



UNIVERSITÀ DEGLI STUDI DI ANCONA
DIPARTIMENTO DI ECONOMIA

**LEGAL SYSTEM EFFICIENCY,
INFORMATION PRODUCTION, AND
TECHNOLOGICAL CHOICE: A BANKING
MODEL**

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Legal System Efficiency, Information
Production, and Technological Choice: A
Banking Model¹

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Abstract

Recent empirical studies have shown that the structure of the legal system and the efficiency in law enforcement influence the financial structure of the firm, their ability to gain access to capital markets, and the growth rate of economic systems. This paper uses a simple banking model with ex-ante and ex-post information asymmetries between borrowers and lenders to analyse the effects that the efficiency of the legal system may exert on the credit market. Its main conclusions are: (i) an efficient legal system reduces loan interest rates and, in the majority of the cases, the average amount of defaults on loans; (ii) an improvement in the efficiency of legal institutions improves banks' selection procedures only provided the efficiency of the legal system is already high.

Keywords: Judicial enforcement of laws, information production, stochastic debt contracts.

JEL classification: G21, K41, K42.

1 Introduction

When firms borrow, they entitle investors to a flow of payments (in fixed or variable amounts) which will be paid in the future as a reward for an amount of money granted today. For this transaction to be sufficiently attractive, so that entrusting one's financial resources to someone else is deemed economically worthwhile, these rights must be protected, in order the firms' managements do not dissipate the money collected, but remunerate outside investors fairly¹. The degree of protection of creditors' rights depends crucially on the efficiency of the legal and judicial system, on the transparency degree of accounting rules, on the costs of the access to the judicial system, on the rapidity and certainty of courts' rulings, and so on. Investors finance firms because their rights are protected by the law. However, when information is incomplete and asymmetrically distributed and transactions are costly, protecting creditors' rights is an extremely costly and inevitably incomplete process. Those intending to finance a firm must therefore always spend some resources on gathering the information required to select the best applicants, i. e. those least likely to require legal action or recourse to some other form of credit protection. As the degree of protection of creditors' rights grows stronger, however, the incentives for creditors to screen and control debtors may become weaker, and this may increase on average the riskiness of firms (investment projects) financed. In other words, to some extent information production and legal protection may be substitutes.

The intimate linkages between law and finance are actually the center

¹These issues have been widely explored by literature on "property rights", "corporate governance" and "optimal bankruptcy procedures". For complete surveys on these literatures see Bebchuk (1997), Hart (1995, 1999), Shleifer and Vishny (1997), Schwartz (1998).

of a wide-ranging debate initiated by La Porta, Lopez-de-Silanes, Shleifer and Vishny (1997, 1998, 1999 henceforth LLSV). These authors show that the legal 'family' (Anglo-Saxon, French, German or Scandinavian) to which a legal system belongs, the content of laws, and the quality of law enforcement influence not only the degree of protection afforded to creditors' rights, but also the performance of capital markets. In particular, LLSVs' comparative studies depict a situation in which 'common law' countries (i. e. those with an Anglo-Saxon legal tradition) provide stronger protection for investors than do 'civil law' countries (i. e. those with a German, French or Scandinavian legal tradition). This feature may help to explain why countries belonging to the first group have more developed financial markets, more concentrated ownership, higher equity returns than do those belonging to the second one (Lombardo and Pagano, 1999). Levine (1998, 1999) and Beck et al. (1999) have extended the analysis to the banking system, noting that countries with more stringent enforcement of contracts and closer creditor protection are also those with more developed banking systems and a higher economic growth rates (both in terms of GDP and per-capita productivity)². Demirgüç-Kunt and Maksimovic (1998) and Rajan and Zingales (1998) have employed a cross-country statistical approach to show a strong positive correlation between the efficiency of the legal system and the growth of firms (or industries) dependent on external finance. Lastly, Cecchetti (1999) finds that the differences among legal systems have a substantial effect on monetary policy transmission channels.

The working of legal and judicial systems may be very different not only

²Other papers focusing on the influence of legal institutions and property rights enforcement on economic development as well as on the corporate performance are Scully (1988), Gray (1991), Knack and Keefer (1995), Mueller and Yurtoglu (1999).

from country to country, but also among regions belonging to the same law system. Usually, creditors' protection is more effective in the industrialized regions than in the backward ones. So, for instance, from a survey recently carried out by the Bank of Italy on a large sample of Italian banks, it was found out that in Southern regions (the so called 'Mezzogiorno') the practices for debt collection both through executive and bankruptcy proceedings take much more time (five additional months, in the case of bankruptcy proceedings, and over fifteen additional months in the case of personal estate executive proceedings) than in Centre or Northern regions, and the share of debt seized is sometimes also lower (Table 1). Moreover, the same survey showed that the difference in the length of debt collection is due essentially to an insufficient functioning of the law courts in Southern regions that, in turn, draws local creditors to rely on obstructionistic conducts (Table 2).

[Insert Table 1 and 2]

Going through this literature one could infer a clear-cut relationship between the efficiency of the legal system, the degree of protection accorded to creditors' rights and the sound performance of financial markets. The underlying idea seems to be that the more creditors are protected, the more debtors tend to behave accordingly to creditors' interests, thereby making it easier for an entrepreneur to get external funding³. However, as Manove, Padilla and Pagano (1998, p. 13) point out, "incentive problems also arise on the creditor's side". More effective protection of creditors' interests means that they have less incentive to screen and to control their counterparts, which

³Following this line of reasoning, Fabbri (2000) shows that a better judicial enforcement of laws mitigates moral hazard problems, reducing credit rationing phenomena and increasing the level of investment.

suggests that a more efficient legal system is not necessarily associated with better credit allocation.

This paper presents a banking model which assumes that the efficiency of the legal and judicial system affects screening costs as well as the results of monitoring (in terms of money recovered by banks) of bankrupted firms. More specifically, it considers a one-period competitive credit market characterized by both *ex-ante* and *ex-post* asymmetric information between banks and firms, both of which are assumed to be risk-neutral. Banks are unable to observe either the entrepreneurs' ability or the outcome of their investment projects. Entrepreneurs, indeed, may be of two types: the good ones, who can choose between two investment projects which, though they involve different levels of risk, are both of positive net present value; and the bad ones, who are able to implement only one type of project with a negative net present value. The number of good entrepreneurs in the economy is such that, from the banks' perspective, a randomly selected (from the original population) entrepreneur is endowed with a negative net present value investment project. Thus, the credit market exists if and only if banks use some creditworthiness tests to screen their customers. These tests allow banks to discriminate between types of entrepreneur. Despite the care taken in performing these tests, banks commit evaluation mistakes with a frequency inversely proportional to the amount of resources spent on that activity. The efficiency of the legal system influences both the screening costs and the amount of loans granted to defaulting firms which the banks are able to recover through bankruptcy proceedings.

The main results obtained are the followings: (i) the optimal debt contract is a stochastic standard debt contract according to which banks monitor only a portion of firms announcing default; the frequency of monitoring is

inversely related to the efficiency of the legal system; (ii) an increase in the legal system efficiency has contrasting effects on the optimal level of information production by banks: on the one hand, by reducing screening costs, it makes it more profitable for banks to increase the thoroughness of screening; on the other, by heightening the efficacy of bankruptcy procedures, it makes a careful selection of applicants less important; when the legal system is highly inefficient the negative effect on screening incentives prevails, whereas if creditors' claims are already adequately protected, the positive effect on screening incentives predominates; (iii) a large share of bad loans may be the result not only of the low ability of entrepreneurs but also of a legal and judicial system unable to enforce creditors' claims satisfactorily; (iv) an improvement in efficiency of the legal system gives rise to a reduction in loan interest rates and thus induces entrepreneurs to choose safer projects; this in turn gives rise to a further reduction in interest rates.

This paper draws from different research areas. Firstly, as just said, it refers to the debate on the extent to which the efficiency of capital markets and firms' investment choices depend on the protection given to creditors by bankruptcy procedures. According to this approach there is a trade-off between creditors' protection and the riskiness of externally financed projects or the level of specific investments in human capital undertaken by firms' management⁴. However, differently from the common approach featuring this literature, here we suppose that the average probability that financed firms will default (and therefore file for bankruptcy) depends on the amount of information produced by banks in screening those firms.

The issue of *ex-ante* information production by banks has been widely

⁴ Among others see papers by Bebchuk and Picker (1998), Berkovitch, Israel and Zender (1998).

explored in models based on information externalities on the credit market (Broecker, 1990; Riordan, 1993; Chiesa, 1998; Gehrig, 1998). These studies analyse the relation between competition on the loan market and the thoroughness with which banks screen their applicants. They show the existence of a 'winner's curse' dilemma, whereby more competition generally induces lenders to produce less information, with the consequence that the percentage of "bad" loans increases. Manove et al. (1998) show the negative influence of debt collateral guarantees on the incentive for banks to produce *ex-ante* information⁵. In contrast to these studies, in our model the statistical properties of the screening technology are derived endogenously (as in Gehrig, 1998). Moreover, the coexistence of both *ex-ante* and *ex-post* asymmetric information allows endogenous determination of the debt contract form as well, while also taking into account, as suggested by Stephen and Gillanders (1993), the consequences of post-contractual monitoring costs on the pre-contractual screening activity.

Finally the effect exerted on firms' technological choices by the transaction costs of dealings on the credit market has been recently examined by Bencivenga, Smith and Starr (1995) and Boyd and Smith (1996) within the literature on finance and growth. These studies argue that when auditing costs rise, firms tend to choose projects whose returns are more easily observable by outside investors, and they increasingly resort to capital markets. In this paper, by contrast, auditing costs can affect the incentive for banks to screen their applicants, as well as the interest rates that they choose, given that they are faced with an *ex-ante* moral hazard problem (i. e. the

⁵Conversely Rajan and Winton (1995) remark the positive effects of collateral or contractual clauses providing for loan covenants on the incentive for banks to conduct accurate *ex-post* monitoring of firms that they have previously funded.

'non-verifiability' of the technological choice made by good firms). As in Campbell and Chan (1992), the existence of both *ex-ante* and *ex-post* moral hazard problems (the latter stemming from the non-observability of projects' returns) produces a tendency to under-invest in safe assets (projects).

The paper is organized as follows: Section 2 describes the form of the credit-game and the role played by the legal system; Section 3 derives the form of the optimal debt contract; Section 4 examines the relation between the efficiency of the legal system and the information production; Section 5 analyses the relation between banks' pricing choices and firms' technological choices; Section 6 concludes.

2 A simple banking model with costly *ex-ante* and *ex-post* state verification

In this section we present a very stylized partial equilibrium model of a credit market characterized by both *ex-ante* and *ex-post* costly state verification in order to capture the basic intuitions described in the Introduction.

Let us consider a one-period credit market consisting of N risk-neutral entrepreneurs each of whom can undertake an investment project, and M risk-neutral lenders (banks) competing *a la* Bertrand and raising funds at zero interest rate. Each investment project requires one unit of resources. Entrepreneurs have no resources on their own, so that one unit of outside finance must be raised to fund the project. Lenders have enough capital to finance the entrepreneurs but they do not share with them the know-how to pursue the investment projects by themselves.

2.1 Entrepreneurs and project technologies

Any investment project generate a random return with two possible realizations: $y^H > 1$, in case of success, and $y^L = 0$, in case of failure. Project return is observed by the entrepreneur, whereas it is observable by outside financiers only bearing some fixed cost. Investment projects, however, are heterogeneous with respect to two further aspects: the first (exogenous to the model) concerns the entrepreneurial ability of individuals, the second (endogenously derived) the technology adopted by entrepreneurs. Both of these aspects affect the probability of success of any entrepreneurial project. More precisely the probability of success is $p_a(\tau) = (1 + \tau)a$, where a denotes the entrepreneur's ability and τ the chosen technology. For the sake of simplicity, we consider a highly stylized form of heterogeneity where both a and τ can assume just two values: $a = \{b, g\}$, with $0 < b < g < 1$, where b stands for bad entrepreneurs and g for the good ones; $\tau = \{0, h\}$ where 0 stands for the riskier technology and h for the safer one. We assume that only good entrepreneurs have the know-how to pursue the safer technology; hence the parameter h must be such that $h \leq \frac{1-g}{g}$. It follows that the probability of success of bad and good entrepreneurs is respectively:

$$p_b(0) = b \quad (1)$$

$$p_g(\tau) = \begin{cases} (1+h)g & \text{if } \tau = h \\ g & \text{if } \tau = 0 \end{cases} \quad (2)$$

The adoption of the safer technology by good entrepreneurs is costly. The cost function is $K(h) = kh$. Moreover we assume that good entrepreneurs are endowed with positive net present value (NPV) projects, but the safer technology, when self-financed, guarantees higher expected returns. Bad entrepreneurs' projects, instead, have negative NPV. Formally this is to assume that:

Assumption 1. $gy^H > \max(1, k)$; $by^H < 1$.

From a societal point of view, therefore, safe projects run by good entrepreneurs should be ever funded, while neither safe projects nor risky ones run by bad entrepreneurs should ever be. The proportion of good entrepreneurs with respect to the entire entrepreneur population is θ .

2.2 Law, Screening and Monitoring

The credit market is characterized by both ex-ante and ex-post asymmetric information. Firstly bankers know the share of type- g entrepreneurs but they are unable to distinguish them from the bad ones. Self-selection devices for entrepreneurs are not available⁶. Conversely, the banks are endowed with a costly screening technology: before granting a loan they may perform a creditworthiness test resulting in a noisy signal, S , of the applicant's ability.

Screening costs increase with the resources $s \in [0, \infty)$ (expressed in terms of effort) that the banks employ in evaluating a loan application⁷. However, besides s , screening costs also depend on *the quality and the efficiency of the legal system*. As stated in the Introduction, the efficiency of the legal system is a highly composite variable which comprises various aspects, such as the enforcement of property and contractual rights, bankruptcy procedures, and

⁶Contrary to what one might imagine, this does not follow from entrepreneurs' zero wealth hypothesis but it is a consequence of both the investors' risk-neutrality hypothesis and the linear form of expected returns function. Indeed, in this case it is easy to show (see Scalera and Zazzaro, 1999, Proposition A, pp. 272-74) that even if firms are endowed with positive wealth strictly smaller than the initial investment outlay, the equilibrium standard debt contract (which is the optimal contract, as we will show later) would be of *pooling type*.

⁷Banks have to spent resources on checking and evaluating financial statements as well as on gathering extra information on the quality of the applicants' projects.

the type of accounting rules. In order to handle this complexity, we reduce the quality and efficiency of a legal system to a single parameter $\ell \in (0, 1]$, something similar to the Law and Order Index, measured by the International Country Risk Guide or the Accounting Standard Index measured by the International Centre for Financial Analysis and Research⁸. When a country's corporate governance legislation is defective or its legal machinery does not perform properly (i. e. the courts are not able to enforce these laws rapidly and unambiguously) ℓ is low. In these cases gray economy and 'hidden' businesses are widespread, tax evasion and breaches of contracts are common, uneven accounting practices are the order of the day and economic dealings frequently involve corruption and nepotism. In a context of this kind, screening the entrepreneurs' ability becomes a highly costly activity for banks⁹. Formally, we assume that screening costs increase linearly with the screening intensity and they decrease convexly with ℓ :

$$C(s, \ell) = \frac{c}{\ell} s \quad (3)$$

with $c > 0$.

The signal obtained by banks from performing a creditworthiness test can assume only two values, i. e. $S = \{G, B\}$. Once the signal has been received, banks must decide whether or not to grant the loan; hence the set of feasible actions for a bank is $A = \{Y, D\}$, where Y denotes that the loan is granted and D that it is refused.

The greater the resources spent by banks on screening, the more accurate the signal becomes, i. e. the greater is the probability that a loan will

⁸These indicators have been used in several empirical studies. Among others see Knack and Keefer (1995), Demirgüç-Kunt and Maksimovic (1998) and Rajan and Zingales (1998).

⁹To simplify the analysis, we suppose here that ℓ affects only screening costs and not the screening outcome as well.

be granted to a good entrepreneur, or the lower the probability that bad projects will be funded. Let us call $\Pr(G|g, s)$ the probability that a bank will correctly recognize a good entrepreneur as a good one when the resources employed in screening loan applications are s , and $\Pr(G|b, s)$ the probability that it will erroneously evaluate a bad entrepreneur as a good one. The probability of correctly recognizing a good or a bad entrepreneur increases with s . More specifically, selecting an entrepreneur randomly from N , we assume that:

$$\Pr(G|g, s) = 1 - (1 - \alpha)e^{-\gamma s} \quad (4)$$

$$\Pr(G|b, s) = \alpha e^{-\gamma s} \quad (5)$$

where $\gamma > 0$ is a parameter measuring the information content of s , whereas $\alpha \in [0, 1]$ denotes banks' ability to recognize a good entrepreneur and $(1 - \alpha)$ their ability to recognize a bad one (i. e. an higher value of α denotes an higher probability of making type-II errors and a lower probability of making type-I errors)¹⁰. From (4) and (5) we can infer that, when s is 0, the probability of recognizing a good entrepreneur coincides with the probability of not recognizing a bad entrepreneur: in other words the signal received by banks is in this case totally uninformative:

$$\Pr(G|g, s = 0) = \Pr(G|b, s = 0) = \alpha.$$

In turn, at the limit, when banks employ an infinite amount of resources in their screening activity, the probability of committing type-I or type-II errors vanishes, i. e. the signal received by banks is fully informative:

$$\lim_{s \rightarrow \infty} \Pr(G|g, s) = 1 \text{ and } \lim_{s \rightarrow \infty} \Pr(G|b, s) = 0.$$

¹⁰A similar screening technology has been employed, among others, by Riordan (1993), Gehrig (1998), Zazzaro (1999).

Now assume that an unscreened project (i. e. a project screened at intensity 0) has a negative net present value:

Assumption 2. $[\theta(1+h)g + (1-\theta)b]y^H < 1$.

Assumption 2 simply states that loans granted to unscreened projects cannot be funded by banks, even when good entrepreneurs choose the safer technology. Consequently banks in equilibrium must exercise some positive screening effort in order for the credit market to exist.

Remark 1 Depending whether the share of good entrepreneurs is high or low with respect the probability of committing type-II errors, a greater screening effort increases or decreases the probability of receiving the signal G , i.e. $\frac{\partial \Pr(G)}{\partial s} \geq 0$ iff $\theta \geq \alpha$.

Proof. From (4) and (5) it follows that, $\Pr(G) = \theta - (\theta - \alpha)e^{-\gamma s}$. ■

Besides the type of borrower, banks cannot observe the returns on a project, unless they perform a costly monitoring activity. There is now a large body of literature on the optimal financial contract in a costly ex-post state verification (CESV) environment¹¹; the principal result is that, in a context of this kind, the optimal contract is the so-called *standard debt contract*, which specifies a fixed non-contingent repayment (principal plus interest). When the borrower fails to honor the contract, costly monitoring and bankruptcy procedures ensue, resulting in seizure of all borrower's earnings from the project by the lender.

However, we assume here that due to inefficiency in the legal system, when the borrower defaults the banks may not be able to extract all borrower's earnings - ascertained by means of monitoring - to which they are

¹¹The standard references are Townsend (1979), Diamond (1984), Gale and Hellwig (1985) and Williamson (1986, 1987).

contractually entitled. Indeed the amount of credit recovered by banks depends on the effectiveness of the legal and judicial system in protecting their claims. Where bankruptcy procedures do not enforce creditors' rights adequately, or when courts are inefficient, the debt recovery process may be costly, time-consuming, and highly uncertain in its outcome. In such a situation creditors may prefer to rely on some extra-judicial 'private' procedures, foregoing large parts of their credit.

From a formal point of view, we assume that for any unit of money ascertained by the auditor and owed to him, the amount he can seize from the borrower is just ℓ^{12} . The remaining $(1-\ell)$ units of money are kept by the borrower, who can therefore take advantage of the structural inefficiency of the legal system¹³. Conversely monitoring costs are in a fixed sum of $m > 0$ ¹⁴. Drawing on the CESV literature, in the next section we shall show that even in this enriched context the optimal financial contract is the so-called *standard debt contract* requiring a fixed non-contingent repayment R^H (principal plus interest) to be specified. When the borrower defaults, costly monitoring and bankruptcy procedures are carried out, and all borrower's *legally available* resources are seized. However, in contrast to standard CESV models, we shall show that it is not optimal for creditors always to monitor

¹²Differently than in Diamond (1996), we assume that liquidation of debtors' assets does not imply any deadweight losses. However, as the optimal contract is incentive compatible and $y^L = 0$, it remains true that in equilibrium banks never obtain anything from liquidation.

¹³Of course, inefficiencies of the legal and judicial system also imply some form of deadweight loss, like liquidation costs. For the sake of simplicity, we abstract from these costs (see note 12).

¹⁴Obviously, the inefficiency of the legal system or excessively "pro-debtor" bankruptcy procedures can also affect monitoring costs. However, for the sake of simplicity, here we assume that monitoring costs do not depend on the legal machinery performance.

debtors' default statements.

2.3 The credit game

To sum up the discussion so far, banks and entrepreneurs play the following game:

Time 0: Nature chooses the entrepreneurs' ability and reveals it to them.

Time 1: Banks decide the loan interest rate and make their decision public. Individuals apply for loans and choose the project technology.

Time 2: Banks screen loan applications and decide whether or not to satisfy the demand for credit.

Time 3: Investment projects generate their returns which are privately observed by entrepreneurs. Entrepreneurs announce the investment returns to banks, which decide whether or not to audit the announcement.

The equilibrium is given by: (i) an amount of resources, s^* , devoted to the screening of loan applications; (ii) a lending rule $\Lambda^* = \{\lambda|S = G; \lambda|S = B\}$, for $\lambda = Y, D$; (iii) a gross interest rate R^{H^*} which holds the banks' expected payoff at zero; (iv) a probability (or frequency) q^* of auditing failure announcements by borrowers; (v) a technological choice $\tau = \{0, h\}$ made by good entrepreneurs in order to maximize their expected payoff.

3 The optimal debt contract

As in all CESV models, with $y^L = 0$ as a possible project outcome, the financial contract must be such that lenders monitor their counterparts in some states of the world. If they do not, it is always optimal for borrowers to claim a null-return, which means banks would never recover granted loans. Consequently, the contract must specify a stream of payments R^j , contingent on

the investment outcome announced by the borrower, $j = \{H, L\}$, the states of the world in which monitoring occurs, and a stream of payments F^{ji} contingent on both the borrower's announcement and the monitoring outcome, where $i = \{H, L\}$ is the true cash-flow realized. In that monitoring is costly, it takes place only when the borrower declares bankruptcy, i. e. when $j = L$. However, this does not imply that the lender has to monitor *all* bankrupted borrowers, as is generally assumed in CESV models. Following Border and Sobel (1987), Townsend (1988), Mookherjee and Png (1989) and Boyd and Smith (1994), indeed, it is possible to conceive a more complex debt contract where the lender commits himself to audit the borrower's bankruptcy announcement only stochastically¹⁵.

As far as payments R^j are concerned, given the standard limited liability clause, we have that $R^L = y^L = 0$, and $R^H \leq y^H$. When the borrower defaults and the bank decides to audit, the true investment outcome is ascertained. If a false announcement is made, the payment owed to the bank is $F^{LH} \leq y^H$ (of course, $F^{LL} = y^L = 0$). However, although the auditing activity reveals the true investment cash-flow with certainty, the lender is able to recoup just a portion ℓ of F^{LH} .

Given the assumption of Bertrand competition among banks, the optimal contract is the incentive-compatible one (inducing truthful revelation of the state of the world by the borrower) which maximizes the borrower's expected payoff, subject to the lender's participation constraint. As already pointed out, the banks need to screen loan applicants and this gives rise to two possible results: the creditworthiness test is passed or it is failed. Therefore, in principle, two different contracts should be drafted, one for

¹⁵Obviously the ex-ante probability that a failed borrower will be audited coincides exactly with the frequency with which failed borrowers are audited.

type-G entrepreneurs and the other for type-B entrepreneurs. However this eventuality can be excluded by the following proposition.

Proposition 1 *If in equilibrium banks consider it convenient to devote a positive amount of resources to the screening of loan applicants, the optimal lending rule is $\Lambda^* = \{Y|S = G, D|S = B\}$. Otherwise the optimal lending rule is $\Lambda^{**} = \{D|S = G, D|S = B\}$ and the credit market collapses.*

Proof. The proof follows directly from Assumption 2 and from the fact that the screening technology is informative, i.e. from the fact that, applying Bayes' rule to (4) and (5), $\Pr(g|B, s^* > 0) < \theta$, and $\Pr(b|G, s^* > 0) < (1 - \theta)$, where s^* denotes the optimal screening effort (to be derived below). ■

Hence the optimal lending rule states that banks should refuse loans to entrepreneurs who have not passed the creditworthiness test. Consequently, the optimal debt contract must be drafted in such a way as to maximize the expected type- g borrowers' payoff. More precisely the optimal incentive-compatible contract results from the following program:

$$\max_{R^H, F^{HL}, q, s} E(\pi^E) = p_g(y^H - R^H)$$

$$\text{s. t. } y^H - R^H \geq q[y^H - \ell F^{HL}] + (1 - q)y^H \quad (\text{IC})$$

$$\begin{aligned} E(\pi^B) &= \Pr(G)[b + (p_g - b)\Pr(g|G)]R^H + \\ &- \Pr(G)[(1 - b) - (p_g - b)\Pr(g|G)]qm - \frac{c}{\ell}s - \Pr(G) = 0 \end{aligned} \quad (\text{PC})$$

$$R^H \leq y^H; F^{HL} \leq y^H; 0 \leq q \leq 1$$

where $p_g = p_g(\tau)$ is the probability of success of good entrepreneurs (which assumes one of the values as in (2)), and q is the probability that the bank

audits the borrower's failure claim. The first constraint is designed to induce truthful announcement from the borrower (Incentive-Compatible constraint); the second is necessary in order to induce the lender to accept the contract (Participation Constraint). The last set of constraints is required to enable the drafting of a feasible contract.

Proposition 2 *Provided that the signal resulting from the screening activity is G , the optimal payment schedule is $R^{H*} = \frac{[cs^* + \ell \Pr(G)]y^H}{\Pr(G)[(\ell y^H + m)(p_g - b)\Pr(g|G) + b] - m}$, when the borrower announces 'success', and $R^{L*} = 0$ when the borrower announces 'failure'. In the latter case the borrower's announcement will be audited with probability $q^* = R^{H*}/\ell y^H$, and if the auditing reveals a false announcement the payment is $F^{LH} = y^H$.*

Proof. From the IC constraint the minimum auditing probability which induces truthful announcement is:

$$q^* = \frac{R^{H*}}{\ell F^{LH}} \quad (6)$$

From the PC constraint it follows that R^H is positively related to q . Hence, the borrower's expected payoff is maximized for the minimum q -value such that the IC constraint holds with equality, i. e. for $q = q^*$ and $F^{LH} = y^H$. Substituting these values in the PC constraint and solving it with respect to R^H yields the payment schedule defined in the Proposition ■

Therefore, whatever the optimal screening effort, the optimal contract is a particular kind of standard debt contract which commits the lender to auditing the announcements by failed borrowers on a sufficient number of occasions to induce them to be truthful¹⁶. Moreover the conditions stated

¹⁶To be precise, in that monitoring is costly, the problem that the contract is renegotiation-proof may arise. Banks may indeed announce they will audit their failed

by the optimal contract, but not its form, depend on the technological choice made by good entrepreneurs.

Since, as we shall show in the next section, R^{H*} decreases with ℓ , if for $\ell = 1$ the credit market works, there will always exist a minimum legal system efficiency level at which (and above which) the optimal debt contract requires only a *stochastic monitoring* by the lender. Banks will therefore monitor all failed firms only when the legal system is highly inefficient. The contention is that the more efficient the auditing activity (in terms of both monitoring costs and percentage of credits recovered), the less frequently will it be necessary for the lender to monitor its counterparts in order to persuade them to report the outcomes of their projects truthfully. Indeed, even if borrowers know that there is a lower probability of being audited, they also know that when they are audited, they will be forced to pay the lender a higher share of their income. Thus whenever (and wherever) the legal system and the monitoring technology are efficient enough, the lender does not need to monitor the borrower whenever the latter declares bankruptcy.

4 Information production

Thus far we have defined the optimal lending rule and the optimal debt contract. However a complete representation of the credit market equilibrium requires us to determine the resources that banks decide to invest in screening their loan applicants and the technological choice made by good entrepreneurs.

debtors with probability $q^* > 0$ but than they may never do so. For the sake of simplicity we exclude this possibility by implicitly assuming that a commitment technology exists such that banks can credibly commit themselves to monitor failure announcements with an exact frequency q^* .

Provided banks compete *à la* Bertrand, the optimal screening intensity is given by the value of s that minimizes the equilibrium debt face value R^H (i. e. the debt face value for which the bank Participation Constraint is satisfied with equality), subject to the feasibility condition $R^H \leq y^H$:

$$\min_{s \geq 0} R^H = \frac{[cs + \ell \Pr(G)] y^H}{\Pr(G) \{(\ell y^H + m) [(p_g - b) \Pr(g|G) + b] - m\}} \quad (7)$$

s.t. $R^H \leq y^H$.

The optimal screening intensity can thus be implicitly determined by the following expression:

$$\frac{\ell y^H + m}{m} \left\{ b + (p_g - b) \Pr(g|G) - \frac{(p_g - b) \Pr(G) \frac{\partial \Pr(g|G)}{\partial s} [cs^* + \ell \Pr(G)]}{c[\Pr(G) - s^* \frac{\partial \Pr(G)}{\partial s}]} \right\} = 1 \quad (8)$$

Equation (8) is derived from the first order condition employed to minimize the program described in (7), assuming of course that the denominator of the interest factor R^H expression is different from 0. The second order condition is satisfied by referring to the model construction¹⁷.

Given Assumption 2, at $s = 0$, $R^H > y^H$. If $\frac{\partial R^H}{\partial s}|_{s=0} < 0$, then the solution to the minimization program (7) assumes positive values. If we denote this solution with s^* , whenever $R^H(s^*) > y^H$ there is no screening intensity s such to induce banks to participate in the credit market. In this latter case, we may state that the solution for the minimization program is $s^* = 0$ and the credit market collapses.

Proposition 3 *An improvement in the legal system efficiency causes a reduction in the equilibrium interest factor R^{H*} . If the net present value of an*

¹⁷ Indeed it is possible to show that the second derivative of the objective function with respect to s is always positive.

un-screened project is not particularly negative and if the screening technology is sufficiently informative, then a minimum efficiency level of the legal system $\underline{\ell} \leq 1$ can be found such that the credit market exists, i. e. such that $R^H(s^*) = y^H$.

Proof. An improvement in the legal system efficiency leads to an increase in banks' expected profits. It follows that when ℓ rises the entire relationship between R^H and s described by expression (7) shifts downwards and hence, if $s^* > 0$, $R^H(s^*)$ shrinks. Moreover, from (8) it is easy to prove that $\frac{\partial \ell}{\partial \gamma} < 0$. It follows that, if neither θ nor $(p_g - b)$ are close to 0 (i.e. if $R^H(0)$ is not particularly larger than y^H) and γ is sufficiently high (i.e. if the screening technology is very informative), there is a legal system efficiency level $\underline{\ell} \leq 1$ above which the constraint $R^H(s^*) \leq y^H$ is satisfied ■

Proposition 3 states that when the legal machinery performs satisfactorily, the costs incurred by banks in screening and monitoring their customers are low, and loan interest rates are on average lower than those fixed by banks in countries in which the legal system is inefficient. This, however, does not imply that the intensity with which entrepreneurs are screened by banks is unambiguously related to the efficiency of the legal system. Indeed a more efficient legal system reduces marginal screening costs but it does reduce marginal screening benefits as well. The benefit accruing to banks from screening is proportional to auditing costs they are able to avoid because of previous screening activity. An increase in ℓ reduces the frequency with which banks check their borrowers' announcements, so that accurate screening of entrepreneurs' ability becomes less profitable. These observations motivate the following proposition:

Proposition 4 *The optimal contractual auditing frequency is always decreasing in ℓ . Conversely, when marginal screening costs c are sufficiently*

high with respect monitoring costs m , the optimal screening intensity may be decreasing in ℓ .

Proof. The first part of Proposition can be directly derived from equation (6). As regards the second part, we know that $\text{sign} \frac{\partial s^*}{\partial \ell} = -\text{sign} \frac{\partial^2 R^H}{\partial s \partial \ell} |_{s=s^*}$. By means of equation (8), it is easy to show that $\frac{\partial s^*}{\partial \ell} \geq 0 \Leftrightarrow \ell \geq \hat{\ell}$, where

$$\hat{\ell} = \frac{c[\text{Pr}(g|G)(p_g - b) + b][\text{Pr}(G) - s^* \frac{\partial \text{Pr}(G)}{\partial s}]}{2 \frac{\partial \text{Pr}(g|G)}{\partial s} \text{Pr}(G)^2 (p_g - b)} - \frac{cs^*}{2 \text{Pr}(G)} - \frac{m}{2y^H}$$

From Bayes's rule, $\text{Pr}(g|G) = \frac{\theta[1-(1-\alpha)e^{-\gamma s^*}]}{\text{Pr}(G)}$, and then $\frac{\partial \text{Pr}(g|G)}{\partial s} = \frac{\alpha \gamma \theta (1-\theta) e^{-\gamma s^*}}{\text{Pr}(G)^2}$. Substituting these expressions and that for $\text{Pr}(G)$ in $\hat{\ell}$, it follows that

$$\hat{\ell} > \underline{\ell} \Leftrightarrow c > A \text{Pr}(G) \left(\frac{m + 2y^H \underline{\ell}}{y^H} \right)$$

where, $A = \frac{\alpha \gamma \theta (1-\theta) (p_g - b) e^{-\gamma s^*}}{[\theta(1-(1-\alpha)e^{-\gamma s^*})(p_g - b) + b(\theta - (\theta - \alpha)e^{-\gamma s^*})][\theta - (\theta - \alpha)(1 + s^* \gamma) e^{-\gamma s^*}] - s^* \alpha \gamma \theta (1-\theta) e^{-\gamma s^*} (p_g - b)} > 0$. ■

[Insert Figure 1]

Of course both the efficiency of the legal system and the accuracy of screening affect the amount of expected defaults on granted loans. More precisely it is easy to demonstrate the following proposition:

Proposition 5 *In equilibrium the larger the amount of information collected by banks (i.e. the higher the screening effort s^*), the smaller the proportion of expected defaults on granted loans, d^e .*

Proof. The share of expected defaults on loans granted by banks is given by

$$d^e = (1 - b) - \text{Pr}(g|G)(p_g - b) \quad (9)$$

and hence ,

$$\frac{\partial d^e}{\partial s^*} = -\frac{\theta(1-\theta)\alpha\gamma e^{-\gamma s^*}}{\Pr(G)}(p_g - b) < 0.$$

■

Proposition 3 states that, when the proportion of good entrepreneurs the bank may meet is low and the legal system is highly inefficient, a small improvement in its functioning may reduce the frequency of bank auditing so substantially that the benefits from screening loan applicants decrease more than do the associated costs. In these circumstances, banks find it worthwhile to rely on the ex-post seizure of borrowers' earnings and to reduce their screening effort. When, instead, the legal system is sufficiently efficient and the ability of entrepreneurs is high, ex-post vetting by lenders of their customers is unusual. It follows that a further increase in the efficiency of the legal system reduces screening costs more than the relative benefits, and consequently makes it more convenient for banks to gather more ex-ante information on entrepreneurs' ability, thereby reducing the number of expected defaults. Clearly, both the efficiency of legal system and entrepreneurial talent are usually poorer in backward regions. This means that, though in backward regions an important cause of a badly performing credit market is often a highly rudimentary legal system, (even non-marginal) reforms intended to improve the latter may reduce the accuracy with which lenders screen their loan applicants. As a consequence, a larger number of bad firms are financed through the credit market (for instance, in figure 1, assuming that the initial legal system efficiency level is ℓ_0 , legal reform policies may induce banks to step up their information production activity only if these policies raise the efficiency level of legal institutions to above ℓ_1).

From a more general point of view, the non-monotonic relation existing between information production (or screening intensity) and the efficiency of

the legal system may suggest an interesting policy observation. In markets with significant forms of asymmetric information, like the credit market, the protection afforded by non-market institutions (like the legal system) may in some cases substitute for the self-protection devices devised by private individuals. For this reason, policies intended to improve the efficiency of those institutions may give rise to perverse effects, especially when they are of limited magnitude. If the intention is to increase the efficiency of the legal system, the measures aimed to reach this goal must be conceived in order to push this efficiency beyond some critical threshold, otherwise we may be confronted with bad surprises regarding a lower efficiency of the credit market.

5 Legal system efficiency, and technological choices

Thus far the probability of success of good entrepreneurs has been generally denoted with p_g , a parameter which, however, can assume one of the two different values depending on chosen technology. By assumption, the safer technology is the first best solution pursued by good entrepreneurs if they are able to self finance the investment. In fact, when investment project must be funded from outside, the technology $\tau = h$ is still the optimal choice iff $h(y^H - R^H) - k \geq 0$. This expression trivially asserts that investment in technological improvements is worthwhile for entrepreneurs if and only if the net gains therefrom are positive. For good entrepreneurs, therefore, the optimal technological choice depends on the interest factor R^H . In particular

the technological choice by good firms will be:

$$\tau = \begin{cases} h & \text{if } R^H \leq \bar{R}^H = y^H - \frac{k}{h} \\ 0 & \text{if } R^H > \bar{R}^H = y^H - \frac{k}{h} \end{cases} \quad (10)$$

Firms' technological choices are not verifiable, which means that contract cannot be made contingent on them. This aspect gives rise to a second potential moral hazard problem in the model. If the loan interest rate announced by banks is too high, then entrepreneurs will find it convenient to declare their decision to adopt the safer technology although, once the loan has been granted, they will not make the investment necessary to implement it. However the probability distribution of any type of project return as well as the distribution of the entrepreneurs' population is common knowledge. Bankers are consequently aware of the existence of the potential moral hazard problem mentioned above. In other words, banks know that if the equilibrium interest factor is lower than $\bar{R}^H$ entrepreneurs will choose the safer technology, otherwise they will opt for the riskier one. Thus the assessment of any bank will be that, given the optimal debt contract, the probability of being refunded by good entrepreneurs will be:

$$p_g = \begin{cases} (1+h)g & \text{if } R^{H*} \leq \bar{R}^H \\ g & \text{if } R^{H*} > \bar{R}^H \end{cases} \quad (11)$$

Proposition 6 *There exists a legal system efficiency level $\tilde{\ell} > \underline{\ell}$ such that the equilibrium interest factor $R^{H*} = \bar{R}^H$, and*

$$R^{H*} = \begin{cases} \frac{[cs^* + \ell \Pr(G)]y^H}{\Pr(G)\{(ty^H + m)[(g-b)\Pr(g|G)+b]-m\}} & \text{if } \ell \leq \tilde{\ell} \\ \frac{[cs + \ell \Pr(G)]y^H}{\Pr(G)\{(ty^H + m)[(1+h)g-b]\Pr(g|G)+b]-m\}} & \text{if } \ell > \tilde{\ell} \end{cases} \quad (12)$$

Proof. The proposition trivially follows from the observation that, from (10), $\bar{R}^H < y^H$ and, from Proposition 3, $\frac{\partial R^{H*}}{\partial \ell} < 0$. ■

[Insert Figure 2]

The relationship between the equilibrium interest rate on the credit market and the efficiency of the legal system is thus a discontinuous function as represented in Figure 2. Of course this discontinuity stems from our hypothesis that there are only two types of entrepreneur and two types of technology. More generally, however, if we assume the existence of a continuum of technologies available to an entrepreneur, the interest rate will be much more elastic to the efficiency level of the legal system. Indeed, a legal reform which introduces more efficient rules and better-performing judicial institutions induces banks to lower the interest rate. But this in turn makes it convenient for some firms to invest in safer (or more productive) technologies, giving rise to a further reduction in the interest rate.

It follows that high interest rates and a large proportion of defaults on bank loans which typify weak regions may not necessarily be due to low average entrepreneurial ability or to a very strong market power of the banks themselves. This evidence may instead be due to an inefficient legal machinery which incentives lenders to increase interest rates, thereby inducing firms to undertake riskier investment projects.

Nonetheless, apart from the interest factor, the probability of success of good entrepreneurs also affects the screening strategy of banks.

Proposition 7 : *If the marginal screening costs c/ℓ are high, the optimal screening intensity s^* decreases when entrepreneurs adopt the safer technology.*

Proof. As before, we know that $\text{sign} \frac{\partial s^*}{\partial p_g} = - \text{sign} \frac{\partial^2 R^H}{\partial s \partial p_g} |_{s=s^*}$. By differentiating the implicit equation (8)¹⁸ it is easy to show that

¹⁸Of course, in principle, given that only two level of p_g exist in our model, we cannot

$$\frac{\partial s^*}{\partial p_g} \geq 0 \Leftrightarrow \frac{\frac{\partial \Pr(g|G)}{\partial s} [s + \frac{c}{\ell} \Pr(G)]}{\Pr(g|G) [\frac{\Pr(G) - s(\partial \Pr(G)/\partial s)}{\Pr(G)}]} \leq 1$$

Using equations (4) and (5) and developing this inequality it follows that

$$\frac{\partial s^*}{\partial p_g} \geq 0 \Leftrightarrow$$

$$\frac{c}{\ell} \leq \frac{\alpha\gamma(1-\theta) [\theta - (\theta - \alpha) e^{-\gamma s^*}] e^{-\gamma s^*}}{[(1 - (1 - \alpha) e^{-\gamma s^*})] [\theta - (\theta - \alpha) (1 + s^*\gamma) e^{-\gamma s^*}] - s^*\alpha\gamma(1 - \theta) e^{-\gamma s^*}}.$$

■

Therefore, when the marginal screening costs are low, then an inefficient legal system which determines an equilibrium interest factor above $\bar{R}^H$ - thereby inducing good entrepreneurs to choose riskier projects - will cause a lower information production on entrepreneurs' ability and consequently, recalling Proposition 5, a higher observed default share in the economy. If, instead, the marginal costs of screening are high, the inefficiency of the legal system on the one hand induces good firms to opt for riskier businesses, giving rise to a reduction in p_g , while on the other, it makes it worthwhile for banks to devote greater effort to screening, exactly because of this contemporary p_g reduction. In this case, paradoxically, the inefficiency of the legal system has an ambiguous effect on the credit market's performance (in terms of the average quality of financed projects) and on the average share of non-recovered debts: good firms choose the riskier technology, which is inefficient from the social welfare point of view; but at the same time the percentage of bad firms that obtain credit decreases.

use differential calculus. However, since the sign of the derivative does not depend on p_g , the conditions satisfied following the continuum approach are also satisfied following the discrete one.

6 Conclusions

Recent empirical researches have convincingly shown that the structure of the legal system and its efficient operation influence the financial structure of firms, their ability to gain access to capital markets, and the growth of economic systems. This article used a simple banking model with ex-ante and ex-post information asymmetries between borrowers and lenders to analyse the effects that the efficiency of the legal system may exert on the performance of the credit market. Its main conclusions have been that (i) when the legal system is efficient, loan interest rates are lower; (ii) a large amount of defaults on loans may be due not only to a pool of low-skilled entrepreneurs or to the market power of banks but also to a legal system unable to adequately protect the credit rights of banks; (iii) if improvement in the efficiency of the legal institutions is to have a beneficial effect on bank screening procedures, and on their accurate selection of firms to finance, the efficiency of the legal system must exceed a certain threshold.

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Table 1. Length of debt collection and share of debt seized

Regions	Length of personal estate executive proceedings (months)	Length of real estate executive proceedings (months)	Length of bankruptcy proceedings (months)	Secured debt recovered through real estate executive proceedings (%)	Unsecured debt recovered through personal estate executive proceedings (%)	Secured debt recovered through bankruptcy proceedings (%)	Unsecured debt recovered through bankruptcy proceedings (%)
North	57	19	71	65	18	51	11
Centre	68	20	72	55	12	49	9
South	72	26	76	59	28	41	14

Source: Generale and Gobbi (1997, p. 201).

Table 2. Factors causing the length of debt collection*

Regions	Delaying tactics of debtors	Overload of work for law courts	Insufficiency of law	Judicial practices favourable for debtors	Other
North West	1,84	2,67	1,61	1,57	1,30
North East	1,61	2,60	1,72	1,40	1,19
Centre	1,75	2,78	1,70	1,63	1,26
South	1,95	2,87	1,65	1,85	1,11
Italy	1,79	2,73	1,67	1,61	1,22

Source: Generale and Gobbi (1997, p. 198).

* 1 = Unimportant; 2 = Important; 3 = Very Important.



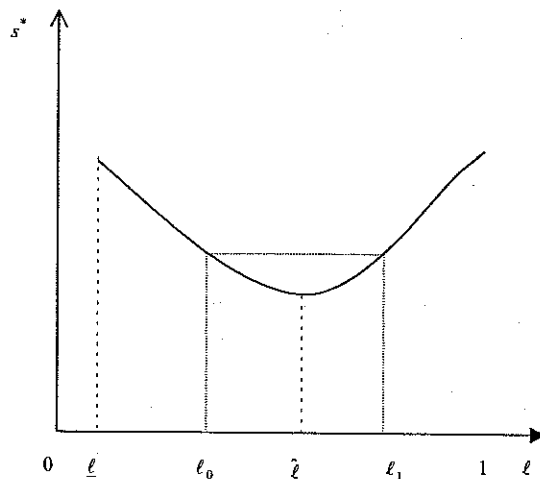


Figure 1. The Efficiency of the legal system and the optimal screening intensity

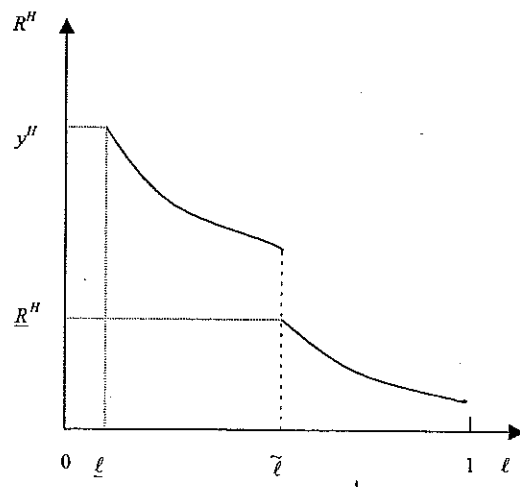


Figure 2. The Efficiency of the legal system and the loan interest rate

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