduces the banks’ screening intensity, \( dq^*/ds < 0 \). It reduces the aggregate loan volume, \( d(\text{Loan Volume})/ds < 0 \). It reduces the average borrower’s default probability, \( d\text{PD}/ds < 0 \).

Looking at Figure 3, loan rates increase due to information sharing. There are countervailing effects. On the one hand, banks have lower screening costs, and the quality of their borrowers increases, hence they can grant lower loan rates. But on the other hand, information sharing softens competition between banks. They no longer have to fear to get a negative selection of applicants because their competitor has already picked all cherries. In the figure, one can see that this second effect can dominate. As a consequence, banks’ profits increase (second picture).

**Proposition 2b** Information sharing increases loan rates, \( dR^*/ds > 0 \), and it increases bank profits, \( d\Pi/ds > 0 \).

Figure 4-1 shows the consequence on borrowers’ profits. With information sharing, more applicants are rejected, and those who are accepted pay higher loan rates. Information sharing is thus detrimental for borrowers. The effect on aggregate welfare (second picture) is positive, for three reasons. First, more projects with negative NPV are rejected. And second, aggregate screening costs are reduced. All the other variables cancel out in the welfare calculation. Third, more borrowers apply only at one bank, saving application costs.

The third picture shows the aggregate output, which can be identified with GDP. For the above reasons, save the third one, aggregate output increases with information sharing.

**Proposition 3b** Information sharing reduces the borrowers’ profits, \( d\Pi_B/ds < 0 \). It increases both welfare and aggregate output, \( dW/ds > 0 \) and \( d\text{GDP}/ds > 0 \).
5 The Borrowers’ Decision

In the above model, the aggregate demand for loans was fixed at 1, because the supply of projects was a continuum of mass 1. As a consequence, the result of better creditor rights was straightforward. Banks needed to screen less, hence they accepted more loans. The result of information sharing was also straightforward. Information got more precise, hence banks accepted fewer loans. Therefore, the potential effect of information sharing and creditor rights on the borrowers’ decisions was not taken into account. We will now endogenize the borrowers’ behavior, first by assuming that the supply of projects is variable.

5.1 Variable Demand for Loans

Assume that an borrower must exert effort to gain access to an investment project. At a cost $e(p)$, the probability to find a project is $p$. We assume that $e'(p) > 0$ and $e''(p) < 0$, and that $e(p)$ is such that there is a unique interior solution. For example, the Inada conditions, $e'(0) = 0$ and $e'(1) = \infty$, would be sufficient (but not necessary). When deciding how hard to work to find a project, the borrower does not yet know whether the project will be good or bad. The time structure is thus expanded by one date, $t = 0$. After creditor rights and the degree of information sharing are fixed, but before nature draws the type of borrowers, potential borrowers can exert effort to get access to a project in the first place.

Using backward induction, the model is already solved after the inserted date. Especially, we know how borrowers’ aggregate profits depend on creditor rights and information sharing. These aggregate profits are driving borrowers to exert effort. Figure 4-1 shows the borrowers’ profits from an ex ante perspective. Consequently, information sharing will reduce the borrowers’ effort to generate projects. Also creditor rights can be detrimental, especially if little information is shared (under full sharing, creditor rights are beneficial).

The effect of creditor rights and information sharing will also change. When no information is shared, better creditor rights will induce higher welfare, for a double reason. Borrowers’ expected profits will increase, hence they will work harder to generate projects.
in the first place. Banks’ profits will also increase (compare to the dashed curves in Figure 4). But with information sharing, the effect from an increase in creditor rights is ambiguous. The effect of an increase in creditor rights is also ambiguous. The sign of the aggregate welfare effect depends on the elasticity of projects supply, hence on the shape of \( e(p) \). If a marginal decrease in borrowers’ expected profits hardly affects the borrowers’ incentives to generate projects, the comparative statics are as in Figure 4. But if borrowers react sensitively to cuts in their expected profits, then welfare effects are reversed. More information sharing then reduces aggregate welfare.

5.2 Quality Choice

Assume now that borrowers can exert effort to increase the quality of their projects. In other words, borrowers already have a project, but the number \( \gamma \) is endogenous. If a borrower works hard, he can make his project succeed. Again, assume the borrower must spend \( e(\gamma) \) in order to get a probability \( \gamma \) for a good project. Let \( e(\gamma) \) fulfil the self-evident properties, like \( e'(\gamma) > 0 \) and \( e''(\gamma) > 0 \), and possibly the Inada conditions \( e'(0) = 0 \) and \( e'(1) = \infty \) to ensure a unique inner optimum. The effort \( e(\gamma) \) is spent at date \( t = 0 \), before the original model starts.

![Figure 5: Borrowers’ Rents and Aggregate Welfare](image)

Again, due to backward induction, the comparative statics are straightforward. We need to calculate only the expected profits of good and bad borrowers, and consider the difference. Then the first-order condition

\[
e'(\gamma^*) = \Pi_B^{\text{good}} - \Pi_B^{\text{bad}} = \Delta \Pi_B
\]

will hold, with \( \gamma \) increasing in \( \Delta \Pi_B \) because \( e''(\gamma) \) is positive. Figure 5 shows the expected profits for good entrepreneurs (solid) and bad ones (dashed), once for the case
of no information sharing (black), once with full information sharing (dashed). The difference $\Delta \Pi_B$ is thus the difference between either the solid, black curves or the dashed curves. The profits for bad entrepreneurs take into account that they all apply for loans, but only some are successful.

Two facts are visible immediately. First, bad entrepreneurs default with a higher probability than good ones (in our case, probability 1). Therefore, they suffer more from an increase in creditor rights. The difference increases, $d\Delta \Pi_B/d\lambda > 0$. In our specification, bad entrepreneurs suffer from better creditor rights, whereas good entrepreneurs profit. Consequently, better creditor rights lead to higher incentives to invest in project quality, $d\gamma^*/d\lambda > 0$.

Second, information sharing is detrimental for good entrepreneurs (solid curves). The reason is the competitive effect. Under information sharing, banks need to compete less for entrepreneurs to avoid the lemons problem. Although the effect is only indirect, the figure shows it can be strong. Bad entrepreneurs do not suffer from an increase in loan rates, because they will be unable to repay the loan anyway. However, they are rejected with a higher probability. But this also implies that they need not apply at another bank, saving them application costs. Summing up, information sharing harms good entrepreneurs more than bad ones, $d\Delta \Pi_B/ds < 0$. Consequently, with information sharing, incentives to invest in project quality decrease, $d\gamma^*/ds < 0$.

### 6 Conclusion

Overall, the implications of our theory model are mostly consistent with the findings of HLLM and totally consistent with the findings of SLLV. Better creditor rights or information sharing lead to more economic growth. Stronger creditor rights are associated with greater bank risk taking, in the sense that the probability of loan default increases with the strength of creditor rights. As banks enjoy more rights, they have less incentives to screen borrowers applying for loans. Consequently, the aggregate PD increases. Information sharing increases bank profitability and reduces bank risk exposure. We also find an interesting interaction effect in which the effect of creditor rights (information sharing)
depends on the level of information sharing (creditor rights). HLLM report empirical results that look rather similar. The obvious implication is that empirical researchers need to investigate variations in both creditor rights and information sharing simultaneously. And we, like HLLM find that stronger creditor rights are associated with lower loan rates.

There is one major issue where we part company with HLLM. They report that stronger creditor rights are associated with lower rates of return for banks. We find exactly the opposite. However, HLLM candidly admit that the finding they report is an anomaly, and seemingly inconsistent with other results they have reported. Obviously, more research is required to determine which answer is correct. Overall, however, there is a great deal of consistency between LLSV, HLLM and our theoretical results.

A Proofs

Proof of Proposition 1a. Taking the derivative,

\[
\frac{dq^*}{d\lambda} = \frac{c}{2(r - \lambda)^2} \cdot \left( \frac{\Psi - \frac{1}{(1-s)(1-\gamma)}}{\sqrt{\Psi^2 + \frac{1}{1-s} \frac{c}{1-\gamma r - \lambda}}} - 1 \right).
\]

This is negative if and only if

\[
1 > \frac{\Psi - \frac{1}{(1-s)(1-\gamma)}}{\sqrt{\Psi^2 + \frac{1}{1-s} \frac{c}{1-\gamma r - \lambda}}}
\]

\[
\sqrt{\Psi^2 + \frac{1}{1-s} \frac{c}{1-\gamma r - \lambda}} > \Psi - \frac{1}{(1-s)(1-\gamma)},
\]

\[
\Psi^2 + \frac{1}{1-s} \frac{c}{1-\gamma r - \lambda} > \left( \Psi - \frac{1}{(1-s)(1-\gamma)} \right)^2.
\]

Substituting \(\Psi\), this simplifies to

\[
\frac{1}{(1-s)(1-\gamma)^2} - \frac{s}{1-s} \frac{1}{1-\gamma} < 1,
\]

which is true for \(\gamma \in (0, \frac{2}{1-s})\), hence especially for all \(\gamma \in (0, 1)\). \(\blacksquare\)

We now turn to the second part of the proposition and show that the aggregate loan volume increases in creditor rights \(\lambda\). The aggregate volume consists of three parts,

\[
V = \gamma + (1-\gamma)(1-q) + (1-\gamma)q(1-s)(1-q).
\]
Good borrowers (fraction $\gamma$) always get a loan after screening. Bad borrowers (fraction $1 - \gamma$) are accepted in the first round with probability $1 - q$. The third part consists of borrowers who have been rejected by the first bank, but then accepted by the second bank. The derivative with respect to $q$ is

$$\frac{\partial V}{\partial q} = -(1 - \gamma) \left( 2 (1 - s) + s \right),$$

which is negative. Because $q$ is decreasing in $\lambda$, this proves the second statement.

Concerning the third statement, the PD and its derivative with respect to $q$ are given by

$$PD = \frac{0 \cdot \gamma + 1 \cdot (1 - \gamma)(1 - q) + 1 \cdot (1 - \gamma) q (1 - s) (1 - q)}{\gamma + (1 - \gamma)(1 - q) + (1 - \gamma) q (1 - s) (1 - q)},$$

$$\frac{\partial PD}{\partial q} = - \frac{(1 - \gamma) \left( 2 (1 - s) + s \right)}{\left( 1 - q^2 (1 - \gamma) - q s (1 - \gamma) \right)^2},$$

which is negative. Because $q$ is decreasing in $\lambda$, this proves the third statement.

Proof of Proposition 2a. Consider $R^*$ as in (6), substitute $q^*$ as in (4), and set $s = 0$. Take the derivative with respect to $\lambda$, and then let $\lambda \to \lambda_{\text{max}}$ as in (5). Then the derivative converges,

$$\frac{dR^*}{d\lambda} \to 1.$$

This shows that better creditor rights can actually lead to greedier banks, charging higher interest rates.

For full information sharing, this effect disappears. Again consider $R^*$ as in (6), substitute $q^*$ as in (4), but now let $s \to 1$. Then $R^*$ turns into

$$R^* = r + \frac{c}{\lambda} + \frac{1}{2 \phi} - \frac{c}{\gamma} \log \left( \frac{c}{(r - \lambda)(1 - \gamma)} \right).$$

The derivative with respect to $\lambda$ is positive.

Now consider the profits of a single bank. Consider $\Pi_1$ as in (3), in the symmetric case with $R_1 = R_2 = R$ and $q_1 = q_2 = q$. Then substitute $R^*$ as in (6), substitute $q^*$ as in (4), and let $sto1$. The profit then becomes

$$\Pi_1 = \frac{\gamma}{4 \phi}.$$
This is a typical result in a setting à la Hotelling. Additional profits due to better creditor rights are completely competed away. The profit is independent from creditor rights.

For \( s = 0 \), for \( \lambda = \lambda_{\text{max}} \), profits are the same as with \( s = 1 \). However, competition becomes fiercer as creditor rights decrease. The lemons problem increases, thus banks want to be the first in line to make the borrower an offer. As a consequence, for \( s = 0 \), \( d\Pi/d\lambda > 0 \).

**Proof of Proposition 3a.** The dependence of the borrowers’ profits on creditor rights (Figure 4-1) cannot be shown formally. Typically, the borrowers’ profits decrease in creditor rights for full information sharing, but they increase in creditor rights in the absence of sharing. However, one can find numerical examples where the effects are exactly the other way around (for \( \lambda \) close to the maximum and \( c \) small). More tbw.

**Proof of Proposition 1b.** First, consider the equilibrium screening level \( q^* \) as a function of information sharing \( s \). The derivative with respect to \( s \) is positive if and only if \( \lambda > \lambda_{\text{max}} \), which is a contradiction. The aggregate loan volume is

\[
V = \gamma + (1 - \gamma) (1 - q^*) (1 + q^* (1 - s)),
\]

where \( q^* \) implicitly depends on \( s \). The derivative is

\[
\frac{dV}{ds} = (1 - \gamma) \left( q^2 - s \frac{\partial q}{\partial s} - q (1 + 2 (1 - s) \frac{\partial q}{\partial s}) \right).
\]

Inserting the optimal \( q^* \) from (4) and solving for \( \lambda \) shows again that the term is algebraically positive if and only if \( \lambda > \lambda_{\text{max}} \), hence in the parameter region where banks do not screen at all. As a result, \( dV/ds < 0 \). Finally, the PD depends negatively on \( s \) because of the one-to-one relation between PD and aggregate volume \( V \), just like in the proof of Proposition 1a.

**Proof of Proposition 2b.** tbw.

**Proof of Proposition 3b.** tbw.
B Micro-Foundations

Micro-Foundation of Individual Loan Demand (1). Assume that, like in the setting à la Hotelling, the entrepreneurs are located evenly along a straight line between banks 1 and 2. Costs of applying are quadratic in distance. From position $x$, the cost of applying at bank 1 are $t \cdot x^2$, those for applying at bank 2 are $t \cdot (1-x)^2$. Banks cannot observe $x$. Entrepreneurs apply before knowing whether they are good or bad. Hence, a entrepreneur is indifferent between banks if

$$
\gamma (Y - R_1) + (1 - \gamma) (1 - q_1) \lambda - t \cdot x^2 = \gamma (Y - R_2) + (1 - \gamma) (1 - q_2) \lambda - t \cdot (1-x)^2.
$$

(8)

We assume that $R_1$ and $R_2$ are announced, but screening decisions $q_1$ and $q_2$ are taken at a later stage. The screening decisions are also independent from interest rates and applicant volumes. Consequently, entrepreneurs anticipate banks to choose identical screening levels, hence terms $(1 - \gamma) (1 - q_1) \lambda$ and $(1 - \gamma) (1 - q_2) \lambda$ drop out of the equation. Solving (8) for $x$, we obtain

$$
x = \frac{1}{2} + \frac{\gamma}{2t} (R_2 - R_1).
$$

(9)

Because the entrepreneur at location $x$ is indifferent, all agents closer to bank 1 prefer to first apply at bank 1, then (if rejected) at bank 2. Consequently,

$$
L_1 = x = \frac{1}{2} + \frac{\gamma}{2t} (R_1 - R_2) \quad \text{and} \quad L_2 = 1 - x.
$$

(10)

This is (1) with $\phi = \gamma/(2t)$. Note that $L_1$ and $L_2$ denote the volume of entrepreneurs who first apply at bank 1 and 2, respectively. The aggregate loan volume of banks is larger.

Let us also calculate the aggregate application costs in symmetric equilibrium. All entrepreneurs apply at least once. The fraction of rejected entrepreneurs $(1 - \gamma) q$ will apply again. Hence, aggregate costs are

$$
C_{\text{App.}} = \left( 1 + (1 - \gamma) q \right) \left( \int_0^{1/2} t \cdot x^2 \, dx + \int_{1/2}^1 t \cdot (1-x)^2 \, dx \right) = \left( 1 + (1 - \gamma) q \right) \frac{t}{12} = \left( 1 + (1 - \gamma) q \right) \frac{\gamma}{24 \phi}
$$

(11)

because $t = \gamma/(2 \phi)$. This term will later be relevant in the welfare calculation. \textit{Per se}, rejecting entrepreneurs has a negative welfare effect because these entrepreneurs will apply somewhere else.
Micro-Foundation of the Cost Structure (2). The specific cost structure can be justified as follows. Assume that, by spending some $\bar{c}$, a banker can sort out a fraction $\bar{q}$ of bad applicants. Then, by spending another $\bar{c}$, and assuming that the ensuing negative signals are uncorrelated, the banker can sort out $\bar{q} + (1 - \bar{q}) \bar{q}$. Spending an aggregate of $3 \bar{c}$, the banker can sort out $\bar{q} + (1 - \bar{q}) \bar{q} + (1 - \bar{q})^2 \bar{q}$. By spending $n \bar{c}$, one can screen out an aggregate $q = \bar{q} \sum_{i=0}^{n-1} (1 - \bar{q})^i = 1 - (1 - \bar{q})^n$. Solving for $n$ yields $n = \log(1 - q) / \log(1 - \bar{q})$, so the costs for screening out $q$ bad entrepreneurs are $\bar{c} n = \bar{c} \log(1 - q) / \log(1 - \bar{q})$. Redefining $c := \bar{c} / \log(1 - \bar{q}) > 0$ yields an aggregate cost of $C(q) = -c \log(1 - q)$ to screen out a fraction of $q$ bad entrepreneurs, i.e., equation (2).

References


