THE IMPACT OF LEGAL SANCTIONS ON MORAL HAZARD WHEN DEBT CONTRACTS ARE RENEGOTIABLE.

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Abstract:
This research investigates how bankruptcy law influences the design of debt contracts and the investment choice through the sanction of faulty managers. We model a lending relationship between a small firm and a monopolistic bank which decides the loan rate. The firm may perform asset substitution, which is punished by the Law through legal sanctions. These sanctions are implemented in case of costly bankruptcy only. This way of resolving financial distress can be avoided yet, if a private agreement is achieved.
First, – when sanctions are high – we show that costly bankruptcy may be preferred by honest firms over private negotiation. Thus costly bankruptcy cannot be avoided under a severe legal environment. However, as the bank internalizes the rules of default, debt contracts are designed so that this situation never happens at equilibrium (“legal efficiency”).
Second, a peculiar legislation may incite banks to accept generalized moral hazard (“economic inefficiency”). Then, the legislator can indirectly enforce economic efficiency. However he must consider effects beyond the simple comparison between legal sanctions and bankruptcy costs, and focus on the impact of such legal sanctions on the design of the debt contract.
Simulated results show that even small changes of legal sanctions may have drastic effects on the firm’s investment policy. Besides, it appears that extreme severity (i.e. 100% of the manager’s wealth is subject to legal sanctions) is not needed to ensure economic efficiency. Last, in some cases, the legislator may have the choice between several levels of legal sanctions all leading to economic efficiency: when choosing between them, the legislator affects the profit sharing only.

Keywords: Bankruptcy, Credit Lending, Moral Hazard, Sanctions

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1. Introduction

Bankruptcy law has received considerable attention from academics because of its implications regarding the continuation of firms and of its impact on the financing and investment decisions of firms. Two complementary aspects of the “efficient bankruptcy” have been thoroughly investigated. On the one hand, *ex-post* efficiency of bankruptcy law focuses on the maximization of value of the distressed company by considering all the stakeholders: financial distress is considered as given. On the other hand, *ex-ante* efficiency analyzes the effects of bankruptcy law on the incentives of all involved parties (managers, creditors).

The literature on *ex-post* efficiency of bankruptcy codes investigates the tradeoff between rival ways of resolving financial distress: following the Coase theorem, Haugen and Senbet [1978] and [1988] prove the superiority of the market solution over the legal one, through a mechanism of internalization of bankruptcy costs. On the contrary, but following the same *ex-post* perspective, other authors investigate the advantages of implementing particular procedures to distressed firms (different from simple renegotiation): auctions and options (Bebchuk [1988] and [2000]), or procedures allowing deviations from the absolute priority rule (Jackson [1986], Baird and Picker [1991], Blazy and Chopard [2005]). Nevertheless, the major drawback that can be addressed to the *ex-post* view is that it ignores the impact of such procedures – whatever their design – on the strategies taking place before default. Then, turning to the literature on *ex-ante* efficiency of bankruptcy codes provides interesting views on how bankruptcy influences managers’ and creditors’ behavior in the presence of information asymmetries (Aghion and Bolton [1992]; Berkovitch and al. [1998]). However, it does not provide an explicit explanation of the influence of bankruptcy law on the design of debt contracts. Namely, as former papers such as Cornelli and Felli [1997] show the influence of bankruptcy law on creditors’ behavior in terms of monitoring firm behavior or granting
loans, bankruptcy law may also influence the design of debt contracts through the recovery process. Our paper tries to fill the gap between *ex-post* and *ex-ante* approaches to bankruptcy, by addressing two issues: first, the process of internalization of bankruptcy costs through private renegotiation under asymmetric information (*ex-post* “legal efficiency”); second, the financing and investment decisions which are taken formerly to possible financial distress (*ex-ante* “economic efficiency”).

When focusing on the fundamentals of bankruptcy codes, the literature isolates three major functions of the “Court solution”: First, bankruptcy codes play a crucial role in the coordination of conflicts of interest between diverse claimants. Without any coordination between creditors, distressed firms are likely to be dismantled through an anarchic creditors’ run, which eventually reduces the value of the firm. This common pool problem has been addressed by Bulow and Shoven [1978], Gertner and Scharfstein [1990], and more recently by Longhofer and Peters [2004]. Through specific legal mechanisms (stay of claims, specific voting procedure, and/or Court enforcement, *etc.*), the design of bankruptcy codes helps solving the lack of coordination between the creditors. Second, bankruptcy codes produce information, through the implementation of audit procedures, monitored – directly or not – by the Court. This characteristic is linked with the literature regarding the economic justification of standard debt contracts (Townsend [1979], Gale and Hellwig [1985]). Such debt contracts are efficient as they limit the occurrence of states of the nature under which the creditors have to check the actual value of the debtor’s assets. Here, the costly state verification process takes place only when the debtor cannot repay its debt anymore, which is the most common triggering criterion of formal bankruptcy. Third, bankruptcy codes are superior to the out-of-court solution, in the sense they help in the determination of the value of assets and of claims. By forcing or deviating from the absolute priority order (White [1989], Hart [2000]), by helping in the verification of claims, and/or in the distinction between anterior, posterior, junior, and senior claims, or by transferring the management from the previous directors to the creditors (Harris and Raviv [1991]), bankruptcy codes settle specific rules which, eventually, reduce uncertainty. In a sense, this third function of bankruptcy can be viewed as a mix of the two previous functions (coordination and information).
In our paper, we focus on a fourth function of bankruptcy: the sanction of faulty managers. Indeed, this feature is the angular stone of the modern approach to bankruptcy. Until the middle of the twentieth century, in major developed countries, bankruptcy codes did not distinguish the firm’s fate from the manager’s one. Financial distress had to be punished every time, as a sanction resulting from the non-respect of previous financial commitments. On the contrary, in most modern economies nowadays, it is widely admitted that default may be due to lack of chance or to unfavorable economic environment. From that perspective, legal sanctions should apply to faulty managers only, whose bad or tricky choices increase, eventually, the financial consequences of default. We consider this issue as fundamental here. Following Bester [1985], one could argue that implementing external collateral on the manager’s patrimony is an efficient means to reduce moral hazard incentives. Indeed, such personal guarantees are an efficient way to discriminate between good and bad risks. Yet, the systematic use of such collaterals, by breaking limited liability, may lead to under-investment. Thus, we focus on the role of legal sanctions, which have the advantage on external collateral to be enforceable each time moral hazard is discovered. Of course, this implies a costly state verification process, which is one of the fundamental functions of bankruptcy.

In this paper, we model a three stage lending relationship between a monopolistic bank and a small firm, directed by a shareholder-manager. The bank proposes a loan rate to the firm, which directly affects the firm’s probability of default. The firm’s manager has initial incentives to perform asset substitution at the time of investment: after the funds are leveraged, he can undertake a riskier and less profitable investment project, contrary to the one announced to the bank (this remains the manager’s private information). In case of default, a bankruptcy procedure may be triggered off: then, a costly state verification process takes place and legal sanctions may apply to the manager, if it appears he has previously performed moral hazard. Costly bankruptcy can be avoided yet, if the firm achieves a private agreement with the bank.

The structure of the paper is as follows. Section 2 presents the general structure of the model. In section 3, we solve the model. We provide some simulations and discuss the results in section 4. Section 5 concludes.
2. The Model: General Structure and Hypotheses

We describe in this section the general structure of the model and the basic hypotheses. The model analyzes a single lending relationship between a small firm managed by a shareholder-manager (named “the Firm”, in the rest of the paper) and a monopolistic bank (named “the Bank) which decides the loan rate. As described below, the Firm may perform asset substitution at the time of investment, after having received the leveraged funds from the Bank. Such a moral hazard behavior is punished by the Law in case of default leading to formal bankruptcy. Such a costly way of resolving financial distress can be avoided yet, if both parties achieve an informal agreement and turn to private renegotiation.

In the rest of the paper, we adopt a specific distinction between “economic efficiency” and “legal efficiency” (see definitions D1 and D2).

**Definition D1. Economic efficiency.** A firm strategy is defined as economically efficient if and only if it relies on the project with the maximum expected value.

**Definition D2. Legal efficiency.** A way of resolving default is said to be efficient from a legal point of view, as soon as the chosen solution maximizes the value of the firm or, equivalently here, is able to avoid costs related to the resolution of financial distress (as mentioned by Haugen and Senbet [1978 and 1988], bankruptcy costs reduce the overall value of the firm’s project, even if they help in revealing public information).

As described below, the model relies on six groups of hypotheses. These cover [H1] the lending relationship under risk neutrality, [H2] the Firm’s initial incentives to asset substitution, [H3] the renegotiation process after default, [H4] the Bayesian revision process, [H5] absolute rationality and mixed strategies, [H6] reservation amounts.
Hypotheses H1. The lending relationship under risk neutrality

All agents are risk neutral. At time (t), a monopolistic bank\(^3\) (the Bank) trades with a company (the Firm) for a loan with a unitary amount, aimed at financing an investment project. The project is fully financed by debt, and the Bank is the sole creditor of the Firm. The manager – who has a personal wealth (w) for a unitary amount (his/her house: \(w = 1\)) – owns 100% of the Firm, so that we can indifferently talk of “manager” or “shareholder”. The project’s earnings equal \((1+x)\) two periods later, at time \((t+2)\) (\(x\) takes non-strictly positive values and is the realization of a continuous random variable \(X\)). At time (t), the Bank defines a unique debt contract, characterized by a specific level of interest rate (i). Repayment is scheduled for time \((t+2)\), so the firm has to repay \((1+i)\). Under H1, the worst case for the bank occurs when \(x\) equals zero, so that all interests \((i)\) are lost: the bank only recovers the capital part. In other words, the risk of loss only affects interests\(^4\).

Hypotheses H2. The Firm’s initial incentive to asset substitution

At time (t), when the debt contract is signed, the Firm declares to the bank it will undertake a specific investment project (j) during the next period. In real, at time \((t+1)\), when the Firm effectively receives money, its shareholder-manager may change of project, turning to another one (j’). We assume this standard asset substitution issue happens as soon as the other project leads to a strictly\(^5\) higher level of expected profits. Asset substitution is the Firm’s private information: of course, even if the Bank remains unformed of such a change, it knows moral hazard is likely to happen. Compared to (j), project (j’) is riskier and less profitable, or equivalently, less economically efficient.

We denote \((X|J)\) as the random earnings conditioned by any generic project \((J, \forall J \in (j,j'))\) chosen eventually at time \((t+1)\). Both variables \((Xj)\) and \((Xj')\) follow the same

\(^3\) This assumption is in accordance with the observed imperfect competition on banking markets (De Bandt and Davis, [2000]). Moreover, it fits well intermediated economies composed of numerous SMEs heavily financed by a main bank, such as in Europe (France, Belgium, Italy, Spain or Germany).

\(^4\) This assumption is made for simplicity reason. Another presentation – where default affects not only interests but also the principal share of the debt – is possible: this would not affect the main propositions, but lead to a more complex modeling without improving the results.

\(^5\) In case both projects lead to identical levels of expected profit, we suppose the firm respects its commitments, and chooses project (j). This assumption is not only made for simplification purpose: when two projects have the same expected value, it is natural to turn to the project with the minimum standard deviation, which is the case for project (j), less risky than project (j’).
probability density function, but with differences on the two first moments, as shown as below:

\[ E(X|j) > E(X|j') \]  \hspace{1cm} (1a)

\[ \sigma(X|j) < \sigma(X|j') \]  \hspace{1cm} (1b)

Where \( E(.) \) and \( \sigma(.) \) are respectively the expectation and the standard deviation operators.

Inequality (1a) illustrates the fact project \((j')\) is sub-optimal compared to project \((j)\), leading to lower expected earnings. This gives rationale to the legal punishment of moral hazard, due to the negative effect on global welfare. Inequality (1b) is necessary so that the manager has initial incentives to perform asset substitution. More precisely, such incentives to take risk directly result from the basic form of any standard debt contract, which settles the fundamentals for limited liability: from Stiglitz and Weiss [1981] (see Theorem 3 in their paper), we know any increase of risk leads to a rise (respectively reduction) of the debtor’s (resp. creditor’s) expected profit. In addition here, asset substitution involves a reduction of profitability (see (1a)) besides this increase of risk (see (1b)). So, we need a technical condition on \( E(X|j') \) so that the firm has initial incentives to turn to a riskier but less profitable project (in other words, moral hazard should be possible in such a context only if the earnings expectation attached to project \((j')\) is not too small). Inequality (2) reflects such condition on \( E(X|j') \): there is initial incentive to asset substitution from project \((j)\) to project \((j')\) if and only if the following condition prevails:

\[ E(X|j') > E^b_{\{i\}}(X|j) + E^b_{\{i\}}(X|j) - I \cdot \left( F_{X|j'}(i) - F_{X|j}(i) \right) \]  \hspace{1cm} (2)

Where: \( E^b_{\{i\}}(X|J) \) is the truncated expectation operator for any continuous random variable conditional to project \( J ((X|J), \forall J \in (j,j')) \) (i.e. the integral of expectation, limited to interval \([a,b]\)). \( F_{X|j'}(a) \) is the distribution function for variable \((X|J)\).
Proof [inequality (2)]. Considering a standard debt contract\(^6\), the Firm’s expected profit depends on the chosen project \((j)\) or \((j')\). Remembering the Firm is in default as soon as the realized earnings \((x)\) are lower than the interest rate \((i)\), we have (where \(f(x|J)\) is the density function of the random variable \((X|J), \forall J \in \{j,j'\}\)):

\[
\text{E} \left( \Pi \left| \text{project (j); standard debt contract} \right. \right) = \int_{-\infty}^{\infty} \left( (x - i) \cdot f(x|j) \right) \, dx = \text{E}^X_i \left( X|j \right) - i \cdot \left( 1 - F_X|j| (i) \right) \tag{3}
\]

\[
\text{E} \left( \Pi \left| \text{project (j'); standard debt contract} \right. \right) = \int_{-\infty}^{\infty} \left( (x - i) \cdot f(x|j') \right) \, dx = \text{E}^X_i \left( X|j' \right) - i \cdot \left( 1 - F_X|j'| (i) \right) \tag{4}
\]

The firm has initial incentive to undertake project \((j')\) instead of project \((j)\) as soon as profit shown in equation (4) leads to a higher profit compared with equation (3). This lead to inequality (5), so that the tradeoff between projects \((j)\) and \((j')\) leads to a minimum value for \(E(X|j')\), as described in Figure 1:

\[
\text{E}^X_i \left( X|j' \right) + i \cdot F_X|j'| (i) > \text{E}^X_i \left( X|j \right) + i \cdot F_X|j| (i) \\
\iff \text{E}(X|j') > \text{E}(X|j) + \text{E}^X_i \left( X|j \right) - i \cdot \left( F_X|j| (i) - F_X|j'| (i) \right) \tag{5}
\]

\[\text{Figure 1. Condition for Having Initial Incentive to Moral Hazard: Standard Debt Contract and Two Projects (j) and (j')}\]

The expected profitability for project \((j')\) must exceed the “\(\text{IAST}(j,j')\)” threshold

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\(^6\) In our approach a debt contract is said to be “standard” as soon as it preserves limited liability and the derived expected profits (Firm and Bank) do not take into account nor private renegotiation in case of default, neither the contingent appliance of legal sanctions. From that perspective, the debt contract considered in the Stiglitz and Weiss [1981]’s paper is “standard.”
Hypotheses H3. The renegotiation process after default: bankruptcy and legal sanctions

In case of default \((x < i)\), and whatever its initial choice \((j)\) or \((j')\), the Firm may intend to avoid bankruptcy, offering a renegotiation amount to the Bank: let us denote it by \((R)\). Of course, we shall see that tricky firms (those having chosen project \((j')\)) have incentives to offer a higher amount to the Bank so that they avoid legal sanctions prevailing under formal bankruptcy. We consider a “one shot” renegotiation process, so that the Bank accepts or refuse the firm’s offer\(^7\). In case \((R)\) is accepted, the story ends (the Firm’s debt is forgiven); otherwise, a formal bankruptcy procedure is triggered off. Then, bankruptcy costs \((c)\) are paid out of the Firm’s assets \((1+\alpha)\)\(^8\) so that an audit of the Firm can be performed, and previous asset substitution – in any – discovered. Bankruptcy costs are paid first and foremost in comparison to other payments. They consequently reduce the value of the firm. Their amount \((c)\) is expressed in percent of the size of loan, as a proxy of the firm’s size. Such a production of information is one of the basic functions of any bankruptcy codes\(^9\): as mentioned by Webb [1987], bankruptcy costs are basically revelation costs. If it appears that the wrong project \((j')\) was undertaken at time \((t+1)\), the manager-shareholder’s wealth \((w, \text{normalized to } 1)\) is subject to legal sanctions \((s)\). The amount \((s)\) is expressed in percent of the personal wealth \((w)\). So, the legal environment, either clement or severe, defines an \textit{ex ante} level of sanctions \(s \in [0;1]\). It has to be stressed these are financial sanctions only (no jail or ban to manage other firms, here): the manager-shareholder is punished by breaking in some extent limited liability.

Hypotheses H4. The Bayesian revision process

\(^7\) There is no place for counter-proposals from the Bank. This hypothesis leads to simple properties which have the advantage to reflect the short delays characterizing the bargaining period through most of the European countries. For instance, under the French law, the bankruptcy procedure must be triggered within 15 days after default.

\(^8\) Remember there is not initial contribution from shareholders.

\(^9\) Bankruptcy procedures have three major theoretical justifications: the coordination of individual interests, the production of public information, and the evaluation of the firm’s assets and of the financial claims.
At time (t), the bank has beliefs on the firm’s choice: let’s denote \( p \) the *a priori* probability of undertaking the announced project \((j)\). Afterwards, two successive public signals are transmitted—voluntarily or not—by the firm to the bank: [a] the realized earnings at time \((t+2)\),  
\[ p \rightarrow p(j|x); \]
[b] the renegotiation amount at the time of default,  
\[ p(j|x) \rightarrow p(j|x,R), \forall (R) \] the amount proposed to the Bank (we shall see the level of R depends on the project \( J \in (j,j') \) initially chosen at time \((t+1)\)). In other words, the observed earnings and the firm’s willingness to renegotiate are signals for the bank to revise in a Bayesian way its beliefs on the project choice. After \((x)\) is realized and before \((R)\) is disclosed, the Bank computes the revised probability, given by equation (6).

\[
p(j|x) = \frac{f(x|j)p}{f(x|j)p + f(x|j')p(1-p)}
\]  

**Hypotheses H5. Absolute rationality and mixed strategies**

First, the rules of the game are common knowledge. Second, all agents behave in an absolute rational manner. Third, the Firm adopts mixed strategies (as a generalization of pure strategies, in case these ones lead to indifference between rival strategies), meaning that it decides the probability \( (p) \) of choosing project \((j)\) so that the Firm’s expected profit is maximized. At equilibrium, of course, such a probability must equal the Bank’s beliefs *a priori*, so that we shall use the same notation for both \((p)\)^10.

**Hypotheses H6. Reservation amounts**

All agents have access to alternative investment projects, i.e. to reservation amounts. On the one hand, we assume the shareholder-managers’ reservation amounts are zero: i.e. if the debt contract offered by the Bank is not signed, the manager closes the Firm and turns to another activity, supposed to be non-profitable for simplification purpose. On the other hand, in case the debt contract is not signed with the Firm, the Bank allocated the unitary amount to another risk-free financing activity (we assume here that the risk-free rate equals zero).

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^10 If the Bank believes *a priori* that the probability of choosing project \((j)\) equals 50%, whereas the Firm decides at time \((t+1)\) to undertake project \((j)\) with a probability of 80%, the Bank’s initial belief is not sustainable at equilibrium (remember the optimal value 80% comes from the Firm’s program at time \((t+1)\); the Bank can include it in its own calculus at time \((t)\)).
Figure 2. The General Structure of the Model

The Bank:
- Lends $1 to the firm
- Ignores the firm’s project (j or j’)

Interest rate: i

The Firm:
- Announces project (j) to the bank, but may turn to a riskier and less profitable one (j’) with probability (p).
- $\$(1+x)$ is the operating income the project yields, with (x) the realization of random variable $X|J$ ($J \in \{j, j’\}$): $E[X|j] > E[X|j’]$ and $\sigma(X|j) < \sigma(X|j’)$

Bayesian successive revisions of probabilities (by the Bank):

Success : $x \geq i$ with probability: $1 - F_{X|j}(i)$
Default $x < i$

Gains are:
- The Bank: $1+i$
- The Firm: $x-i$

The Firm proposes $R$ to the bank

Accepts $R$ Refuses $R$

Private renegotiation Formal bankruptcy

Gains are:
- Bank: $R$
- Firm: $1+x-R$
Comments: No legal audit and no disclosure of information about the project choice.

Gains are:
- Bank: $1+x-c$
- Firm: $0$
Comments: (c) are bankruptcy costs (legal audit: the project (j) is discovered and no sanction applies.

Gains are:
- Bank: $R$
- Firm: $1+x-R$
Comments: No legal audit and no disclosure of information about the project choice.

Gains are:
- Bank: $1+x-c+s$
- Firm: $-s$
Comments: (c) are bankruptcy costs (legal audit: project (j’) is discovered, which leads to sanctions (s).
Figure 2 displays the general structure of the model. The decisions of agents are successively made through a three time sequence model. At time (t), the bank defines the level of interest rate (i). At time (t+1), the firm chooses the project to undertake ((j) or (j')). The project leads to random earnings (x) at time (t+2): all parties observe the success or the failure of the project. In case of success (x ≥ i), all payments are made and the game ends. Otherwise (x < i), the firm defaults and a “one shot” bargaining process begins between the bank and the firm: each of them tradeoff between private renegotiation and costly (c) formal bankruptcy. This tradeoff is directly influenced by the net gains expected by each party under each rival solution. The legal environment concerning legal sanctions (s) exerts an impact on the resolution of default. Consequently, decisions made at times (t) and (t+1) will be changed.

3. The Resolution of the Model

This section is devoted to the resolution of the model using backward induction. Namely, we analyze first the bargaining process taking place between the Bank and the Firm in case of default at time (t+2) (section 3.1). We then study the project choice by the Firm at time (t+1) (section 3.2). Finally, we investigate the design of the debt contract by the Bank at time (t) (section 3.3).

3.1. Time (t+2): The Bargaining Taking Place After Default

At time (t+2), the project generates earnings (x) which are the basis for interest repayment. In case of success (x ≥ i), the Firm’s earnings (1+x) are the sole basis of a full payment to the bank (1+i), so we have:

\[
\begin{align*}
\text{Gain of the Firm (success):} & \quad x - i \quad \text{(7a)} \\
\text{Gain of the Bank (success):} & \quad 1 + i \quad \text{(7b)}
\end{align*}
\]

Contrary to the success event, default is made difficult by the possible efforts of the Firm to renegotiate its debt contract. The Firm may then try to avoid bankruptcy by proposing a renegotiation amount (R) to the Bank. An agreement is reached when each
party earns as much as\textsuperscript{11} or more under private renegotiation than under formal bankruptcy. It has to be reminded that the bank updates its beliefs when receiving the signal \(R\), so that probability \(p(j|x)\) is revised to \(p(j|x,R)\). We describe below the conditions under which all parties prefer to privately renegotiate \textit{just before signal \(R\) is released}. Then, we define individual “acceptance thresholds” (denoted “AT”), based on prior probability \(p(j|x)\). These thresholds are the minimum levels of \(R\) each party wants (respectively accepts) to receive (respectively grant) outside bankruptcy. Of course, because amount \(R\) is a new signal for the Bank, these thresholds will change as soon as \(R\) is proposed.

- First, the Bank prefers to privately renegotiate if the proposed amount \(R\) equals or exceeds the expected gains if bankruptcy is triggered: in the latter case, the recovered amount equals earnings \((1+x)\) net of bankruptcy costs \((c\times1)\), plus – possibly – legal sanctions \((s\times1)\), in case moral hazard prevailed at time \((t+1)\): this happens with probability \(1−p(j|x)\). Namely, just before \(R\) is disclosed, the Bank prefers private renegotiation if and only if condition (8) prevails\textsuperscript{12}:

\[
R \geq 1 + x - c + \left[1 - p(j|x)\right]s
\]

(8)

The Bank’s acceptance threshold defined in equation (8), “BankAT\(x\)”, depends on the probability of choosing project \(j\), \(p(j|x)\). This probability represents the beliefs of the Bank after the level of earnings \((x)\) is disclosed and just before receiving signal \(R\).

- Second, all firms having undertaken project \(j\) (referred as “Honest Firms”) prefer to privately renegotiate if their earnings \((1+x)\) net of the amount granted to the Bank \(R\) are equal or greater than the net amount the manager-shareholder recovers under formal bankruptcy: i.e. simply 0. The acceptance threshold for Honest Firms (named “jAT\(x\)”) is given by relation (9): Honest Firms prefer private renegotiation over bankruptcy if and only if:

\[
1 + x - R \geq 0 \Leftrightarrow R \leq \frac{1 + x}{jAT(x)}
\]

(9)

\textsuperscript{11} We suppose that all parties privately renegotiate, when their gains under formal bankruptcy or under private renegotiation happen to be equal.

\textsuperscript{12} In case legal sanctions \(s\) are very high, this can lead to an expected recovery rate greater than 100\% for the bank. This in not a problem when sanctions are considered only for dissuasion: their purpose is to give the right incentives to the firms – even if this is paid in disproportionate proportions by faulty managers.
Third, other firms having undertaken project (j’) (referred as “Tricky Firms”) compute a similar tradeoff as for “Honest Firms”, given the exception that their manager-shareholder has to pay (s) in case formal bankruptcy is triggered off. The acceptance threshold for Tricky Firms (named “j’AT(x)”) is given by relation (10): Tricky Firms prefer private renegotiation over bankruptcy if and only if:

\[ 1 + x - R \geq -s \iff R \leq \frac{1 + x + s}{j'AT(x)} \]  

(10)

It must be stressed that the acceptance threshold is a minimum amount for the Bank and a maximum amount for the Firm. Depending on [a] the level of \( p(j|x) \) (before R is disclosed by the Firm), and [b] the legal environment (either “severe” \( s \geq c \) or “clement” \( s < c \), compared to the bankruptcy costs), relations (8) to (10) lead to two rival equilibria which may arise from the bargaining process (see proposition 1).

Proposition 1. Under H1 to H5, and considering the private solution as a more legal efficient output than the costly bankruptcy solution, the “one shot” bargaining process taking place in case of default (at time \((t+2)\)) may lead to two exclusive equilibria (either pooling or separating); each of them is attached to a typical solution (either private renegotiation or formal bankruptcy: see below, propositions 1.1. and 1.2. and their proofs).

Proposition 1.1. If the legal environment is “severe” (here, \( s \geq c \)) and the bank is “suspicious” before signal (R) is disclosed (here, suspicion prevails when \( p(j|x) < \hat{p} \), where \( \hat{p} \) is given by equation (11)), the bargaining process leads to separating equilibrium and the initial project choice is discovered. Honest Firms go to formal costly bankruptcy, whereas Tricky Firms privately renegotiate (at a high price). We consider such equilibrium as inefficient because bankruptcy costs (c) are not fully internalized.

Proposition 1.2. If [a] the legal environment is “clement” (here, \( s < c \)) or [b] the legal environment is “severe” (here, \( s \geq c \)) and the bank is “confident” before signal (R) is

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13 The degree of severity is defined relatively to bankruptcy costs. We could symmetrically describe the legal environment, not in terms of severity, but of costs: then, relation “\( s \geq c \)” would not characterize a “severe law” but a “cheap bankruptcy regime”, which are two equivalent notions in our view.
disclosed (here, \( p(j|x) \geq \hat{p} \)), the bargaining process leads to a pooling equilibrium: the initial project choice is not discovered and private renegotiation prevails. We consider such equilibrium as efficient because bankruptcy costs \( c \) are internalized.

\[
\hat{p} = 1 - \frac{c}{s}
\]  \hspace{0.5cm} (11)

**Proof [Proposition 1].** The bargaining equilibrium comes from the comparison of all individual thresholds. These are primarily affected by the position of legal sanctions \( s \) compared to bankruptcy costs \( c \).

**Proof [Proposition 1.1.]** Legal environment is “severe”: \( s \geq c \)

Figure 3a represents all possible configurations given by equations (8) to (10), depending on the initial level of probability \( p(j|x) \), which can be viewed as the bank’s beliefs on the project choice after \( x \) is disclosed and before the firm proposes \( R \).

![Figure 3a. Individual Minimum Acceptance Thresholds and Bargaining Tradeoffs (s≥c)](image)

The bold and black arrow indicates all possible values of \( R \). Points are minimum thresholds for the Bank when probability \( p(j|x) \) respectively takes value 0, \( \hat{p} \) and 1. The direction of small black arrows indicates that the greater (the
lower) (R) is, the more the Bank (the Firm) is willing to informally renegotiate. The comparison between the levels required by the Bank directly depends on the level of probability \( p(j|x) \) compared to the following pivot parameter (\( \hat{p} \)), derived from equation (11) below:

\[
1 + x - c + (1 - \hat{p}) \cdot s = 1 + x \\
\Leftrightarrow \hat{p} = 1 - \frac{c}{s} \in [0,1] \text{ when } s \geq c
\]

\[ (11) \]

- **If the bank has a high expectation to deal with an Honest Firm (i.e. \( p(j|x) \geq \hat{p} \)):** the bank is said to be “confident” and requires a relatively low minimum amount, anticipating that bankruptcy has little chance to involve legal sanctions. On the other side, all firms (honest and tricky ones) prefer relatively to turn to private renegotiation, because debt forgiveness allows the manager to internalize bankruptcy costs. Here, the Bank minimum requirement is always lower than the amount acceptable to pay by both types of firms: threshold values \( j_{AT}(x) \) and \( j'_{AT}(x) \) totally overlap with \( Bank_{AT}(x) \). We then obtain a pooling equilibrium, so that signal (R) is “empty”, meaning it does not provide any additional information to the bank:

\[
p(j|x) \geq \hat{p} \rightarrow p(j|x,R) = p(j|x)
\]

\[ (12) \]

All firms propose the minimum amount required by the Bank with an unchanged probability \( p(j|x) \) (see equation (8)). Then, all firms avoid bankruptcy by offering the following amount (\( R^* \)):

\[
R^* = 1 + x - c + [1 - p(j|x)] \cdot s
\]

\[ (13) \]

- **If the bank has a low expectation to deal with an Honest Firm (i.e. \( p(j|x) < \hat{p} \)):** the bank is said to be “suspicious” (it believes there is a good chance project (\( j' \)) was previously selected) and, then, more inclined to trigger bankruptcy, leading to the appliance of legal sanctions. As a consequence, the Bank requires a rather high minimum amount to accept renegotiation. On the other side, any Honest Firm prefers relatively formal bankruptcy, whereas any Tricky Firm prefers private renegotiation. Then, any strictly positive offered amount (R) can only come from
Tricky Firms because only BankAT(x) and j’AT(x) overlap. In that case, signal (R) perfectly reveals the project initial choice, which is (j’) only:

\[ p(j|x) < p \rightarrow p(j|x, R) = 0 \quad (14) \]

As shown in relation (14), the Bank anticipates this update and rationally replace \( p(j|x, R) \) by zero. Replacing this value in equation (8) leads to a revised value for the bank’s minimum required amount, BankAT(x) (which equals \( 1 + x - c + s \) from now on). Tricky Firms finally propose the minimum amount (\( R^* = 1 + x - c + s \)), which is always accepted by the bank because renegotiation internalizes bankruptcy costs. Honest Firms do not propose anything and prefer bankruptcy, because renegotiation is too expensive:

\[
\begin{align*}
\text{Honest Firm} & : \text{does not propose anything (formal bankruptcy)} \\
\text{Tricky Firm} & : \text{proposes } R^* = 1 + x - c + s \text{ (private renegotiation)}
\end{align*}
\]

Hence, the bargaining taking place at time (t+2) when the legal environment is “severe” leads to two equilibria: a separating one and a pooling one. Each case relies on the comparison between probability \( p(j|x) \) and the pivot value given by relation (11).

*End of proof (Proposition 1.1.) ■*

**Proof [Proposition 1.2.]** Legal environment is “clement”: \( s < c \)

Figure 3b describes a bargaining similar to Proposition 1.2. Following the same reasoning as for proposition 1.1., it is easy to show that the Bank has no incentive to trigger bankruptcy, which costs more (c) than it may reward, in case the Firm previously selected project (j’).

---

\(^{14}\)It is essential to notice that Tricky Firms are not incited to bluff, by proposing nothing to the Bank, so that they appear as Honest Firms. Indeed this would imply automatic bankruptcy triggering, and the bluff would be directly discovered (remember bankruptcy costs are revealing costs).
Whatever the level of the Bank’s belief $p(j|x)$, private renegotiation prevails over bankruptcy, and all firms (whatever their choice at time $(t+1)$) offer a renegotiation amount ($R^*$) equal to the bank’s minimum required amount, $\text{BankAT}(x)$ (see equation (8)). Here again, this lead to a pooling equilibrium, and signal ($R^*$) does not provide any additional information to the bank: we obtain the relations identical to (12) and (13).

* * *

End of proof (Proposition 1.2.)

* * *

Table 1 sums up expected gains and solution prevailing under default, depending on the level of legal sanctions compared to bankruptcy costs, and on the bank’s beliefs. Under H5, such gains are incorporates by both agents. Particularly, at time $(t+1)$, the Firm computes the probability of choosing project $(j)$ given all future expected gains, either in case of success or in case of default (see Table 1 for the latter).
Table 1. Bargaining gains and equilibria

| Bargaining solution: | s ≥ c and p(j|x) ≥ \( \hat{p} \) | s ≥ c and p(j|x) < \( \hat{p} \) |
|---------------------|---------------------------------|---------------------------------|
| The firm chooses:   | s ≥ c and p(j|x) ≥ \( \hat{p} \) | s ≥ c and p(j|x) < \( \hat{p} \) |
|                     | → Pooling equilibrium            | → Separating equilibrium         |

Project J=j

- Prob. revision: \( p(j|x,R) \rightarrow p(j|x) \)
- Renegotiation, with \( \forall J \in (j,j') \):
  \[ R^* = 1 + x - c + [1 - p(j|x)] \cdot s \]
- The firm earns: \( c - [1 - p(j|x)] \cdot s \)
- The bank earns: \( 1 + x - c \)

Project J=j’

- Renegotiation, with:
  \[ R^* = 1 + x - c + s \]
- The firm “earns” (it pays):
  \( c - s \)
- The bank earns: \( 1 + x - c + s \)

Proposition 1.1. Corollary 1.

Contrary to Haugen and Senbet [1978, 1988], costly bankruptcy may be preferred by Honest Firms over private negotiation. This is due to asymmetric information and happens when the separating equilibrium prevails, i.e. when the legal environment is “severe” and the bank is “suspicious” before signal (R) is disclosed (see proposition 1.1.). Given the fact default can be solved in two manners, some severe legal environments may lead to a suboptimal solution, so that costly bankruptcy cannot be avoided for Honest Firms, which can be interpreted as a legal inefficiency of bankruptcy law\(^{15}\).

---

\(^{15}\) Nevertheless, proposition 3 (section 3.3) will show that – as the bank fully internalizes the bankruptcy design at time (t) –, debt contracts are designed so that separating equilibrium can apply to Tricky firms only: i.e. formal bankruptcy never happens because no firm behave in an honest way if the anticipated bargaining equilibrium is a separating one. In other words, even if bankruptcy is legally inefficient, banks – by incorporating the design of the Law in their decisions – ensure that inefficient ways of resolving default will never prevail: by following their private interests, banks ensure legal efficiency.
3.2. Time (t+1): The tradeoff between rival projects after lending

At time (t+1), the Firm decides between projects (j) and (j’). Following H6, the Firm adopts mixed strategies, meaning that it computes the optimal probability of choosing project (j), \( p^* \), maximizing its expected profit. As shown previously in Table 2, gains computed for time (t+2) depends on three conditions: [1] the state of default \((x < i)\), [2] the level of legal sanctions (s) compared to bankruptcy costs (c), and – when legislation is “severe \((s \geq c)\) – [3] the Bank’s beliefs on the project choice (either “confident” or “suspicious”, depending on the position of the revised probability \(p(j|x)\) compared to threshold \(\hat{p}\)). The two latter conditions lead to either pooling or separating equilibria, and then, to different expected gains. So, at time (t+1), when the firm computes the optimal probability of choosing project (j), two cases should be distinguished (pooling and separating equilibria).

3.2.1. The Firm’s first program under pooling equilibrium

Here, the Firm decides the probability of choosing project (j), \(p\), given the fact default always leads to private renegotiation with no disclosure of information: i.e. the equilibrium is pooling\(^{16}\). We know from proposition 1 such equilibrium prevails under two cases: either when the legal environment is “clement” or when it is “severe” and the bank is “confident”. If the pooling equilibrium prevails at time (t+2), then, all expected gains are of same amount (see Table 1). The Firm’s program is described below: at time (t+1), the Firm defines the level of \(p\) which maximizes the value of its expected profits (denoted as \(\Pi\)).

\[
\max_p \ E[\Pi_{\text{pooling}}] = p \cdot \left\{ \int_0^i \left[ c - (1 - p(j|x)) \cdot s \right] \cdot f(x|j)dx + \int_i^\infty (x - i) \cdot f(x|j)dx \right\} \\
+ (1 - p) \cdot \left\{ \int_0^i \left[ c - (1 - p(j|x)) \cdot s \right] \cdot f(x|j')dx + \int_i^\infty (x - i) \cdot f(x|j')dx \right\} \\
\text{with:} \\
p(j|x) = \frac{f(x|j) \cdot p}{f(x|j) \cdot p + f(x|j') \cdot (1 - p)}
\]

\(^{16}\) As usual, this conjecture can be out of equilibrium, when the full game is resolved at time (t).
The first expression in the Firm’s expected profit corresponds to the gains obtained when choosing project (j). The second expression applies for project (j'). In both expressions, default leads to an internalization of bankruptcy costs, whereas the Firm recovers all of (x), net of interest charges (i), in case of success. To sum up, all expected gains are equal, whatever the project is, and differ in the probabilities of success only. Last, it is essentially noting that the Firm’s decision variable (probability (p)) is the one which is used to describe the revised Bank’s beliefs $p(j|x)$. Indeed, as previously mentioned (see hypotheses (H4)), the Bank’s initial belief (p) must be sustainable at equilibrium with the effective Firm’s decision on project choice (p, again), so that the Firm and the Bank both make compatible conjectures.

**Proposition 2a.** Under H1 to H5 and when the conjectured bargaining equilibrium for default time (t+2) is pooling, the Firm’s expected profit is a linear function of (p). As a consequence, at individual equilibrium, the Firm’s strategies on the project choice are pure strategies: the Firm chooses not to trick the Bank as soon as condition (17a) is respected, i.e.: $s \geq s_1(i)$.

Firm chooses project (j) if and only if condition (17a) prevails. When the Firm is indifferent between projects (j) and (j') (i.e. when legal sanctions (s) are equal to threshold $s_1(i)$), we derive from hypotheses H2, the Firm decides to respect its commitments and chooses project (j):

$$s \geq s_1(i) \quad \text{with:} \quad s_1(i) = \frac{E_i^\infty(X|j') - E_i^\infty(X|j)}{F_{X|j'}(i)} + (c + i) \cdot \left(1 - \frac{F_{X|j}(i)}{F_{X|j'}(i)}\right)$$  \hspace{1cm} (17a)

Under pure strategies, conjectures on the Banks beliefs for time (t+2) (i.e. the value of $p(j|x)$) either equal 0 or 1. Thus, the Firm’s expected profits are rewritten as below (see (17b) and (17c)):

$$E[\Pi|pooling, p=1] = c \cdot F_{X|j}(i) + E_i^\infty(X|j) - i \cdot \left(1 - F_{X|j}(i)\right)$$  \hspace{1cm} (17b)

$$E[\Pi|pooling, p=0] = (c - s) \cdot F_{X|j'}(i) + E_i^\infty(X|j') - i \cdot \left(1 - F_{X|j'}(i)\right)$$  \hspace{1cm} (17c)
As shown in relation (17a), the Firm chooses not to trick the Bank as soon as the level of legal sanctions \( s \) is sufficiently high, i.e. greater than \( s_1(i) \). Interestingly, this threshold depends on the level of the interest rate. It appears here there is an area for the Bank to drive the decision of its customer. The first expression in \( s_1(i) \) equals the difference between the two truncated first moments for both projects, \( E_1^\infty(X|j') - E_1^\infty(X|j) \), when the firm is profitable \( (x \geq i) \) (relatively to the probability of default when project \( (j') \) is chosen). The difference \( E_1^\infty(X|j') - E_1^\infty(X|j) \) - either positive or negative \(^{17}\) - represents the Firm’s expected surplus derived from asset substitution, before interest repayment and when the Firm appears to be profitable. In other words, this excess amount is the net gains derived from moral hazard when the Firm is profitable. The second expression of \( s_1(i) \) is the excess amount the Firm\(^{18}\) earns when it defaults, after having turned to project \( (j') \) instead of project \( (j) \) (relatively to the probability of default when project is \( (j') \)). Indeed, financial distress – which is more likely under project \( (j') \) – allows the firm to capture bankruptcy costs \( (c) \) through renegotiation; moreover it has no to repay interests \( (i) \). Thus, \( s_1(i) \) can be interpreted as the Firm’s overall net relative surplus due to asset substitution. Legal sanctions should exceed this threshold in order to give the Firm the right incentives.

### 3.2.2. The Firm’s second program under separating equilibrium

The Firm follows a similar computation as in section 3.2.1., but given the fact the bargaining process prevailing after default reveals all information on previous choices: equilibrium is separating. Then, Honest Firms go to bankruptcy, whereas Tricky ones prefer to privately renegotiate. In the latter case, nevertheless, such a renegotiation is more expensive compared to pooling equilibrium, because moral hazard is fully discovered: only bankruptcy costs can be internalized. We know from proposition 1 that a separating equilibrium prevails when the legal environment is “severe” and the bank is

\(^{17}\) As project \( (j') \) has a higher variance and a lower expectation compared to project \( (j) \), this surplus is negative for small values of \( (i) \) and positive for great values.

\(^{18}\) As project \( (j') \) has a higher variance and a lower expectation compared to project \( (j) \), this surplus is to be positive for small values of \( (i) \) and negative for great values.
“suspicious”. Table 1 gives the expected default gains when separating equilibrium prevails\(^{19}\). The Firm’s program – similar to program (16) – is given by (18): 

\[
\max_p \ E[\Pi|\text{separating}] = p \left\{ \int_x^\infty (x - i) \cdot f(x|j)dx \right\} + (1 - p) \left\{ \int_x^i (c - s) \cdot f(x|j')dx + \int_x^\infty (x - i) \cdot f(x|j')dx \right\} \\
\text{with:} \\
p(j|x) = \frac{f(x|j) \cdot p}{f(x|j) \cdot p + f(x|j') \cdot (1 - p)}
\]

As for program (16), the first (respectively the second) expression in the Firm’s expected profit gives the gains linked to project (j) (resp. project (j')). In case project (j) was chosen, we derive from proposition 1 that the Firm earns nothing, whereas it has to pay sanctions net of internalized bankruptcy costs (c – s). We derive from program (18) proposition 2b, similar to proposition 2a, in the sense that strategies are pure, at the Firm’s equilibrium.

**Proposition 2b.** Under H1 to H5 and when the conjectured bargaining equilibrium for default time (t+2) is separating, the Firm’s expected profit is a linear function of (p). As a consequence, at individual equilibrium, the Firm’s strategies on the project choice are pure strategies: the Firm chooses not to trick the Bank as soon as condition (19a) is respected, i.e.: \( s \geq s_2(i) \).

The Firm chooses project (j) if and only if condition (19a) prevails (as for proposition 2a, we derive from hypotheses H2, the Firm chooses project (j) when it is indifferent between projects (j) and (j')):

\[
s \geq s_2(i) \text{ with: } s_2(i) = c + \frac{E_i^\infty(x|j') - E_i^\infty(x|j)}{F_{x|j'}(i)} + i \left( 1 - \frac{F_{x|j'}(i)}{F_{x|j}(i)} \right) \]

\(^{19}\) Gains are zero for Honest Firms.
Under pure strategies, conjectures on the Banks’ beliefs for time \((t+2)\) (i.e. the value of \(p(j|x)\)) either equal 0 or 1. Thus, the Firm’s expected are rewritten as below (see (19b) and (19c)):

\[
E[\Pi|\text{separating}, p=1] = E^{\infty}_i(X|j) - i \cdot (1 - F_{X|j}(i)) \tag{19b}
\]

\[
E[\Pi|\text{separating}, p=0] = (c - s) \cdot F_{X|j'}(i) + E^{\infty}_i(X|j') - i \cdot (1 - F_{X|j'}(i)) \tag{19c}
\]

Condition (19a) can be interpreted in the same way as for condition (17a). Moreover, it appears threshold \(s_2(i)\) is higher than threshold \(s_1(i)\), for any given value of interest rate:

\[
s_2(i) \geq s_1(i), \quad \forall i \tag{20}
\]

Indeed, remembering the project choice is a pure strategy at equilibrium, it appears Honest Firms earn less under a separating equilibrium than under a pooling equilibrium (see equations (17a) and (17b)). Then, the minimum level of legal sanctions has to be relatively higher under separating equilibrium, so that asset substitution is discouraged.

### 3.3. Time \((t)\): The Design of the Debt Contract

At time \((t)\), the Bank has to design an optimal debt contract (i.e. the level of interest rate) which gives the Firm incentives to choose a peculiar project: i.e. the project maximizing the expected profit of the Bank. Of course, under hypotheses (H5), the debt contract totally internalizes the trade-off between private renegotiation and formal bankruptcy taking place under financial distress (time \((t+2)\)). This pure Bayesian equilibrium leads to four alternative cases, which have to be successively considered by the Bank. At time \((t)\), the Bank has to be sure its conjectures are verified at equilibrium: it has to check whether the case it focuses on applies eventually, whereas all the others do not. The four following cases depend on the comparison, of legal sanctions \((s)\) with, first, bankruptcy costs \((c)\), and, second, both thresholds \(s_1(i)\) and \(s_2(i)\). The latter comparison

---

20 Notice that equation (19c) is exactly the same as equation (17c).

21 Remind thresholds \(s_1(i)\) and \(s_2(i)\) are linked to a specific bargaining equilibrium, taking place at time \((t+2)\): respectively pooling and separating ones.
leads to different conjectures on the Firm’s strategy for time (t+1): that is, either the choice of project (j) \( (p = 1) \), or of project (j’) \( (p = 0) \): see Table 2.

<table>
<thead>
<tr>
<th>Economic inefficiency ( (p = 0) )</th>
<th>Clemency ( (s &lt; c) )</th>
<th>Severity ( (s \geq c) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case IA:</td>
<td>• Condition: ( s &lt; c ) and ( s &lt; s_1(i) )</td>
<td>• Condition: ( s \geq c ) and ( s &lt; s_2(i) )</td>
</tr>
<tr>
<td>Comments: The Bank conjectures all firms shall substitute assets at time ( (t+1) ), and a pooling equilibrium applies in case of financial distress, at time ( (t+2) ) (see proposition 1.2).</td>
<td>Comments: The Bank conjectures all firms shall substitute assets at time ( (t+1) ), and a separating equilibrium* applies in case of financial distress, at time ( (t+2) ) (see proposition 1.1).</td>
<td></td>
</tr>
<tr>
<td>Economic efficiency ( (p = 1) )</td>
<td>Case IB:</td>
<td>Case II.B:</td>
</tr>
<tr>
<td>Comments: The Bank conjectures all firms shall respect their initial commitment at time ( (t+1) ), and a pooling equilibrium applies in case of financial distress at time ( (t+2) ) (see proposition 1.2).</td>
<td>• Condition: ( s &lt; c ) and ( s \geq s_1(i) )</td>
<td>• Condition: ( s &lt; c ) and ( s \geq s_1(i) )</td>
</tr>
<tr>
<td>Comments: The Bank conjectures all firms shall respect their initial commitment at time ( (t+1) ), and a pooling equilibrium** applies in case of financial distress at time ( (t+2) ) (see proposition 1.1).</td>
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<td></td>
</tr>
</tbody>
</table>

(*) From \( p = 0 \), we derive \( p(j|x)=0 (\hat{p}) \), and the equilibrium prevailing at time \( (t+2) \) is separating.  
(**) From \( p = 1 \), we derive \( p(j|x)=1 (\hat{p}) \), and the equilibrium prevailing at time \( (t+2) \) is pooling.

From Table 2, it has to be stressed that each case is consistent with the initial conditions which drive to different bargaining equilibria. This is of high importance for both cases II.A and II.B, especially. Indeed, we know from proposition 1.1 that a separating equilibrium prevails provided the Bank is “suspicious”, meaning its revised belief, \( p(j|x) \), is lower than the threshold value \( (\hat{p}) \). This condition is consistent with the conjecture “\( p = 0 \)”’ when all firms choose to trick the bank, then, the revised value \( p(j|x) \) equals 0 \( (\hat{p}) \). In a similar way, pooling equilibrium prevails provided the bank is “confident”: i.e. \( p(j|x) \geq \hat{p} \): this conjecture is verified a fortiori as soon as all firms chose to be honest \( (p=1) \). Each case is exclusive from the other: that is, when one case prevails, the others do not, so that all conjectures are verified ex post.

Finally, the Bank must respect two participation constraints. Following hypotheses H6, the debt contract must provide to the shareholder-manager greater gains than the reservation amount, normalized to zero. Second, the Bank accepts to finance the Firm, provided its claim has an expected value which exceeds the proceeds of a unitary risk-free investment (the risk-free rate is supposed to be null). The two corresponding
participation constraints are shown below (relations (20a) and (20b), where Π and Π_B respectively denote the Firm’s and the Bank’s profits).

The Firm’s participation constraint: \( E(\Pi) \geq 0 \) \hspace{1cm} (20a)

The Bank’s participation constraint: \( E(\Pi_B) \geq 1 \) \hspace{1cm} (20a)

**Proposition 3.** Under H1 to H6, the Bank computes several optimal interest rates, attached to the cases I.A, I.B, II.A, and II.B. These four cases depend on the level of legal sanctions and of conjectures about the Firm’s choice for time \( (t+1) \). At equilibrium, only three optimal levels of interest rates may apply, depending on the prevailing case. Cases I.A and II.A both lead to the same interest rate \( (i_1^*) \); whereas cases I.B and II.B respectively lead to interest rates \( (i_2^*) \) and \( (i_3^*) \).

**Proposition 3 Corollary 1.** At equilibrium, the case where [a] all firms choose to be honest, and [b] the bargaining equilibrium is separating, is simply impossible: such a case is non-consistent with the Bank’s conjectures at equilibrium. In fact, even if a costly bankruptcy is possible, a priori\(^{22}\), banks – by taking into account the entire environment of default in their decisions – ensure that such a costly way of resolving financial distress will never happen: by following their individual interests, banks finally ensure legal efficiency.

**Proof [Proposition 3]** see below: sections 3.3.1 and 3.3.2.

### 3.3.1. The Bank’s two first programs: clement legal environment (case I)

When the legal environment is “clement” (i.e. legal sanctions are lower than bankruptcy costs), the conjectured bargaining equilibrium for time \( (t+2) \) is pooling, whatever the Firm’s choice at time \( (t+1) \). Consequently, only threshold \( s_1(i) \) affects the Firm’s decision on \( (p) \): if the levels of legal sanctions and of interest rate are so that condition \( s < s_1(i) \) prevails, the Firm shall trick the Bank, and be honest otherwise. These incentive constraints are taken into account by the Bank at time \( (t) \), for each case I.A and I.B.

\(^{22}\) Remember Honest Firms turn to costly bankruptcy, when a separating equilibrium prevails at time \( (t+2) \).
A. Case I.A: Clemency ($s < c$) and economic inefficiency ($p = 0$)

Considering case I.A, the Bank knows legal sanctions do not cover bankruptcy costs and conjectures the Firm will choose asset substitution. Thus, it computes the optimal interest rate ($i_{I.A}^*$) which maximizes its expected profit at time (t), and which is consistent with this first possible case. We know from proposition 2a asset substitution appears as soon as condition $s < s_1(i)$ applies. Last, the Bank adds to this constraint the two participation constraints. The Bank’s program is given below by (21a).

$$\max_i E\left[\Pi_B | \text{pooling, } p=0 \right]$$

\[ u.c. \]

- Participation (Firm): $E\left[\Pi | \text{pooling, } p=0 \right] \geq 0$

- Participation (Bank): $E\left[\Pi_B | \text{pooling, } p=0 \right] \geq 1$

- Case I.A prevails and other cases do not: $s < s_1(i)$

Where the Firm’s expected profit was previously given by (17c), and the Bank’s expected profit is given by (21b), below: all density functions are conditioned by project ($j'$). The Bank is fully repaid ($1 + i$) if the Firm is profitable at time (t+1), and privately renegotiate in case of default: then, the Bank receive the operating profits ($1 + x$), bet of bankruptcy costs ($c$, which are internalized through renegotiation, by the Firm), plus the full part of legal sanctions ($s$). As a matter of fact, under case I.A, the Bank conjectures the choice of project ($j'$) by the Firm, so that, even if the equilibrium is pooling, the full population of customers behaves in a tricky way, so that, in (t+1), the revised Bank’s beliefs, $p(j|x)$, are simply equal to 0 (i.e. the Bank is sure to recover 100% of ($s$) in case of bankruptcy).

$$E[\Pi_B | \text{pooling, } p=0] = \int_0^i (1 + x - c + s) \cdot f(x|j')dx + \int_i^\infty (1 + i) \cdot f(x|j')dx$$

$$= 1 + i - (c - s + i) \cdot F_{X|j'}(i) + E_0^i \cdot E[X|j']$$

(21b)
B. Case I.B: Clemency ($s < c$) and economic efficiency ($p = 1$)

When case I.B is conjectured, legal sanctions still do not cover bankruptcy costs and the Bank conjectures the Firm will respect its commitments. Thus, it computes a second optimal interest rate ($i^*_{I,B}$) consistent with case I.B. Following proposition 2a, we know honesty requires that condition $s \geq s_1(i)$ prevails. The Bank’s program is given by (22a).

$$\begin{align*}
\text{Max } & E[\Pi_{B|\text{pooling, } p=1}] \\
\text{u.c. } & \begin{cases} 
\text{Participation (firm): } & E[\Pi_{B|\text{pooling, } p=1}] \geq 0 \\
\text{Participation (bank): } & E[\Pi_{B|\text{pooling, } p=1}] \geq 1 \\
\text{Case I.B prevails and others do not: } & s \geq s_1(i) 
\end{cases}
\end{align*}$$

(22a)

Where the Firm’s expected profit was previously given by (17b), and the Bank’s expected profit is given by (22b), below: contrary to the previous case, all density functions are conditioned by project ($j$). Moreover, because case I.B implies all firms choose project ($j$), the Bank’s beliefs for time ($t+1$), $p(j|x)$, equal 1. Thus, the internalization of legal sanctions through renegotiation is not possible anymore for the Bank.

$$E[\Pi_{B|\text{pooling, } p=1}] = \int_0^i (1 + x - c) \cdot f(x|j)dx + \int_i^\infty (1 + i) \cdot f(x|j)dx$$

$$= 1 + i - (c + i) \cdot F_{X|j}(i) + E_0(x|j)$$

(22b)

3.3.2. The Bank’s two second programs: severe legal environment (case II)

When the legal environment is severe, the Bank has to make specific conjectures on the future bargaining equilibrium (pooling or not) in case of default at time ($t+2$). We know from proposition 1.1 that the nature of the equilibrium depends on the Bank’s beliefs at this time (compared to threshold $\hat{p}$), and, hence, on the effective choice the Firm makes at time ($t+1$). Figure 4 illustrates both cases II.A and II.B. When the Bank works on case II.A, it knows this case prevails only if the Firm chooses project ($j'$) ($p = 0$), which is true when $s < s_2(i)$. On the contrary, when the Bank works on
case II.B, it knows this case prevails only if the Firm chooses project \( (j) \) \( (p = 1) \), which is true when \( s \geq s_1(i) \). When legal sanctions and interest rate are such that \( s \in [s_1(i):s_2(i)] \) (see the dark area in Figure 4), both equilibria II.A and II.B may apply: this would lead to an indetermination on the Firm’s behavior for time \( (t+1) \), which is not consistent with the pure Bayesian equilibrium (all conjectures have to be verified \textit{ex post}). Thus, the Bank has to be sure the proposed rate does not belong to interval \([s_1(i):s_2(i)]\). In other terms, cases II.A and II.B are exclusive from each other. These incentive constraints have to be taken into account by the Bank at time \((t)\), for each case II.A and II.B.

![Figure 4. Comparison between cases II.A and case II.B](image)

\[\begin{align*}
\text{Case II.B:} & \quad \text{Pooling equilibrium} \\
\text{Case II.A:} & \quad \text{Separating equilibrium} \\
\end{align*}\]

- **Equilibrium is stable and unique**
- **Equilibrium is neither stable nor unique**
- **Equilibrium is stable and unique**

**A. Case II.A: Severity \( (s \geq c) \) and economic inefficiency \( (p = 0) \)**

Considering case II.A, legal sanctions exceed bankruptcy costs. The Bank conjectures the choice of the project \( (j') \) by the Firm (asset substitution), and the prevalence of a separating equilibrium in case of default. Thus, it computes a third optimal interest rate \( (i_{II.A}^*) \) consistent with case II.A (see below, program \((23a)\)).
Max $E[\Pi_B|\text{separating, } p=0]$  
\[
\begin{align*}
&\begin{cases}
\text{• Participation (firm): } E[\Pi|\text{I.A, } p=0] \geq 0 \\
\text{• Participation (bank): } E[\Pi_B|\text{I.A, } p=0] \geq 1 \\
\text{• Case II.A prevails: } s < s_2(i) \Rightarrow s_i \leq s_2(i), \forall i \Rightarrow s < s_1(i)
\end{cases}
\end{align*}
\]

Where the Firm’s expected profit was previously given by (19c)\(^{23}\), and the Bank’s expected profit is given by (23b), below:

\[E[\Pi_B|\text{separating, } p=0] = 1 + i - (c - s + i) \cdot F_{X|j}(i) + E_0^j(X|j)\quad (23b)\]

It must be stressed that, even if the bargaining equilibrium is separating – contrary to the one prevailing under case I.A –, it leads to exactly the same situation, because, for both cases I.A and II.A, all firms are tricky: as the Bank conjectures this, the outcomes of renegotiation are identical for both cases. Therefore the sole difference between cases I.A and II.A should rely on the constraints: for case I.A, the constraint was $s < s_1(i)$. It is $s < s_2(i)$\(^{24}\) and $s < s_1(i)$\(^{25}\) (see figure 4). From (20), we know that $s_1(i) < s_2(i)\ldots$ So that these two previous constraints linked to case II.A can be reduced to the same single constraint for case I.A: $s < s_1(i)$. We derive from this, that cases I.A and II.A lead to the same program, and solution (denoted $i_1^*$), as shown in (24):

\[i_{I\text{LA}}^* = i_{I\text{A}}^* = i_1^*\quad (24)\]

**B. Case II.B: Severity ($s \geq c$) and economic efficiency ($p = 1$)**

When the Bank considers case II.B (legal sanctions exceeds bankruptcy costs), the Bank conjectures the Firm will choose project (j), and a pooling equilibrium prevails in case of default. It computes then a fourth optimal interest rate ($i_{I\text{LB}}^*$) (see program (25)).

\(^{23}\) Identical to equation (17c).
\(^{24}\) When this condition prevails, the firm chooses $p=0$, forecasting a separating equilibrium for time $(t+2)$.
\(^{25}\) As explained before, this condition is needed so that there is no indetermination on the Firm’s actual choice at time $(t+1)$: it is for certain it will choose project $(j')$ (case II.A).
\[
\text{Max } E[\Pi_B|\text{pooling, } p=1]
\]

\begin{align*}
\text{u.c.} & \quad \begin{align*}
\bullet \text{ Participation (firm)}: & \quad E[\Pi_{\text{pooling, } p=1}] \geq 0 \\
\bullet \text{ Participation (bank)}: & \quad E[\Pi_B|\text{pooling, } p=1] \geq 1 \\
\bullet \text{ Case II.B prevails: } & \quad s \geq s_1(i) \quad \Rightarrow \quad s \geq s_2(i) \\
\bullet \text{ Other cases do not: } & \quad s \geq s_2(i)
\end{align*}
\end{align*}

We notice that, all expected profits are similar to those obtained for case I.B (see equations (17b) and (22b)): for both cases I.B and II.B, the conjectured bargaining equilibrium is pooling and all firms choose project (j). Nevertheless, the difference between cases I.B and II.B comes from their respective constraints, which differ: for case I.B, the constraint was \( s \geq s_1(i) \), whereas it is \( s \geq s_2(i) \) for case II.B (see program (25a)).

Then, cases I.B and II.B lead to the same expected profit expressions, but also to two distinct solutions (respectively denoted \( i_2^* \) and \( i_3^* \); see relation (26) below).

\[
i_{II.B} \neq i_{I.B} \quad \Rightarrow \quad i_2^* = i_{II.B} \quad \text{and} \quad i_3^* = i_{II.B}
\]

\textit{End of proof (Proposition 3)}

3.3.3. The Bank’s final choice between cases I.A, I.B, II.A, and II.B

From proposition 3, we know the Bank derives from the four alternative cases (I.A, I.B, II.A, and II.B), three levels of equilibrium rates (\( i_1^*, i_2^*, \) and \( i_3^* \)). Each of them relies on a peculiar legal environment and on different conjectures on the Firm’s behavior. Comparing – for every equilibrium interest rate – the corresponding expected profits, the Bank finally chooses optimal the interest rate (denoted \( i^{**} \)) linked to the greatest profit (see (27)):

\[
i^{**} = \arg \max_{i^*} \left\{ E\left( \Pi_B \mid i^* = i_1^*, p^* = 0 \right) ; E\left( \Pi_B \mid i^* = i_2^*, p^* = 1 \right) ; E\left( \Pi_B \mid i^* = i_3^*, p^* = 1 \right) \right\}
\]

From this, we derive proposition 4.
Proposition 4.
Under H1 to H6, and from relation (27), cases I.B and II.B may prevail at equilibrium: then, the optimal interest rate ($i^{**}$) is equal to either ($i^*_2$) or ($i^*_3$). We know from Table 2 such cases are characterized by economic efficiency, so that all firms respect their initial commitments.

Proposition 4 Corollary 1.
A peculiar bankruptcy environment (here, reduced to the levels of legal sanctions ($s$) relatively to bankruptcy costs ($c$)) may incite banks to accept moral hazard: this happens when cases I.A and II.A prevail. By following their interests, banks finally accept economic inefficiency.

Proposition 4 Corollary 2.
At equilibrium, there is an area for the legislator to enforce economic efficiency. However, whereas the “clement” regime ($s < c$) always lead to “legal efficiency” compared to the “severe” regime ($s \geq c$), none of them can be preferred to the other, in terms of economic efficiency. Indeed, generalized moral hazard ($p^* = 0$) may apply in both cases. Thus, to enforce economic efficiency, the Legislator has to consider effects beyond the simple comparison between ($s$) and ($c$): especially, he must consider the impact of legal sanctions ($s$) on the design of debt contract.

4. Simulated Results

In this section, we provide a simulation based on results from section 3. Here, both variables ($X|j$) and ($X|j'$) follow a Normal distribution law\textsuperscript{26}, whose parameters

\textsuperscript{26} The attentive reader may notice Normal distribution law allows for both negative and positive values, whereas variable ($x$) (the realization of ($X|j$), $\forall j \in \{j, j'\}$) is supposed to take positive values only (see Hypotheses H1). Using other distribution law, such as Log-Normal or Exponential laws may avoid this problem. However, we choose to keep the Normal law for our simulations, given the fact that the two first moments (mean and standard deviation) may vary in opposite directions when using a Normal distribution. This is not the case for other standard statistical laws, for which the mean and the standard deviation are positively linked together. This would not be consistent with hypotheses H2, so that asset substitution leads to a decrease of profitability and to an increase of risk. In order to be sure that negative values are unlikely to happen in our simulations, we choose rather high values for the mean – whatever the project ($j$) or ($j'$) – so that the probability of getting negative values for ($x$) is lower than 0.5%.
respectively equal 0.501 and 0.499 (mean), and 0.05 and 0.20 (standard deviation). Graphs 1, 2, 3 and 4 respectively show the evolution of the optimal interest rate, $i^*$, the associated probability of default, $F_{X|J}(i^*) \forall J \in (j, j')$, the Bank’s expected profit, $E(\Pi_B|.)$, and the Firm’s expected profit, $E(\Pi_\text{entr}|.)$\[^{27}\], when legal sanctions ($s$) vary from 0 to 0.55\[^{28}\].

\[^{27}\] Given the initial values, the global surplus – defined as the sum of both Firm’s and Bank’s expected profits, respectively equal 1.501 and 1.499 when the project is ($j$) or ($j'$).

\[^{28}\] Beyond this level (between 0.55 and 1), all variables remain unchanged.

**Graphs 1 to 4**: simulations : initial values

| $c$ | $E(X|j) = 0.501$ | $E(X|j') = 0.499$ | $\sigma_j = 0.05$ | $\sigma_{j'} = 0.20$ |

**Graph 1. Interest rate with legal sanctions**

**Graph 2. Probability of default with legal sanctions**

**Graph 3. Bank’s expected profit with legal sanctions**

**Graph 3. Firm’s expected profit with legal sanctions**
4.1. Simulations: descriptive analysis

We first provide a description of the simulation we present in graphs 1-4. A simulation does of course provide generalized results of the model. However it will lead afterwards (see section 4.2 below) to interesting specificities of the model. Let us describe first the simulated results. In all graphs, the four segments of the curves represent the succession of the four equilibria drawn from the model (I.A, I.B, II.A, and II.B):

- For very small values of the legal sanctions (below 3%), case I.A applies (s ≥ c and s ≥ s₁(i)). All firms perform asset substitution: indeed, whatever the level of (i), very small values of (s) have little chance to be greater than s₁(i) and s₂(i)²⁹, and the debt contract can not give the right incentives to the firms. Moreover, the interest rate and the corresponding probability of default are rather moderate and increasing with (s): indeed, in the context of very low sanctions, the Bank can not charge excessively high rates to the firms. Such behavior would increase the overall probability of default, leading to very low recovery rates (remind (s) is small here). It is noticeable that, as soon as legal sanctions slightly increase, the Bank can charge a greater rate, because legal sanctions are captured by the Bank under default, through renegotiation.

- For values of the legal sanctions strictly ranging from 3% to 30%, equilibrium I.B applies (s < c and s ≥ s₁(i)). Initially, the Bank can charge greater rates, compared to case I.A, because the probability of default for project (j) is lower than for project (j'). Afterwards, when legal sanctions start increasing, the Bank has to reduce the interest rate in order to stay in case I.B³⁰. It is noticeable that this decrease of interest rate does not reduce the bank’s expected profit. On the contrary, even if a lower interest rate reduces the Bank’s margin, a reduction of (i) lowers the probability of default, and then increases the Bank’s expected profits. This second effect overcomes the first one, and any additional decrease of the interest rate enhances the Bank’s expected profit.

²⁹ In the simulation presented here, threshold s₁(i) takes positive values when the interest rate ranges from 0.5% to 53.4%. Threshold s₂(i) takes positive values when (i) exceeds 0.5%.
³⁰ Here (s < c and s > 3%), the Bank’s expected profit associated to case I.B is always higher than the one associated to case I.A.
- When legal sanctions range from 30% to 40%, equilibrium II.A applies \((s \geq c \text{ and } s < s_1(i))\), where all firms do asset substitution. Legal sanctions are not sufficiently high, compared to bankruptcy costs, to prevent moral hazard. Even if this drives to a higher probability of default, the Bank knows it will recovers more under financial distress because it captures legal sanctions through the renegotiation process. Then, any additional increase of \((s)\) raises the Bank’s expected profits under default. Meanwhile, the interest rate falls as sanctions \((s)\) get higher (this drop of \((i)\) ensures the prevalence of case II.A: see the condition: \(s < s_1(i)\)). Then, the Bank’s expected profit is influenced by two opposite effects: first, the rise of sanctions \((s)\) increases the Bank’s expected recovery rate in case of default; second, the concomitant fall of the interest rate \((i)\) reduces the probability of such a default. The analysis of the evolution of the Bank’s expected profit shows that the first effect overcomes the second one, for “low” levels of \((s)\) (i.e. slightly above 30%), which is not true anymore for higher values of \((s)\) (i.e. slightly below 40%).

- Last, when legal sanctions strictly exceed 40%, equilibrium II.B applies \((s \geq c \text{ and } s \geq s_1(i))\): all firms perform respect their commitment and economic efficiency prevails. Interestingly, the interest rate does not change anymore for legal sanctions beyond 43% (the Bank’s expected profit attains a peak when \((s)\) exceeds this percentage). This means the absence of the necessity for the implementation of sanctions on the full managers’ wealth to ensure economic efficiency.

4.2. Simulated specificities of the model

This simulation described in section 4.1 drives to some important particularities we discuss here (see results 1 to 4). We consider them as results because simulation shows that they may apply, when using the equations of the model.

Result 1 (simulation).

Depending on the exogenous level of legal sanctions, when compared to bankruptcy costs, and for some given states of the economy (see initial values of the simulation), the four equilibria (I.A, I.B, II.A, and II.B) may apply. This stresses the crucial role of the
Legislator plays in the economy: because legal rules are fully internalized in the agents’ programs, the design of bankruptcy law (i.e. sanctions; bankruptcy costs and the legal audit procedure) strongly affects debt contracts and investment choices: a wrong design of the Law may lead to bad investments, and, finally, a reduction of the global surplus. In other words, the design of bankruptcy codes should not be independent from the structure of the economy.

**Result 2 (simulation).**

In some cases, an increase of legal sanctions may be economically inefficient. As shown in our simulations, starting from an initial level of 29%, an additional increase of 1% of legal sanctions makes the economy turn from case I.B (project (j)) to case II.A (project (j')). Even small adjustments of legal sanctions may have drastic effects on the firm’s investment policy. This comes from the non linearity of the firm’s and banks’ expected profits (each of them is linked to a peculiar equilibrium).

**Result 3 (simulation).**

Extreme severity (i.e. when 100% of the manager’s wealth is subject to legal sanctions) is not needed to ensure economic efficiency: this is due to the fact the firms’ incentives are not directly driven by the law: in fact, these are relayed by the banks, through the design of financial contracts they provide to the firms. A level of legal sanctions less than 100% may be sufficient to ensure economic efficiency as soon as it corresponds to an optimum for the banks. From that perspective, the law may enforce extreme severity, but – in our view – this is rationally justified only if the legislator has limited or biased information on the banks’ activity and/or the firms’ profitability.

**Result 4 (simulation).**

In our simulations, the legislator has the choice between two economically efficient situations: either \( s \in (3\% ; 30\% ) \) or \( s \in (40\% ,100\% ) \). Both intervals lead to “economic efficiency” (i.e. there is no asset substitution). Moreover, the impact on “legal efficiency” is the same: for both intervals, financial distressed is resolved through the internalization of bankruptcy costs (pooling equilibrium). Thus, when choosing between these two intervals, the legislator affects the profit sharing only: in our simulations,
sanctions close to 3% and more lead to higher expected profits for the firms, whereas the sharing becomes more in favor of the banks for higher values of legal sanctions.

5. Conclusions

This research has investigated how bankruptcy law influences the design of debt contracts and the investments choices. We have modeled a lending relationship between a small firm and a monopolistic bank who decides the level of the interest rate. The firm may perform asset substitution at the time of investment. Such a moral hazard behavior is punished by the Law through legal sanctions that may apply in case of costly bankruptcy. This way of resolving financial distress can be avoided yet, if both parties privately renegotiate.

Our paper makes several propositions, based on a set of hypotheses\textsuperscript{31}. Based on these, it appears first, that – under specific circumstances – costly bankruptcy may be preferred by honest firms over private negotiation: this happens when the bargaining equilibrium taking place at the time of default is separating. This comes from our asymmetric information framework and may apply when legal sanctions are rather high: thus, a severe legal environment may lead to a suboptimal solution, so that costly bankruptcy cannot be avoided. Nevertheless, we have shown that – as the bank internalizes the rules prevailing after default –, debt contracts are designed so that separating equilibrium cannot apply to honest firms. In other terms, even if bankruptcy is legally inefficient, banks ensure legal efficiency\textsuperscript{32}.

Second, we have shown that a peculiar bankruptcy environment may incite banks to accept generalized moral hazard. In other terms, by following their individual interests, banks finally accept economic inefficiency. From that perspective, the legislator can indirectly enforce economic efficiency. However – whereas the “clement” legal regime\textsuperscript{33}

\textsuperscript{31} Hypotheses H1: lending relationship under risk neutrality; H2: initial incentives to asset substitution; H3: renegotiation process; H4: Bayesian revision process; H5: absolute rationality and mixed strategies; H6: reservation amounts.

\textsuperscript{32} “Legal” and “economic” efficiencies are previously defined in D1 and D2.

\textsuperscript{33} In our approach, “clemency” and “severity” are derived from the comparison between the levels of legal sanctions and of bankruptcy costs.
always lead to *legal efficiency* compared to the “severe” one –, none of them can be preferred to the other, in terms of *economic efficiency*. Indeed, generalized moral hazard may apply in both cases. Thus, to enforce economic efficiency, the Legislator has to consider effects beyond the simple comparison between the levels of legal sanctions and of bankruptcy costs: especially, he has to focus on the impact of legal sanctions on the design of debt contract. In other words, the design of bankruptcy codes should not be independent from the structure of the economy.

More specifically, some simulations show that even small changes of legal sanctions may have drastic effects on the firm’s investment policy (this comes from the non linearity of the expected profits, which are linked to specific equilibria). Besides, it appears that extreme severity (i.e. 100% of the manager’s wealth is subject to legal sanctions) is not needed to ensure *economic efficiency*: legal sanctions much less than 100% may be sufficient as soon as it corresponds to an optimum for the banks. Last, in some situations, the legislator may have the choice between several levels of legal sanctions all leading to *economic efficiency*: when choosing between them, the legislator affects the profit sharing only.

Our approach takes into account *ex-ante* and *ex-post* effects of the bankruptcy design. Moreover, it focuses on the informational and repressive role of bankruptcy and relies on an endogenous probability of default: the central variable is the interest rate which appears as an indirect tool of implementing (or not) *economic efficiency*. It affects the probability of default, and is influenced by the rules prevailing under default. In the future, our approach should be extended to the third major function of bankruptcy: that is the coordination between creditors, which is not discussed here and represents further work.
References


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