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Essays of Applied Microeconomic Theory : An Analysis of Mexico's Privatization Mechanisms And Loan Market Regulation

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Abstract

What is the optimal screening scheme in an auction when the seller of the object cares both about how much revenue he will collect from the sale and about which of the bidders will obtain the object? We compare the seller's utility under two different screening schemes. In one scheme, the seller restricts the number of participants to a subset of the potential buyers that he considers "qualified" and then sets an optimal reservation price. In the other scheme, the seller allows all potential buyers to participate in the auction, but announces a bidder-specific reservation price. We analyze the gain from using the latter scheme and its dependence on such factors as the total number of bidders and the strength of seller preferences.

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1.1 Introduction

Government sales, especially of public sector enterprises, frequently pursue multiple objectives, of which revenue maximization is only one. For instance, the sale of Teléfonos de Mexico (Telmex) reported US $ 6 billion for the Mexican treasury[1]. But when President Carlos Salinas de Gortari announced that Telmex was to be privatized, his message established five non-monetary criteria: 1) respect workers' rights; 2) remain under the control of Mexican nationals; 3) improve services up to international standards; 4) assure network growth; and 5) strengthen research and development[2]. Clearly, if the seller's objectives are broader than revenue maximization, he will care not only about the buyers' willingness to pay but also about the buyers' qualifications according to these other objectives. Such considerations give rise to the use of pre-qualifying rounds in auctions[3]. In the extreme, if the seller wants to give the object to a particular buyer, he can eliminate all other bidders from the contest. However, this screening is not free because without competition the remaining buyer will lack the incentives to bid a high price for the object. This obvious trade-off between both aspects leads to the following question: What is the optimal screening scheme in an auction when the seller cares both about how much revenue he collects and about

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[1] This amount represents 33 percent of the US $ 20 billion Salina's privatization program.

[2] Aspe (1993).

[3] The recent sales of Mexican seaports, railroads, and electric plants follow a two stage format. The first stage is a qualifying round in which all the potential buyers submit applications for the seller's consideration. According to his guidelines, the seller screens whcih buyers "qualify" to participate in the next stage. In the second stage, the "object" is sold to a member of the subset of "qualified" bidders through a first or second price auction, in which the seller may set a reservation price or entry fee. For details on the privatization of the Mexican commercial banks, which also followed this kind of two-stage format see Aspe (1993).

who will obtain the object?[4]

We answer this question by characterizing the optimal auction mechanism of a seller who has preferences over the potential buyers. We find that the seller's optimal auction is implemented with bidder-specific screening levels (minimum levels for accepting a potential buyer's bid) that depend on the seller's value estimate of the object, on the probability distributions of the bidders' value estimates, and on the bidder-specific attributes that the seller values. We compare the seller's payoff from an auction under two different screening schemes. One of these schemes uses bidder-specific reservation prices. The other one is a restricted participation scheme that resembles the pre-qualifying round commonly used in privatization and procurement auctions. We show that in the independent private values setting when the seller implements the scheme with bidder-specific screening levels his expected utility always is at least as high as under the scheme with "restricted participation".

This result is driven by the fact that the seller can always mimic the restricted-participation scheme by announcing sufficiently high reservation prices to discourage the participation of the buyers that he rather leave out. We also find, for an example in which the bidders' value estimate come from the same uniform probability distribution, the range of bidder-specific attributes' values for which both schemes provide the same expected payoff for the seller.

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[4]It probably is helpful to grasp the relevance of this question presenting some figures about the revenues generated from the privatization programs and about the nature of the public enterprises being sold. Privatization revenues, which in one survey includes all former centrally planned economies except East Germany, raised from US $ 2.6 billion in 1988 to US $ 23.1 billion in 1992. This is the year in which the privatization receipts in developing countries exceed those of the industrialized countries for the first time: US $ 23.1 versus US $ 17.3. About 33 percent of the developing countries proceeds was accounted for by infrastructure sectors, such as power, telecommunications, transport, and water; about 25 percent was accounted for by banks and other financial institutions; and another 15 percent was accounted for by firms in the primary sector, that is, mining and extraction, particularly in oil and gas. Within infrastructure, telecommunications accounted for more than half the total, while power accounted for 23 percent and airlines for 12 percent. See Rammamurti (1996) for details.

Our work relates with at least two recent areas of interest in the auction literature: price-preference policies and favoritism in auctions and sales mechanisms in the presence of externalities. McAffee and McMillan (1989) shows that a price preference policy can be cost effective in government procurement auctions in which (national and foreign) firms draw their costs from different probability distributions. Preferential treatment to high cost firms in the awarding of contracts can actually reduce the cost of government procurement because it increases the competition faced by low cost firms. More recently, Ayres and Cramton (1996) and Corns and Schotter (1997) use this argument to challenge the assumption that all affirmative action programs must be cost increasing. Branco (1994) studies the rationale for giving preference to domestic firms, absent comparative advantage, in the award of government contracts when the regulator is interested in maximizing domestic welfare. Ganuza (1997) studies procurement contracts in which the regulator has some prior information about the quality of the bidding firms but the firms have private cost information.

The optimal auction that we develop shares the basic features of these models: implementing the seller's utility maximizing allocation requires discriminatory policies that respond to his preferences. But in our model, the fact that the seller pursues different aims through the sale (for example, maximizing revenue and finding the "right" owner) introduces an additional trade-off in the discriminatory policies. Given the bidders' value estimates and attributes, these different aims may or may not be aligned and, therefore, the allocation policies can be either more or less discriminatory than in those models. It is this trade-off among aims that can potentially make the seller indifferent between the two screening schemes that we study.

On the other hand, to examine the Ukraine's agreements on nuclear weapons, Jehiel, Moldovanu, and Stacchetti (1996) formulate a model that incorporates externalities among the buyers. The optimal sales (or non-sales) mechanism that they derive requires that whoever gets the object gives money transfers to the rest of the participants that compensate them for the externality that he will impose on them. This framework, in the case that there are no cross-buyer externalities (in effect, that only the seller cares about the externalities), delivers a solution analogous to ours.

The rest of this chapter is organized as follows. Section 2 characterizes the scheme of bidder-specific screening levels as a solution to an optimal auction design problem in which the seller's choice is restricted to auction mechanisms with outcomes that depend on the bidders' value estimate announcements[5]. Section 3 compares the seller's payoff under both schemes and develops an example. Section 4 presents some conclusions.

1.2 A selling scheme with bidder-specific screening levels.

For the sake of convenience, we follow closely the presentation of the auction mechanism design problem of Myerson (1981). This formulation considers the problem faced by a seller who has a single object to sell to one of several possible buyers, when the seller has imperfect

[5]In this model, a bidder's type consists of two characteristics. One is the bidder's estimate of the object's value. The other is an attribute that is desirable or undesirable for the seller but that does not affect the bidder's valuation. We focus on mechanisms in which the seller chooses mechanisms with outcomes that depend only on value estimate announcements, in contrast to broader kinds of mechanisms in which outcomes depend on both bidder characteristics' announcements. Our focus obeys to the empirical observation that motivates this paper: we want a framework consistent with the fact that in the privatization and procurement auctions the seller tries to obtain information of at least some of the bidder characteristics through applications, previously to the contests.

information about how much the buyers might be willing to pay for the object. The seller's problem is to design an auction game that maximizes his expected utility, which is the sum of expected payments from the bidders. We will extend this general framework to analyze the situation in which the seller has preferences over the potential buyers.

As we remark in the introduction, when the government is privatizing a firm it is likely that the firm's future economic performance under the new ownership is regarded at least as important as the sales revenue. The government's economic performance goals may or may not be consistent with those that would maximize a potential buyer's gains from acquiring the firm in terms of the size and length of investments, levels of employment, and/or technological choices. Another possibility is that the government perceives different managerial capabilities or aggregate welfare implications according to the potential buyers' nationality[6], business experience[7], or moral quality. All of these considerations can make the government like some buyers better than others.[8]

To model these preferences, we will assume that each buyer has a distinguishing attribute

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[6]Branco (1994) considers a procurement auction in which there are national and foreign firms and only the formers' profits enter the government's objective function.

[7]Ganuza (1997) considers a procurement auction in which the goverment can rank the firms according to a "quality parameter".

[8]Rammamurti (1996) discusses the privatization objectives of Latin American governments in the telecommunications and transport sectors. He concludes that the three goals that explain the privatization of telephone companies and airlines are the following: (1) Maximizing the proceeds from the sale to help end the country's fiscal and balance of payment crises. (2) Sending a positive signal to private investors through a "successful" sale. (3) Improving the performance of the enterprise or sector by encouraging competition and improving regulation and management.

But this ambition of goals is not specific to developing countries. Although no one has defined a comprehensive list of goals for the British privatization program, paramount aims seem to have encompassed: (1) improving efficiency, (2) reducing the public sector borrowing requirement, (3) reducing government involvement in enterprise decision making, (4) easing problems of public sector pay determination, (5) widening share ownership, (6) encouraging employee share ownership and (7) gaining political advantage. See Vickers and Yarrow (1988) for details on the British privatization program in the telecommunications, transport, energy, and water sectors.

that is either desirable or undesirable for the seller. As a result, the seller's expected utility will be the sum of expected payments from the bidders plus the winning bidder's attribute[9]. This specification of the seller's optimization problem is broad enough to capture the government's multiplicity of objectives when it sells a public sector enterprise. We choose to focus on revenue maximization because this is consistent with the privatization experience in developing countries[10]. And on buyer attributes that affect the seller because they can be ubiquitously interpreted as the extent to which the buyers' goals differ from the government's standard. Other favorite possibilities include allocating the object to the buyer that values it the most or maximizing social welfare. But only empirical observation can determine if one objective prevails more often than another one. In addition, we will abstract from the possibility that the government pursues more than two objectives[11] and from the possibility that the government attaches different weights to each objective because discerning among these alternatives is also an open empirical issue.

1.2.1 Notation and Basic Definitions

We will denote $N = \{1, ..., n\}$ as the set of bidders, with i and j representing typical bidders in N. For each bidder i, t_i is her value estimate for the seller's object and L_i is her attribute. A bidder's t_i represents the maximum amount that she would be willing to pay for the object

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[9]This is a richer framework than the usually employed in the auction literature of price preferences and favoritism (see Branco (1994) or Ganuza (1997) for example) because we can examine more differences among the potential bidders. The nature of the privatization problem we address suggests that this is a more proper setup.

[10]Rammamurti (1996).

[11]However, interpreting the buyer's attribute as a composite characteristic instead as only one we could somehow accommodate additional goals.

given her current information about its value. A bidder's L_i represents the gain or loss that the seller will realize if she gets the object. Hence, from the seller's point of view, a bidder's type is this pair of characteristics.

As in Myerson (1981), we will assume that a continuous probability distribution over a finite interval describes the seller's uncertainty about the value estimate of bidder i. Specifically, let a_i be the lowest possible value that i might assign to the object and b_i be the highest possible value that i might assign to the object, then $fi : [ai, bi] \rightarrow \Re_+$ will be the probability density function for $i's$ value estimate t_i. We will assume that $-\infty < a_i < b_i < +\infty$; $f_i(t_i) > 0 \; \forall \; t_i \in [a_i, b_i]$; and $f_i(\cdot)$ is a continuous function on $[a_i, b_i]$. $F_i : [a_i, b_i] \rightarrow [0, 1]$ will denote the cumulative distribution function corresponding to the density $f_i(\cdot)$, so that $F_i(t_i) = \int_{a_i}^{t_i} f_i(s_i)ds_i$.

Let $T = [a_1, b_1] \times ... \times [a_n, b_n]$ denote the set of all possible combinations of bidders' value estimates and, for any bidder i, $T_{-i} = \times_{j=N, j\neq i}[a_j, b_j]$denote the set of all possible combinations of value estimates that the bidders other than i might hold. We will assume that the value estimates of the N bidders are stochastically independent random variables. Therefore, the joint density function on T for the vector $t = (t_1, ..., t_n)$ of individual values estimates is $f(t) = \prod_{j \in N} f_j(t_j)$and the joint density function on T_{-i} for the vector $t_{-i} = (t_1, ..., t_{i-1}, t_{i+1}, ..., t_n)$ of individual values estimates is $f_{-i}(t_{-i}) = \prod_{j \in N, j \neq i} f_j(t_j)$. We will assume that each bidder knows his own value estimate and assesses the probability distribution for the other bidders' value estimates in the same way the seller does.

Regarding the bidder-specific attribute, we will interpret L_i as a loss that the seller incurs when bidder i get the object. We will assume that these losses are independent of the bidder's value estimates and are common knowledge. Independence among both bidder characteristics will allow us to abstract from the bidders' valuations being affected by the attributes[12]. Common knowledge will allow us to abstract from the seller's non-trivial problem of inducing the buyers to truthfully reveal L_i.[13]

We will denote the seller's personal value estimate of the object, in the case where he keeps it and does not sell it to any of the bidders as t_0, and we assume that it is also common knowledge.[14]

There are two general reasons why one bidder's value estimate may be unknown to the seller and to the rest of the bidders: preference uncertainty and quality uncertainty. The former refers to the case where a bidder's personal preference for the object is private and the latter to the case where a bidder has special information about the intrinsic quality of the object. Under preference uncertainty, the fact that bidder i knows bidder $j's$ value estimate does not affect bidder $i's$ estimate. In contrast, under quality uncertainty, the fact that bidder i know bidder $j's$ value estimate affects bidder $i's$ estimate. We will study the first case, which corresponds to the model of independent private valuations.

In the context of the sale of a public sector firm, the assumption of independent private valuations provides a proper characterization when the firm's stream of revenues is known but the potential buyers have different operation costs. For example, if the firm up to sale is

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[12]The cases in which the bidders' attributes affect their valuation for the object would be better addressed with the model proposed in MIlgrom and Weber (1982).

[13]For our purposes it is enough that the seller observes L_i for each bidder. However, since in the optimal mechanism each bidder will be able to infer her opponents' attribute from the seller's mechanism choice, we opt to assume common knowledge from the beginning.

[14]The previous comment also applies for t_0.

an airline or a telephone company. When the firm's stream of revenue is unknown and all the potential buyers have the same operation costs, then the common private valuations model would provide a characterization that is closer to reality. For example, if the government is selling oil wells or radiospectrum frequencies. Another important issue that can favor either one characterization or another is the presence of a resale market. If the resale market is very thin or is banned[15] then independent private valuations is a better assumption than common private valuations.

1.2.2 Optimal auction design problem

We will characterize the seller's problem as a mechanism design game. Mechanism design is typically studied as a three-step game of incomplete information between a principal and a set of agents. The agents' types are private information. In step 1, the principal designs a "mechanism". A mechanism is a game in which the agents send costless messages, and an allocation that depends on the realized messages.[16] The allocation is a decision about the level of some observable variable and a vector of transfers from the principal to the agents (which can be positive or negative). In step 2, the agents simultaneously accept or reject the mechanism. An agent who rejects the mechanism gets some exogenously specified "reservation utility" (usually, but not necessarily, a type-independent number). In step 3, the agents who accept the mechanism play the game specified by the mechanism.

[15] For example, in the sale contract for Telmex explicitly prohibits the control group to sell its shares of the firm for at least 5 years.

[16] The messge game can have simultaneous announcements or a more complex communication process. See Fudenberg and Tirole (1991) for details.

In a direct truth-revelation auction mechanism, the bidders simultaneously and confidentially announce their value estimates[17] to the seller (principal) and then the seller determines who gets the object and how much each bidder (agent) must pay as a function of the vector of announced value estimates t. It follows that we can describe this mechanism with the outcome functions (p, x), where $p = (p_1, ..., p_n)$ and $x = (x_1, ..., x_n)$. For a vector t of announced value estimates $p_i : t \to [0, 1]$ is the probability that bidder i gets the object and $x_i : t \to \Re$ is the amount of money which bidder i must pay to the seller[18]. Therefore, $p : T \to \Re^N$ and $x : T \to \Re^N$. The seller's problem is to choose the auction with outcomes (p, x) that maximize his expected utility, from among all feasible auctions[19].

To state this problem, we must describe the payoffs to the bidders and to the seller in terms of the outcome functions and characterize the set of feasible auctions. Bidder $i's$ expected utility from an auction mechanism described by (p, x) is:

$$U_i(p, x, t_i) = \int_{T_{-i}} [t_i p_i(t) - x_i(t)] f_{-i}(t_{-i}) dt_{-i} \tag{1}$$

Similarly, the seller's expected utility from an auction mechanism described by (p, x) is:

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[17] Requiring that bidders announce their value estimate is equivalent to requiring that they announce their type under the assumption that all the bidder-specific attributes are common knowledge.

[18] In the appendix we analyze mechanisms in which $p_i : t \times L \to [0, 1]$ and $x_i : t \times L \to \Re$, where $L = (L_1, ..., L_N)$. It is worth to emphasize that because here we are restricting the analysis to mechanisms in which (p, x)depend solely on t, only the seller's expected utility is an explicit function of L.

[19] In mechanism design, a payment function $x(t)$ that implements the outcome $(p(t), x(t))$(i.e., satisfies incentive compatibility) is feasible if it satisfies the individual rationality constraints. See Fudenberg and Tirole (1991) for details.

$$U_0(p,x) = \int_T [t_0(1 - \sum_{j\in N} p_j(t)) + \sum_{j\in N}(x_j(t) - p_j(t)L_j)]f(t)dt \tag{2}$$

The set of feasible auctions consists of those that satisfy three requirements. First, the function p must satisfy the following probability conditions:

$$\sum_{j\in N} p_j(t) \leq 1 \text{ and } p_i(t) \geq 0, \forall i \in N, \forall t \in T \tag{3}$$

Second, to guarantee that a bidder i will participate, her individual rationality condition must be satisfied:

$$U_i(p,x,t_i) \geq 0, \forall i \in N, \forall t_i \in [a_i, b_i] \tag{4}$$

Third, to guarantee that a bidder i will reveal her true value estimate, her incentive compatibility condition must be satisfied:

$$U_i(p,x,t_i) \geq \sum_{T_{-i}} [t_i p_i(s_i, t_{-i}) - x_i(s_i, t_{-i})] f_{-i}(t_{-i}) dt_{-i}, \forall i \in N, \forall t_i, \forall s_i \in [a_i, b_i] \tag{5}$$

Hence, the seller has to maximize equation (2) subject to the constraints (3), (4), and (5).

It will be useful to formulate a game that is consistent with this characterization. The players of the game are the seller and N potential buyers described in section 2.1. The game sequence is the following: First, the seller observes each potential buyer's L_i. Second, he announces the auction rules. These rules include a screening scheme and an auction format. The screening scheme indicates the minimum level for accepting a buyer's bid and can consist of the number of participants allowed in the auction (which can be less than or equal to the number of potential buyers), an optimally set reservation price or entry fee, or a combination of all. The auction format indicates if the contest is sealed bid, first price, or open ascending for example. Third, each allowed bidder announces whether she will participate in the auction. Fourth, the seller reports the number of participants in the auction. Fifth, each of the participants submits her bid (along with her entry fee, if such payment was specified) to the seller, in a closed envelope. Sixth, the seller opens the envelopes and proclaims the winner, if one exists. Afterwards the seller awards the object and collects all payments. The game ends.

The Bidders' Utility Maximization Problem

To solve this mechanism design problem we will concentrate on the players' optimal responses given that the seller announced a particular mechanism. For this reason it will be simpler to describe each utility maximization problem in terms of the winning probability and payment conditional on each player's value estimate. Let $q_i(t_i) = \int_{T_{-i}} p_i(t) f_{-i}(t_{-i}) dt_{-i}$ be the conditional expected probability that bidder i wins the object in the auction mechanism (p, x) when her value estimate is t_i, and $y_i(t_i) = \int_{T_{-i}} x_i(t) f_{-i}(t_{-i}) dt_{-i}$ be the conditional expected amount that bidder i pays to the seller in the auction mechanism (p, x) when her value estimate is t_i. With these definitions we can rewrite (1), (2), (4), and (5) as:

$$U_i(q,y,t_i) = t_i q_i(t_i) - y_i(t_i) \tag{1'}$$

$$U_0(q,y) = \int_T t_0 f(t)dt + \sum_{j\in N} \int_{a_j}^{b_j} [y_j(t_j) - (t_0 + L_j)q_j(t_j)]f_j(t_j)dt_j \tag{1.1}$$

$$U_i(q,y,t_i) \geq 0, \forall i \in N, \forall ti \in [a_i, b_i] \tag{4'}$$

$$U_i(q,y,t_i) \geq t_i q_i(s_i) - y_i(s_i), \forall i \in N, \forall ti, \forall si \in [a_i, b_i] \tag{5'}$$

The bidder's utility maximizing payment to the seller in our problem is consistent with the standard solution[20], so we present the details in the appendix. The total amount that each bidder i will optimally pay to the seller is the following:

$$y_i(t_i) = t_i q_i(t_i) - \int_{t_i^m}^{t_i} q_i(r_i)dr_i, \forall i \in N \tag{6}$$

This expression indicates that the optimal payment consists of two terms. The first one is the bidder $i's$ expected gain when her value estimate is t_i. The second one is the probability that bidder i gets the object by announcing a value estimate between her true estimate t_i and a value estimate t_i^m, which represents the lowest value estimate with which bidder i participates in the auction. That is:

[20]For example, see Riley and Samuelson (1981).

$$U_i(q,y,t_i^m) = t_i^m q_i(t_i^m) - y_i(t_i^m) \tag{7}$$

For this type of bidder i, the individual rationality constraint will hold with equality. The individual rationality constraint will bind for the bidder i with the lowest participating value estimate because it will not be utility maximizing for the seller that such bidders obtain a surplus from participating in the auction. If $U_i(q,y,t_i^m) > 0$, the bidder's optimal payment would be lower and, as a consequence, the seller's expected utility.

To complete this section we will look at the bidder's expected utility from the auction mechanism when her payment to the seller is optimal. When we substitute equation (6) into equation (1') we get:

$$U_i(q,y,t_i) = \int_{t_i^m}^{t_i} q_i(r_i)dr_i$$

or, more generally:

$$U_i(q,y,t_i) = U_i(q,y,t_i^m) + \int_{t_i^m}^{t_i} q_i(r_i)dr_i \tag{8}$$

Equation (8) indicates that when bidder i responds optimally her expected utility is increasing in the expected utility that the lowest type of bidder i obtains when she decides to participate and on her conditional probability of winning. Moreover, if bidder $i's$ conditional probability of winning is increasing on her value estimate the incentive compatibility constraint will be satisfied[21]. So in the seller's problem we can replace equation (5) (or (5')) with the following condition:

$$\text{If } s_i \leq t_i, \text{ then } q_i(s_i) \leq q_i(t_i), \forall i \in N, \forall t \in T \tag{9}$$

Seller's Expected Utility Maximization

The seller will maximize his expected utility given the optimal payments that the N bidders choose, according to equation (6). Correspondingly, to solve the seller's problem, first we substitute the bidders' optimal expected payments into equation (2'):

$$\begin{aligned}
U_0(q) &= \int_T t_0 f(t)dt + \\
&\quad \sum_{j\in N} \int_{a_i}^{b_i} \left[(t_j q_j(t_j) - \int_{t_j^m}^{t_j} q_j(r_j)dr_j - (t_0 + L_j)q_j(t_j) \right] f_j(t_j)dt_j \\
&= \int_T t_0 f(t)dt + \\
&\quad \sum_{j\in N} \left[\int_{a_i}^{b_i} (t_j - t_0 - L_j)q_j(t_j)f_j(t_j)dt_j - \int_{a_i}^{b_i} \left(\int_{t_j^m}^{t_j} q_j(r_j)dr_j \right) f_j(t_j)dt_j \right] \\
&= \int_T t_0 f(t)dt + \\
&\quad \sum_{j\in N} \left[\int_{a_i}^{b_i} (t_j - t_0 - L_j)q_j(t_j)f_j(t_j)dt - \int_{a_i}^{b_i} (1 - F_j(t_j))q_j(t_j)dt_j \right] \\
&= \int_T t_0 f(t)dt + \sum_{j\in N} \int_{a_i}^{b_i} \left[t_j - \frac{(1 - F_j(t_j))}{f_j(t_j)} - t_0 - L_j \right] q_j(t_j)f_j(t_j)dt_j
\end{aligned}$$

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[21]This follows from a theorem on mechanism design. For a thorough discussion see Fudenberg and Tirole (1991).

Next we restate the problem in terms of the vector $p(t)$, by substituting the definition of the conditional winning probabilities. This yields:

$$U_0(p) = \int_T t_0 f(t)dt + \int_T \left(\sum_{j \in N} \left[t_j - \frac{(1 - F_j(t_j))}{f_j(t_j)} - t_0 - L_j \right] p_j(t) \right) f(t)dt$$

The first term of the above expression is a constant independent of the variables that the seller controls[22]. Consequently, the seller's objective function will be:

$$U_0(p) = \int_T \left(\sum_{j \in N} [t_j - \frac{(1 - F_j(t_j))}{f_j(t_j)} - t_0 - L_j] p_j(t) \right) f(t)dt \qquad (10)$$

It follows that to determine the optimal auction, the seller can alternatively maximize equation (10) subject to equations (6), (3), and (9). This problem differs from Myerson (1981) only by the bidder-specific attributes that appear in the seller's objective function. In this characterization of the optimal auction it is important to note that the payment schedule $y(t)$ disappears from the seller's objective function. The seller's expected utility will be determined by the vector of winning probabilities $p(t)$ and the expected utilities for the bidders of the lowest participating type. As a consequence, revenue equivalence holds: any two auctions that give the same $p_j(t)$ and $U_j(q, y, t_j^m)$[23] to each bidder j will provide the same expected utility to the seller.[24]

To characterize the optimal auction, it is useful to define the following function:

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[22] Recall that the seller's decision variables in the utility maximization problem are (p, x).

[23] In this case $U_j\left(q, y, t_j^m\right) = 0$.

[24] See Myerson (1981) or Riley and Samuelson (1981).

$$H_j(t_j) = t_j - \frac{(1 - F_j(t_j))}{f_j(t_j)} \tag{11}$$

This function represents bidder $j's$ gains of obtaining the object net of her information rents and is often referred to as bidder's virtual utility. Myerson (1981) and Maskin and Riley (1981) show that if for each bidder Hj(tj) is increasing in t_j, then condition (9), which guarantees incentive compatibility, will be satisfied.[25] In this case we are left with the maximization of (10) subject to (3).

Since maximizing the expected sum of payments will require maximizing the sum of payments, we can determine the optimal auction by solving the following Lagrangian:

$$L\left(p(t), \lambda\right) = \sum_{j \in N} \left[H_j(t_j) - t_0 - L_j]p_j(t) + \lambda[1 - \sum_{j \in N} p_j(t) \right] \tag{12}$$

The $N + 1$ first order conditions are:

$$\frac{\partial L\left(p(t), \lambda\right)}{\partial p_j(t)} = H_j(t_j) - t_0 - L_j - \lambda \leq \ 0, \forall j \in N \tag{13}$$

$$\frac{\partial L\left(p(t), \lambda\right)}{\partial \lambda} = 1 - \sum_{j \in N} p_j(t) \geq 0 \tag{14}$$

with strict inequalities holding in each case if, respectively, $p_j(t) = 0$ or $\lambda = 0$. Thus,

[25] When $\frac{(1-F_j(t_j))}{f_j(t_j)}$ is decreasing, which means that the reliability function $(1 - F_j\left(t_j\right))$is log-concave, $H_j\left(t_j\right)$will be increasing on t_j. This holds for mny well known distributions such as uniform, normal, logistic, extreme value, chi-squared, chi, exponential, Laplace, and any truncation of these distributions. The cases in which this condition is satisfied are reckoned as regular. For discussions about the non-regular cases see Myerson (1981) or Maskin and Riley (1981).

to maximize the seller's expected utility the probability that bidder j wins the object will be non-zero only if $H_j(t_j) - L_j - t_0 > 0$, that is, only if bidder $j's$ virtual utility exceeds the seller's loss $L_j + t_0$ of awarding the object to bidder j. Moreover, it will be optimal to assign the highest winning probability to the bidder for which this expression, which we can refer to as the virtual surplus, is greatest[26] and zero to the rest of the bidders. Our analysis leads to the following proposition:

Proposition 1. *Let* $H_j(t_j) = t_j - \frac{(1-F_j(t_j))}{f_j(t_j)}$ *and suppose that* $\frac{\partial H_j(t_j)}{\partial t_j} \geq 0, \forall j \in N$. *Then the seller's optimal auction will be such that at any vector of announced value estimates* t, *the object is awarded to the bidder* i *only if* $H_i(t_i) - L_i = \max_{(j \in N)} \{H_j(t_j) - L_j\}$ *and* $H_i(t_i) - L_i \geq t_0$; *and the object is not awarded if* $H_i(t_i) - L_i < t_0$.

This allocation rule indicates that the winner of the auction should be the bidder that generates the highest virtual surplus, even though she is not the bidder with the highest value estimate for the object. Nevertheless, inefficiency in the optimal auction is a familiar result[27]. Our optimal auction discriminates against bidders for whom the upper bounds on the value estimates distribution are higher (which are those who have the largest information rents) and for whom L_j is higher.

The requirement that the seller awards the object to the highest bidder if awarding her the object generates a positive virtual surplus ($H_j(t_j) - L_j \geq t_0$) suggests that implementation of the optimal auction will call for the seller setting bidder-specific screening levels for the minimum accepted value estimate announcements. That is, if a bidder's value estimate

[26]In principle, this may hold for several bidders, so a tie-breaking rule would be required to determine a unique winner. However, in this framework ties occur with zero probability.

[27]See Myerson (1981) or McAffee and McMillan (1989).

is so low that the corresponding virtual surplus is negative then it is not worthwhile to be announced. Let t_j^* denote the value estimate where $H_j(t_j^*) - L_j = t_0$. Since the virtual surplus of bidder j getting the object is positive only when her announced t_j exceeds t_j^*, t_j^* represents the seller's screening level for bidder $j's$ value estimate announcements. This will have to be true for anyone who wins, so for each bidder there will exist a screening level that depends on the seller's value estimate, on her bidder-specific attribute, and on the distribution from which her value estimate comes. Concretely:

Proposition 2. Suppose that $\partial H_j(t_j)/\partial tj \geq 0, \forall j \in N$. The bidder-specific screening level associated with the seller's optimal auction mechanism is $t_j^* = L_j + t_0 + \frac{(1-F_j(t_j^*))}{f_j(t_j^*)}, \forall j \in N, \forall t_j^* \in [a_j, b_j]$.

Proof. Appendix.

These screening levels can be implemented with bidder-specific reservation prices[28]. The only difference with previous results on optimal reservation prices arises from the presence of the bidder-specific attributes, which cause the reservation prices to vary across bidders even if all their value estimates come from the same probability distribution functions.[29] In this framework, since we have defined L_i as a loss, each reservation price is an increasing function of the bidder's attribute and the traditional wisdom that the seller's optimal reservation

[28] Two possible ways to distinguish high bidders from low bidders is to announce a reservation price or to charge an entry fee; and either a reservation price or an entry fee, or a combination of both instruments, implements the same screening level within properly specified games. Since we only consider games in which both instruments are equivalent, we will refer to them interchangeably (see Riley and Samuelson (1981) or Milgrom and Weber (1982) for details).

[29] In the independent private values model with symmetric identical bidders the optimal reservation price is $t^* = t_0 + \frac{(1-F(t^*))}{f(t^*)}$ (Myerson (1981) and Riley and Samuelson (1981)). This optimal reservation price is unique and independent of the number of bidders in the auction. Besides, it is higher than the seller's value estimate for the object.

price exceeds his value estimate t_0 applies only if $H_i(t_i) \geq -L_i$.[30]

On the other hand, when solving the bidders' utility maximization problem in section 2.2.1, we showed that bidder $i's$ optimal payment depends on what is the lowest value estimate with which she can participate. It follows that $t_i^m = t_i^*$, which implies that both the probability of winning with an announcement below t_i^* is zero (see equation (6)) and that if bidder $i's$ value estimate lower than t_i^* her individual rationality constraint is violated (see equations (7) and (8)). Thus, understanding the importance of the screening levels in the seller's utility maximization requires looking at their implications for both the seller and the buyers.

From the seller's perspective, setting $p_i(t) = 1$ is optimal only if bidder $i's$ announcement yields the maximum payoff to the seller among all the bidders. Ex-post (to the bidders' announcements) the winning probability of every bidder except i is zero and, therefore, the seller's payoff is equal to bidder $i's$ payment. But each bidder's payment is based on her expected utility of participating, which depends on her ex-ante (to the bidders' announcements) conditional probability of winning. According to equation (6), once that the seller announces the screening level t_i^*:

$$y_i(t_i) = t_i q_i(t_i) - \int_{t_i^*}^{t_i} q_i(r_i) dr_i, \forall i \in N \tag{15}$$

[30]For the same purposes, the seller could design an optimal discriminatory policy that ranks any two bids according to Proposition 2's scoring function. This alternative policy requires exactly the same information that the bidder-specific screening levels. Moreover, allocating the object using a discriminatory policy based only either on the value estimates distribution (McAffee and McMillan (1989), Ayres and Cramton (1996), and Corns and Schotter (1997) or on the bidder-specific attributes (Branco (1994) and Ganuza (1997) is not optimal for our seller whenever the bider differences come from both sources.

This function is decreasing with respect to the conditional probability of winning, which in turn is decreasing with respect to the number of competitors. A bidder perceives an auction with fewer competitors as more favorable for her because the probability that she wins with an announcement below her value estimate and, as a consequence, that her payment to the seller is small increases. Therefore, each bidder's expected payment depends on the screening levels that the seller sets for all bidders, because these determine how many bidders will compete.

These considerations indicate that there is a trade-off for the seller. With a screening scheme the seller guarantees that the object will not be sold for less than the reservation price that corresponds to the screening level. But to the extent that the screening scheme removes potential bidders, reduced competition decreases his ability to extract payments above reservation prices from the participating bidders.

To complete the specification of the optimal auction we need a payment rule $x(t)$. The previous analysis suggests that any vector of payments $x(t)$ that yields the vector $y(t)$, in which each single component $y_i(t_i)$ satisfies equation (15), will be optimal. Hence, in principle there can be more than one such optimal payment rules; as long as these rules generate the same vector of conditional bidder expected payments they will solve the seller's problem.

There are two additional remarks about the optimal auction. First, if the reservation price that the seller sets for a particular bidder is sufficiently high, then such bidder will choose to stay out from the auction, due to her individual rationality constraint. Therefore, the screen is enough to guarantee that any bidder that participates represents a non-negative contribution to the seller's expected payoff. From the seller's perspective, it is optimal to leave a bidder out only if she is not willing to make a payment that covers the loss that her winning imposes on the seller. We will examine this issue in more detail in section 3, where we compare two different screening schemes.

Second, earlier in our analysis we pointed out that the optimal screening levels (in effect, entry fees or reservation prices) vary across bidders even if their value estimates come from the same probability distribution whenever the bidder-specific attributes vary. This result follows from the fact that the seller chooses the optimal auction within the set of mechanisms in which outcome functions depend explicitly on the vector of announced value estimates (t) only. If the seller can choose the auction within a broader set of mechanisms, in which outcome functions depend on both bidder characteristics (t, L), the screening level will be the same for all bidders in the event that the bidders' value estimates come from the same probability distribution. In the appendix we show a simple example of this idea that also helps to grasp the affinity between our model and the classical optimal auction.

1.3 Seller's Expected Utility under Different Bidder-Screening Schemes

We have characterized a sales mechanism that maximizes the seller's expected utility. In this mechanism the auction bidders face different screening levels that reflect the seller's assessment of their characteristics. If the seller does not regard two bidders as equivalent in terms of their characteristics, they will not be treated equally in the auction. While we do observe auctions in which bidders comply to different participation rules, like price-preferences policies[31], it is more common that after a pre-qualifying round the seller auctions the object only among the subset of potential buyers that meet the specified criteria, with all these buyers facing equal participation rules. The obvious question is how well do auctions with pre-qualifying rounds perform compared to the optimal auction. To answer this question in section 3.1 we formulate two schemes, one that is consistent with the optimal auction set up from section 2 and another that is consistent with the pre-qualifying round set up, and compare their allocation properties. We show that the latter scheme may not attain seller's expected utility maximization.

The design of the optimal auction requires that the seller know a lot of information about the bidders. Even under the simplest assumptions the analytical evaluation of the bidders' expected payments is a non-trivial task. This is an important explanation of why in practice most auctions follow the classic formats. In section 3.2 we contrast the seller's expected utility from using two different second best sales methods. We construct a simple example in which the seller uses a second price auction along with a screening scheme. One of these schemes uses bidder-specific reservation prices and the other uses a pre-qualifying round to determine which bidders participate in the auction along with a common reservation price for all participants. We find that the expected utility of the seller always is at least as high under the bidder-specific reservation prices scheme as under the pre-qualifying round scheme.

[31] For details and data of price preference policies on international government procurement auctions see McAffee and McMillan (1989), and on the FCC auctions see Ayres and Cramton (1996) or Corns and Schotter (1997).

1.3.1 Optimal Bidder-Screening Schemes

We will consider two different screening schemes. One of the schemes will resemble the solution to the seller's problem from section 2 and the other will resemble the qualifying round scheme. In screening scheme # 1 the seller observes the vector of bidder-specific attributes and announces the corresponding bidder-specific reservation price that each participant's bid will have to exceed. In screening scheme # 2 the seller observes the vector of bidder-specific attributes, decides which bidders qualify to participate in the auction according to this characteristic, and then announces the reservation prices.

Suppose that the bidder-specific attribute takes only two values, either zero or a positive finite constant significantly different from zero[32]. Let $n_1 = \{j \in N \mid L_j = 0\}$ and $n_2 = \{j \in N \mid L_j > 0\}$, so that $n_1 + n_2 = N$. Then if the seller uses the screening scheme # 1 he allows all the bidders to participate and sets a different screening level for each bidder according to $t_j^* = L_j + t_0 + H_j(t_j^*), \forall j \in N$; and if he uses the screening scheme # 2 he only allows to participate the bidders for which $L_j = 0$ (remember that L_j represents a loss), that is $j \in n_1$, and sets the screening levels for the participants at $t_j^* = t_0 + H_j(t_j^*), \forall j \in n_1$.[33]

From the previous section we know that an auction mechanism that assigns the object to the highest bidder, along with bidder-specific screening levels implied by the screening scheme # 1, will maximize the seller's expected utility. Hence, we only need to examine if

[32] The intuition for requiring that there are significant difference between the bidder-specific attributes is that there exist gains from separation.

[33] More generally, to determine the optimal cut-off value the seller has to balance the expected gains and losses of increasing L_j. Lowering L_j will increase the number of participants, which in turn boosts the bids but also increases the probability of selling the object to a disliked bidder. For a formulation of this optimization problem see Ganuza (1997).

this will also be the case when the seller uses the other scheme. When the screening scheme # 2 is used, the winner (if any) will be the bidder i for which $H_i(t_i) = \max_{(j \in n_1)}\{H_j(t_j)\}$. This allocation may not attain utility maximization if outside the subset n_1 there exists a bidder for whom $H_j(t_j) - L_j$ is higher. Thus, this scheme may not guarantee that the auction winner is the bidder that makes the highest contribution to his utility. In a sense, the seller is solving an optimization problem with an additional constraint, namely that $L_j = 0$; its solution may not solve the original problem. As a result, this mechanism will not satisfy Proposition 1.

1.3.2 Example

In this section our purpose is to compare the seller's expected utility from a second price auction[34] under the two different screening schemes that we described previously. We will consider the game between the seller and the N bidders characterized in section 2. The game sequence is the following. First, the seller observes each potential buyer's L_i. Second, he announces a screening scheme which includes the number of participants allowed in the auction and the optimally set reservation prices. Third, each allowed bidder announces whether she will participate in the auction. Fourth, the seller reports the number of participants in the auction. Fifth, each of the participants submits her bid to the seller in a closed envelope. Sixth, the seller opens the envelopes and proclaims the winner, if one

[34]In the regular case when $\partial H_j(t_j)/\partial t_j \geq 0\ \forall j \in N$, if all the bidders value estimates come from the same probability distribution and bidder attributes are zero for all bidders, the optimal auction can be implemented with a second price auction (exactly as Myerson (1981)). But this is no longer the case once that we introduce non-zero bidder-specific attributes (see Proposition 1). Nevertheless, the example illustrates how the screening scheme matters for the seller's expected utility.

exists. Afterwards the seller awards the object and collects all payments. The game ends.

We will assume that $N = [1, 2]$, $F_i(t_i) = t_i \in [0, 1] \forall i \in N$, $L_1 = 0$, $L_2 = L$, and $t_0 = 0$ because it is the simplest setting in which the optimal reservation prices differ among the bidders. The seller estimates that the object's worth is zero. There are two potential buyers who estimate that the seller's object is worth something but the seller has no information to determine if there are differences in the bidders' value estimates. Thus, he just assumes that these come from the same probability distribution. In addition, the seller dislikes buyer 2. This case has obvious computational advantages. But also, when there are only two potential buyers the trade-off that arises from restricting the number of bidders is greatest.

In a second price auction, each bidder's weakly dominant strategy is to bid her own value estimate for the object. The winner is the bidder with the highest value estimate and she will pay the second highest value estimate. A bidder will choose to bid in the auction if her expected utility of participating is greater than zero. It is important to recall that the number of bidders that actually participate in the auction will coincide with the number of bidders that the seller allows to participate only if all of them have non-negative expected utilities once he announces the scheme.

Seller's expected utility in a second price auction with screening scheme # 2

In the screening scheme # 2 the seller allows only bidder 1 to participate in the auction. The optimal reservation price is $t_1^* = 1/2$, which just equals the bidders' value estimate of the object[35]. The rules of the auction under this screening scheme determine two possible game outcomes (Table 1): if $t_1^* < t_1 \leq 1$ $p(t_1) = 1$(when bidder 1's value estimate is higher than the reservation price the seller will sell her the object for the reservation price) and if $0 \leq t_1 \leq t_1^*$ $p(t_1) = 0$ (when bidder 1's value estimate is lower than the reservation price the seller will keep the object).

Table 1.1

Game outcomes and players' payoffs generated when the seller uses screening scheme # 2

Outcome	Bidder 1's payoff	Seller's payoff
Bidder 1 participates ($t_1^* < t_1 \leq 1$)	$t_1 - t_1^*$	t_1^*
Bidder 1 does not participate ($0 \leq t_1 \leq t_1^*$)	0	0

Once that we know how much the seller will get at each possible game outcome and what is the probability of each we can compute the seller's utility very easily. In this case the seller's expected utility is:

$$U_{02} = (t_1^*)(0) + (1 - t_1^*)(t_1^*) \tag{16}$$

So at $t_1^* = 1/2$, $U_{02} = 1/4$.

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[35]Perhaps the reader may prefer to think that instead of holding an auction with only one participant the seller just makes the buyer a take-it-or-leave-it offer. His optimal offer is to offer the object to the buyer for her expected value estimate.

Seller's expected utility in a second price auction with screening scheme # 1

In screening scheme # 1 the seller allows both bidders to participate in the auction but announces a different reservation price for each one. The optimal reservation prices are $t_1^* = 1/2$ and $t_2^* = \frac{L}{2} + (\frac{1}{2})(L_2+1)^{1/2}$: bidder 1's reservation price is the same as in the other scheme and bidder 2's reservation price exceeds bidder 1's by at least the seller's expected loss.[36]

Under this screening scheme the five possible outcomes (Table 2) are: if $0 \leq t_1 \leq t_1^*$ and $0 \leq t_2 \leq t_2^*$ $p(t_1, t_2) = (0, 0)$ (if both bidders' value estimate don't exceed the corresponding reservation prices the seller will keep the object); if $t_1^* < t_1 \leq 1$ and $0 \leq t_2 \leq t_2^*$ $p(t_1, t_2) = (1, 0)$ (if bidder 1's value estimate exceeds t_1^* and bidder 2's doesn't exceed t_2^* then bidder 1 gets the object and pays t_1^*); if $0 \leq t_1 \leq t_2^*$ and $t_2^* < t_2 \leq 1$ $p(t_1, t_2) = (0, 1)$ (if bidder 2's value estimate exceeds t_2^* and bidder 1's doesn't then bidder 2 gets the object and pays t_2^*), if $t_2^* < t_1 \leq 1$, $t_2^* < t_2 \leq 1$, and $t_2 \leq t_1$ $p(t_1, t_2) = (1, 0)$ (if both bidders' value estimates exceed t_2^* and bidder 1's estimate is higher than bidder 2's then bidder 1 gets the object and pays t_2); and, lastly, if $t_2^* < t_1 \leq 1$, $t_2^* < t_2 \leq 1$, and $t_1 < t_2$ $p(t_1, t_2) = (0, 1)$ (if both bidders' value estimates exceed t_2^* and bidder 2's estimate is higher than bidder 1's then bidder 2 gets the object and pays t_1).

About these game outcomes it is worth noticing that given $t_1^* < t_2^*$ if bidder 2 announces that she will participate in the auction, then bidder 1 will be indifferent between

[36]Notice that the t_2^* differs from the expression contained in Proposition 2. The reason is the second price auction with bidder-specific reservation prices does not implement the optimal auction. Therefore, it is necessary to calculate the reservation price that maximizes the seller's expected utility within the sales mechanism proposed.

participating and not participating whenever $t_1 < t_2^*$ because she will lose against bidder 2 with certainty. On the other hand, the seller would rather give the object to bidder 1 if $t_1 > t_2^* - L$. This shows why the simple second price auction is not the optimal auction. But as we will see even if the seller allows this inefficiency his expected utility under screening scheme # 1 is always at least as high as under screening scheme # 2.

Table 1.2

Game outcomes and players' payoffs generated when the seller uses screening scheme # 1

Outcome	Winning bidder's payoff	Seller's payoff
None of the bidders participate ($0 \leq t_1 \leq t_1^*$ and $0 \leq t_2 \leq t_2^*$)	0	0
Only bidder 1 participates ($t_1^* < t_1 \leq 1$ and $0 \leq t_2 \leq t_2^*$)	$t_1 - t_1^*$	t_1^*
Only bidder 2 participates ($0 \leq t_1 \leq t_2^*$ and $t_2^* < t_2 \leq 1$)	$t_2 - t_2^*$	$t_2^* - L$
Both bidders participate and bidder 1 wins ($t_2^* < t_1 \leq 1, t_2^* < t_2 \leq 1$, and $t_2 \leq t_1$)	$t_1 - t_2$	t_2
Both bidders participate and bidder 2 wins ($t_2^* < t_1 \leq 1, t_2^* < t_2 \leq 1$, and $t_2 > t_1$)	$t_2 - t_1$	$t_1 - L$

The seller's expected utility is:

$$\begin{aligned} U_{01} &= (t_1^*)(t_2^*)(0) + (1-t_1^*)(t_2^*)(t_1^*) + (t_2^*)(1-t_2^*)(t_2^* - L) + \\ & (1-t_2^*)^2 \left(\int_{t_2^*}^{1} \left(2 \int_{t_2^*}^{t} \left[\frac{s}{(1-t_2^*)^2} \right] ds \right) dt + \frac{L}{2} \right) \end{aligned} \tag{17}$$

After solving the integrals and simplifying where profitable this equation becomes:

$$U_{01} = \frac{1}{3} - \frac{L}{2} + (t_1^*)(t_2^*) - (t_1^*)^2(t_2^*) + \left(\frac{L}{2}\right)(t_2^*)^2 - \left(\frac{1}{3}\right)(t_2^*)^3 \tag{18}$$

Once that we substitute t_1^* and t_2^*[37], seller's expected utility depends only on L. In figure 1 we show both U_{01} and U_{02} for $L \in [0,1]$. U_{02} is constant at 1/4. On the other hand, U_{01} is a decreasing function with a maximum at 5/12, corresponding to $L = 0$, and a minimum at 1/4, corresponding to $L \geq 3/4$. When $L = 0$ the optimal bidder-specific reservation price is the same for both bidders, clearly because they are identical from the seller's perspective. Thus, the maximum seller's expected payoff under screening scheme # 1 coincides with the maximum that he would expect to gain in the presence of two identical bidders.

On the other hand, for $L \geq 3/4$ the optimal reservation price for bidder 2 exceeds his maximum value estimate, $t_2^* \geq 1$. Thus, bidder 2 does not participate. In this case, both screening schemes yield the same expected payoff for the seller because they have the same set of participants in the auction facing the same screening level, namely $t_1^* = 1/2$. Or equivalently, the scheme with bidder-specific reservation prices mimics the scheme with pre-qualifying round when the corresponding bidder screening level is sufficiently high to ban unqualified bidders' participation.

At this moment, we may ask if it is optimal for the seller to always allow both bidders to participate and just set a common reservation price. If we set the constraint that $t_1^* = t_2^*$, the optimal reservation price is $t^* = \frac{L}{4} + \frac{1}{2}$. Notice that this reservation price is pooling the seller's expected loss among all the participants. In Figure 2 we compare the seller's

[37]Each t_i^* solves $\partial U_{01}/\partial t_i^* = 0$. The second order conditions are used to select the solution that corresponds to a maximum.

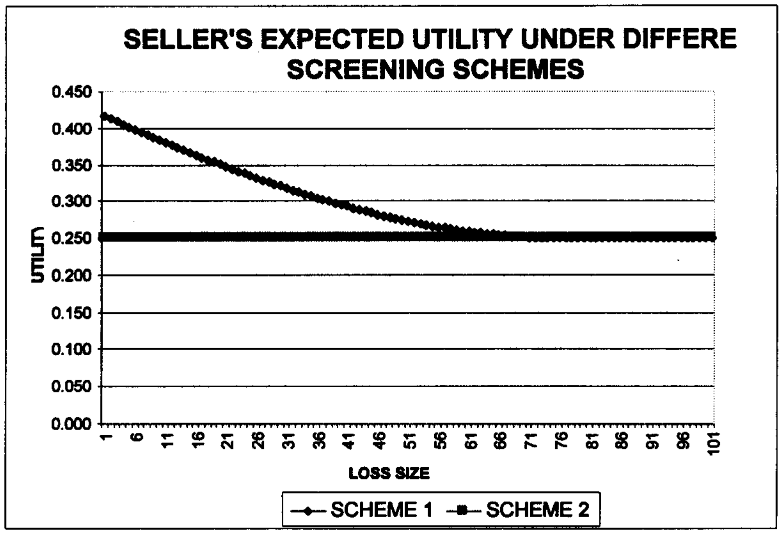

Figure 1-1: Comparison of the seller's expected utility under schemes 1 and 2.

expected utility under this scheme, which we denote U_{03}, with the two previous cases. $U_{02} = U_{03}$ at $L = 0$. Therefore, for low values of L, since the differences among the bidders are small the potential gains of discriminating across them are also small. As L rises U_{03} decreases at a faster rate than U_{02} and has a minimum at 1/8. This suggests that the potential gains of discriminating across bidders rise as the differences among them matter.

Nevertheless, in figure 2 we can see that for $L \leq 1/2$ $U_{03} < U_{01}$, which suggests that in the presence of substantial differences across the buyers if the seller is constrained to give equal treatment to all of them he will do better off restricting the participation the unqualified bidders.

As a final remark, it is worth noting that when the seller is constrained to set the same reservation price the range of L at which it is better for him to allow both bidders in the auction is smaller (1/2 in contrast to 3/4).

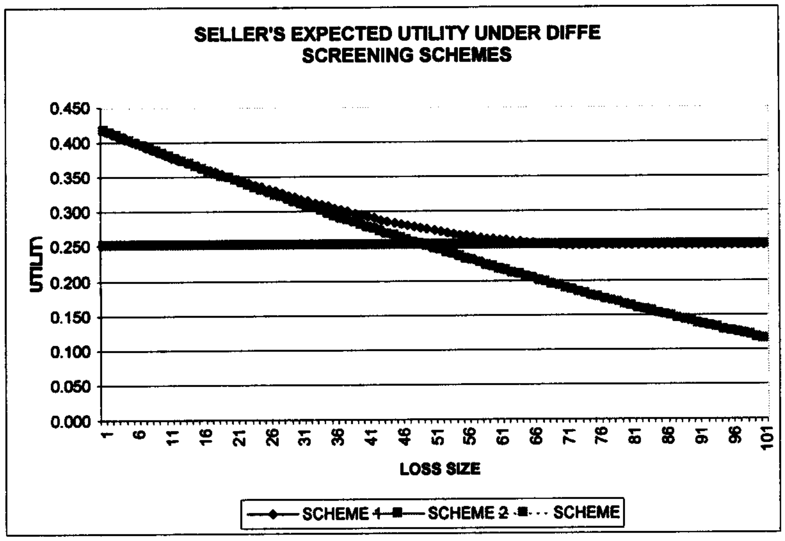

Figure 1-2: Comparison of the seller's expected utility under schemes 1, 2, and 3.

These exercises suggest that even if the seller cannot implement the optimal auction, there are second best mechanisms that perform better than others according to different circumstances. The identification of the situations in which the seller can do well with simple second best mechanisms is an agenda that can shed useful sales policy recommendations. For sales policy, the virtues of an auction format to accommodate complicated allocation and payment rules robustly and to be easily understood by the buyers are relevant.

For instance, in this example, since the bidders' value estimates come from the same probability distribution, the optimal allocation policy is linear on the expected loss. So as an alternative to the reservation prices, the seller can announce a score function to rank the bids according to a constant discount factor. But once that we relax this assumption this conclusion remains valid only if the value estimates' distributions are related in a special way[38].

On the other hand, If we relax the assumption that the bidders' value estimates and attributes are uncorrelated, the seller can use the observed attributes to make inferences about the likely bidder distributions in his mechanism design. Determining how this information can be incorporated in the optimal auction is an open question to which the analytical tools of the multi-signal framework may provide valuable insights. The immediate question that follows is if the seller can still implement simple rules.

1.4 Conclusions

In the context of imperfect information, a seller's expected sales revenue depends not only on the buyer's maximum value estimate for the object but also on the incentives the buyer has to reveal this estimate provided in the sales mechanism. An auction provides these incentives powerfully because it exposes the buyers to competition. The competition among buyers in an auction gives each buyer strong incentives to reveal her value estimate because she will have to outbid her competitors to get the object. However, in the contest the seller has less control over the final allocation of the object. Both considerations are important when the seller observes differences among potential buyers that may affect his payoff, beyond the amount of money that they are willing to pay.

To understand these issues, we model the problem of a seller who has preferences over

[38] If the value estimate distributions generate the same $H_j(t_j)$ functions, the reservation price differential depends only on the seller's value estimate and on the bidder-specific attributes. This example was suggested by John Riley. Suppose that $1 - F_2(t_2) = \phi - \phi \cdot F_1(t_1)$, $\phi > 0$. It is easily verified that both distributions yield the same $H_j(t_j)$.

the possible buyers due to buyer-specific attributes that may be desirable or undesirable for him. Our analysis suggests that the optimal selling mechanism reflects these preferences. In particular, that the bidder-screening scheme in the auction takes into account the differences across the buyers. The optimal screening levels are bidder-specific and depend on the probability distribution of each buyer's value estimates, on the seller's valuation for the object, and on the seller's tastes over the buyers' attributes. Moreover, given that if the reservation price for a particular bidder announced by the seller is sufficiently high, the bidder will choose to stay out from the auction, this screen is enough to guarantee that any bidder who participates represents a non-negative contribution to the seller's expected payoff. As a result, from the seller's perspective it is optimal to leave a bidder out only if she is not willing to make a payment that covers the loss that her winning the object imposes on the seller.

In the example we concentrated on a second price auction. Even though this format does not implement the optimal auction, the example illustrates that seller's expected utility can be enhanced by setting different reservation prices or, more broadly, by discriminating among the bidders. What is perhaps more important is that it shows that the way in which the seller deals with the perceived bidder differences matters. When the differences are moderate the gains from allowing bidders to participate outweigh, through its effect on revenue, the expected loss from possibility that an "unqualified" bidder wins.

But when the stakes are high it is profitable to discourage such bidders. In practice, if the seller is not constrained to grant equal treatment to all the participants in the auction this can be attained through a price mechanism that, when optimally designed, will cover the expected losses that an unqualified winner provokes. On the other hand, if the seller is constrained to grant equal treatment it is wise to not allow unqualified participants since the beginning.

In the model we assume that the seller can design an optimal mechanism, that the bidder attributes are perfectly observed, and that these attributes can be quantified (in effect, that the seller can determine what is going to happen to his expected utility when any of the buyers win). In reality, the presence of legal restrictions, imperfect or limited information about the bidders, and/or the ability to quantify the potential gains or losses of setting specific qualifications matter for auction design. Also, there is probably a strong case for keeping the game rules simple. Notwithstanding, these remarks are valid not only for this model but for any mechanism proposed or currently used. The question is not to discriminate or not to discriminate, but how to discriminate optimally.

1.5 Appendix

1.5.1 Optimal bidder's expected payment

From equation (1') we have that bidder $i's$ expected utility conditional on her value estimate t_i is given by:

$$U_i(q, y, t_i) = t_i q_i(t_i) - y_i(t_i)$$

The change in the expected utility of a bidder i, with value estimate t_i, when she makes an announcement s_i is:

$$\frac{\partial U_i(q,y,s_i)}{\partial s_i} = t_i \frac{\partial q_i(s_i)}{\partial s_i} - \frac{\partial \left[y_i(s_i) q_i(s_i)\right]}{\partial s_i}$$

Optimality requires that this expression is equal to zero when $s_i = t_i$, which implies that:

$$t_i \frac{\partial q_i(t_i)}{\partial t_i} = \frac{\partial y_i(t_i)}{\partial t_i}$$

On the other hand, let tim be the lowest value estimate with which bidder i participates in the auction. Since any surplus to this bidder lowers the seller's expected revenue, he optimally chooses to set this bidder's expected utility of participating equal to zero. As a result, for this type of bidder i, the individual rationality constraint holds with equality:

$$U_i(q,y,t_i^m) = t_i^m q_i(t_i^m) - y_i(t_i^m) = 0$$

We can determine bidder $i's$ optimal payment using this two equations. We integrate both sides of the first one between t_i^m and t_i:

$$y_i(t_i) - y_i(t_i^m) = \int_{t_i^m}^{t_i} r_i \left(\frac{\partial q_i(r_i)}{\partial r_i} \right) dr_i$$

Then we apply integration by parts:

$$y_i(t_i) - y_i(t_i^m) = t_i q_i(t_i) - t_i^m q_i(t_i^m) - \int_{t_i^m}^{t_i} q_i(r_i) dr_i$$

Lastly, we substitute the individual rationality constraint into the above expression. Therefore, the optimal bidder payment is:

$$y_i(t_i) = t_i q_i(t_i) - \int_{t_i^m}^{t_i} q_i(r_i) dr_i$$

1.5.2 Proof of Proposition 2

This proof is similar to Riley and Samuelson (1981). We can express the seller's expected utility as an explicit function of the vector of screening levels t^* rewriting equation (10) as:

$$U_0(q(t^*)) = \sum_{j \in N} \int_{t_i^*}^{b_i} \left[t_j - \frac{(1 - F_j(t_j))}{f_j(t_j)} - t_0 - L_j \right] q_j(t_j) f_j(t_j) dt_j$$

Thus, we can solve for the optimal minimum value estimate announcements at which the seller should accept payments. The N first order conditions are:

$$\begin{aligned} \frac{\partial U_0(q(t^*))}{\partial t_j^*} &= -\left(t_j^* - \frac{(1 - F_j(t_j^*))}{f_j(t_j^*)} - t_0 - L_j \right) q_j(t_j^*) f_j(t_j^*) = 0 \\ &\Leftrightarrow \; t_j^* = L_j + t_0 + \frac{(1 - F_j(t_j^*))}{f_j(t_j^*)}, \forall j \in N \end{aligned}$$

To verify that this critical point corresponds to a maximum we need to calculate the second order conditions:

$$\frac{\partial^2 U_0(q(t^*))}{\partial \left(t_j^*\right)^2} = \frac{\partial \left\{ -\left(t_j^* - \frac{(1-F_j(t_j^*))}{f_j(t_j^*)} - t_0 - L_j\right) q_j(t_j^*) f_j(t_j^*) \right\}}{\partial t_j^*}$$

Solving the right hand side derivative and substituting $H_j(t_j)$ where is appropriate yield:

$$\frac{\partial^2 U_0(q(t^*))}{\partial \left(t_j^*\right)^2} = -\frac{\partial H_j(t_j^*)}{\partial t_j^*} q_j(t_j^*) f_j(t_j^*) - \left(H_j(t_j^*) - t_0 - L_j\right) \left[\frac{\partial q_j(t_j^*)}{\partial t_j^*} f_j(t_j^*) + \frac{\partial f_j(t_j^*)}{\partial t_j^*} q_j(t_j^*)\right]$$

The last term of this expression are equal to zero due to the first order condition. As a consequence:

$$\frac{\partial^2 U_0(q(t^*))}{\partial \left(t_j^*\right)^2} = -\frac{\partial H_j(t_j^*)}{\partial t_j^*} q_j(t_j^*) f_j(t_j^*)$$

and $\frac{\partial^2 U_0(q(t^*))}{\partial \left(t_j^*\right)^2} \leq 0 \Leftrightarrow \frac{\partial H_j(t_j^*)}{\partial t_j^*} \geq 0$. On the other hand:

$$\frac{\partial^2 U_0(q(t^*))}{\partial \left(t_j^*\right) \partial \left(t_i*\right)} = 0, \forall j, \forall i \in N, \forall j \neq i$$

Therefore, the critical point corresponds to a maximum. ■

1.5.3 Auction mechanisms in (t, L)

Suppose that the seller requests that each bidder announce the difference between her value estimate and her bidder-specific characteristic. Let $r_i(t_i, L_i) = t_i - L_i$ be the announcement that each bidder i makes to the seller. Also let $\alpha_i = a_i - L_i$ and $\beta_i = b_i - L_i$. Then the announcement's probability distribution function and cumulative distribution function will be, respectively, $g_i(r_i)$, where $g_i : [\alpha_i, \beta_i] \rightarrow \Re$, and $G_i(r_i)$, where $G : [\alpha_i, \beta_i] \rightarrow [0,1]$ and $G_i(r_i) = \int_{\alpha_i}^{r_i} g_i(s_i)ds_i$.

With this notation we can write the outcome functions of the direct revelation mechanism (p, x) in terms of the vector $r \in R$, where $R : [\alpha_1, \beta_1] \times ... \times [\alpha_n, \beta_n]$ is the set of all possible combinations of bidders' announcements. Thus:

$$U_i(p, x, r_i) = \int_{R_{-i}} [(r_i + L_i)p_i(r) - x_i(r)]\, g_{-i}(r_{-i})dr_{-i} \tag{1.A}$$

$$U_0(p, x) = \int_R \left[\sum_{j \in N}(x_j(r) - p_j(r)L_j)\right] g(r)dr \tag{2.A}$$

$$\sum_{j \in N} p_j(r) \leq \; 1 \text{ and } p_i(r) \geq 0, \forall i \in N, \forall r \in R \tag{3.A}$$

$$U_i(p, x, r_i) \geq 0, \forall i \in N, \forall r_i \in [\alpha_i, \beta_i] \tag{4.A}$$

$$U_i(p, x, r_i) \geq \int_{R_{-i}} [(r_i + L_i)p_i(s_i, r_{-i}) - x_i(s_i, r_{-i})]g_{-i}(r_{-i})dr_{-i}, \forall i \in N, \forall r_i, \forall s_i \in [\alpha_i, \beta_i] \tag{5.A}$$

The seller's optimal auction mechanism (p, x) maximizes (2.A) (notice that we are assuming that $t_0 = 0$) subject to (3.A), (4.A) and (5.A). Defining $q_i(r_i) = \int_{R_{-i}} p_i(r)g_{-i}(r_{-i})dr_{-i}$

and $y_i(r_i) = \int_{R_{-i}} x_i(r)g_{-i}(r_{-i})dr_{-i}$, we can get a set of equations analogous to (1'- 5') that we can solve exactly as before.

In this case, bidder i's optimal payment will be:

$$y_i(r_i) = (r_i + L_i)q_i(r_i) - \int_{r_i^m}^{r_i} q_i(s_i)ds_i$$

After substituting this expression into the seller's expected utility function, integrating by parts appropriately, and substituting the definition of qj(r) we get:

$$U_0(p) = \int_R \left(\sum_{j \in N} \left[r_j - \frac{(1 - G_j(r_j))}{g_j(r_j)} \right] p_j(r) \right) g(r)dr$$

This function coincides exactly with Myerson (1981). In particular, when the bidder's value estimates come from the same probability distribution $g_j(r_j) = g(r_j)$ and $G_j(r_j) = G(r_j)\ \forall\ j \in N$. So the optimal and unique screening level will be:

$$r_j^* = \frac{(1 - G(r_j^*))}{g(r_j^*)}$$

And as McAffee and McMillan (1989) shows, when the bidder's value estimates come from different probability distributions, optimal screening levels will differ again:

$$r_j^* = \frac{(1 - G_j(r_j^*))}{g_j(r_j^*)}$$

The important moral of this exercise is that it makes our problem identical to the standard auction design problem at the same time that stresses the fact that the bidder-specific attributes make the bidders asymmetric. As a result, lessons on asymmetric auctions are applicable to our problem.

1.6 Bibliography

1. Aspe, P., (1993), "Thoughts on the Mexican Privatization Experience", in Economic Transformation The Mexican Way, MIT Press, 1993.

2. Ayres, I., and Cramton, P., (1996), "Deficit Reduction Through Diversity: How Affirmative Action as the FCC Increased Auction Competition", Stanford Law Review, Vol. 48 No. 4., April 1996.

3. Branco, F., (1994), "Favoring domestic firms in procurement contracts", Journal of International Economics, Vol. 37, pages 65-80.

4. Corns, A. and Schotter, A., (1997), "Can Affirmative Action Be Cost Effective: An Experimental Examination of Price-Preference Auctions", NYU manuscript.

5. Fudenberg, D. and Tirole, J., (1991), Game Theory, Cambridge, MA: MIT Press, 1991.

6. Ganuza, J. J., (1997), "Procurement Contracts with Observable Quality", manuscript, Department of Economics, Universidad Carlos III, Spain.

7. Maskin, E. S. and Riley, J. G. (1981), "Multi-unit Auctions, Price Discrimination and Bundling", UCLA Discussion Paper # 201, Department of Economics.

8. Maskin, E. S. and Riley, J. G. (1995), "Asymmetric Auctions", mimeo, UCLA, Department of Economics, June 1995.

9. McAffee, R. P., and McMillan, J., (1989), "Government Procurement and International Trade", Journal of International Economics, Vol. 26, pp. 291-308.

10. Milgrom, P. R. and Weber, R. J. (1982), "A Theory of Auctions and Competitive Bidding", Econometrica, 50 (5), pages 1089-122.

11. Myerson, R. B. (1981), "Optimal Auction Design", Mathematics of Operations Research, Vol. 6, No. 1, pages 58-73.

12. Jehiel, P. Moldovanu, B., and Stacchetti E. (1996), "How (Not) to Sell Nuclear Weapons", American Economic Review, Vol. 86, No. 4, pages 814-829.

13. Rammamurti, R. (1996), Privatizing Monopolies: Lessons from the Telecommunications and Transport Sectors in Latin America, The John Hopkins University Press, 1996.

14. Riley, J. G. and Samuelson, William F. (1981), "Optimal Auctions", American Economic Review, Vol. 71, No. 3, pages 381-392.

15. Riley, J. G. and Li, H. (1996) "Auction Choice: A Numerical Analysis" mimeo, UCLA and University of Science and Technology Hong Kong, May 1996.

16. Vickers, J. and Yarrow, G., (1988), Privatization: An Economic Analysis, MIT Press, Sixth Printing, 1995.

Chapter 2

Trust Loans and Credit Market Default in Economies With Imperfect Law Enforcement

Abstract

In 1996 the Mexican Congress approved a reform to the General Law of Credit Titles and Operations allowing commercial banking institutions to use *trusts* to guarantee loans. Since the assets that a firm agrees to put in trusts are legally excluded of any application of the Law of Bankruptcy and Payment Suspension, in case that this firm defaults, its payment to the bank is higher than under the bankruptcy procedure. As a likely consequence, interest rates on loans that use trust funds will be lower than on loans that do not.

We construct a general equilibrium model with asymmetric information to analyze the welfare effects of introducing "trust loans" into the credit market, stressing their property of improving the banks' capability to foreclose collateral. In an economy populated by (risk neutral) agents with safe projects and agents with risky projects, banks can screen out the different types by offering "trust loans" and "non-trust loans". We characterize both the conditions under which this innovation leads to a reduction of the economy's default rate and to a Pareto improvement.

JEL Classification: D59, D69, D82, G21, K29, and K42.

Keywords: trusts, default, collateral foreclosure

2.1 Introduction

The economic crisis of 1994 revealed serious flaws in Mexico's legal procedures to solve situations of payment default. The Law of Bankruptcy and Payment Suspension (LBPS) frequently leads to long legal proceedings with uncertain outcomes, during which assets often depreciate substantially. Low payments in case of a debtor's default are compensated by creditors through high interest rates and/or collateral requirements that inhibit credit market activity. In response to these difficulties, the Mexican Congress approved a reform to the General Law of Credit Operations and Titles (LCOT) in 1996. This reform, allowing commercial banking institutions to require borrowers to use *trusts,* makes seizure of collateral swifter and more certain. The intent of this reform is to improve social welfare by reducing the losses due to default, thereby reducing interest rates and encouraging lending.

It is not at all clear, however, that these reforms do or can have the desired effect. Loans that are safer for banks and carry lower interest rates encourage borrowing to finance safe projects -but also encourage borrowing to finance risky projects. If banks cannot distinguish between borrowers with safe projects and borrowers with risky projects, welfare conclusions will depend on sorting and pooling of borrowers, which will be determined in equilibrium.

Our objective is to develop a general equilibrium model to investigate these issues. This model has two central features. One is the presence of hidden information and adverse selection (Akerlof, 1970). The other one is the need of collateral to guarantee the payment of loans (Geneakoplos and Zame, 1998). We characterize both the conditions under which the introduction of trust loans (1) leads to a Pareto improvement and (2) reduces the payment default rate, in an economy populated by (risk neutral) agents with safe projects and agents with risky projects where interest-rate-taking banks can potentially screen out the different types by offering "trust loans" and "non-trust loans".

Our main conclusion is that only if there is an adverse selection problem at the initial equilibrium (in effect, if only agents with risky projects borrow) the introduction of trust loans represents a Pareto improvement and lowers the economy's default rate. More generally, exogenous changes on the fraction of collateral that banks can seize always produce winners and losers among the borrowers and, perhaps surprisingly, may not decrease the economy's default rate. These findings suggest, beyond the possibility that minor modifications to the LBPS may generate complex effects, the need for further theoretical and empirical research along various lines.

The rest of this chapter is organized as follows. Section 2 describes Mexico's legal framework for solving default situations under the LBPS and the reforms to the LCOT, emphasizing aspects of the laws that make default payments to banks different under each regime. Section 3 presents a theoretic model. Section 4 presents the welfare analysis. Finally, section 5 provides some extensions and summarizes the main conclusions.

2.2 Mexico's Legal Framework

2.2.1 Law of Bankruptcy and Payment Suspension

The objective of this law is solving situations where an indebted firm cannot pay its creditors. There are two different processes: the bankruptcy process and the payment suspension process. The objective of the bankruptcy process is *solving* this insolvency situation, through the (partial or total) liquidation of the firms' assets to pay all debts in the best feasible way.[1] In contrast, the objective of the payment suspension process is *preventing* that this insolvency situation occurs, through an agreement to reduce the debt size and/or to delay its payment.[2]

The Bankruptcy Process

The LBPS establishes that any firm that ceases to pay its debts[3] can be declared bankrupted[4]. The main purpose of the bankruptcy process is selling the firm's assets and pay all its due and undue debts [5] with the sales revenue. However, several reasons make this process long and its outcomes uncertain, ultimately undermining these objectives.

First, in order to grant equal treatment to all the creditors[6], the LBPS specifies multiple actions[7] that must be executed sequentially and must satisfy exhaustive participation conditions for all parties. Despite that the law establishes a period of three months to make

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[1]The bankrupty process of Mexico's LBPS corresponds to Chapter 7 of the United States' Bankruptcy Code.

[2]The payment suspension process of Mexico's LBPS corresponds to Chapter 11 of United States' Bankruptcy Code.

[3]The bankruptcy declaration can be requested by the debtor firm itself, by one or several of its creditors, or by the judicial authorities whenever the LBPS applies.

[4]The law presumes that a firm has stopped paying under the following circumstances: I. defaulting of due or undue payments; II. having insufficient assets, upon foreclosure, to satisfy unpaid debts; III. rendering assets to its creditors; IV. settling payments based on false files; V. declaring bankruptcy; VI. requesting payment suspension and this process not be conceded by the judge or not conclude with an agreement; VII. defaulting upon a payment suspension agreement.

[5]Undue debts are discounted at the legal rate for early payment. Due debts do not generate interests except if they are guaranteed with assets; however, compensation of guaranteed debts cannot exceed the corresponding guarantee's value.

[6]Contrasting views on the determination of creditors' rights in a bankrupty process are presented in Jackson (1985), Warren (1987), Baird (1987) and Baird (1987a).

[7]Appendix.

an asset inventory and to summon, recognize, and rank the creditors' claims, after which the firms' assets are to be sold[8] and the bankruptcy process extinguished[9], several procedural rules are not explicit and depend largely on the judges' discretion.For example, the LBPS allows the debtor and the creditors to settle agreements[10] anytime after the creditors' claims are recognized and ranked, but does not specify any order for presenting agreement proposals, or a maximum number of proposals that can be submitted, or a maximum lapse for discussing these[11].

Second, the process' comprehensive participation conditions are easily abused of. Parties can appeal to a higher judge the sentence of bankruptcy, the sentence of recognition and rank of the claims, and/or any sentence of agreement approval provided by the first judge. In any case, the appeal paralyzes the bankruptcy process until the second judge resolves about it.

Not to be underestimated is the fact that in Mexico there are few courts legally competent to deal with bankruptcy and payment suspension processes. For example, there are

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[8] To sell an asset the LBPS allows up to 3 auctions, but fails to indicate maximum time periods for assessing and pricing the assets and for preparing and conducting the auctions. Moreover, if after the first two auctions there are no bidders for an asset the judge can choose between calling the third auction, or suspending the sale for 6 months and then call the auction or authorize the legal administrator to sell the asset through sequential search.

[9] The LBPS establishes different ways in which bankruptcy can terminate. Extinguishing the bankruptcy process when there are insufficient assets can be done immediately after bankruptcy is declared; but if there is an agreement it can take several months (there is no explicit maximum number of proposals to be presented by the parties).

[10] Any agreement must be discussed in a properly convoked creditors' meeting and approved by the judge if, in his judgement, meets all the legal norms and the payments and guarantees proposed are sufficient.

[11] In other countries, the bankruptcy legislation provides a time period and an order for presenting agreement proposals. For example, in the U.K. only banks and guaranteed creditors can present agreements. In the U.S. if a debtor firm files bankruptcy under Chapter 11, the debor is the only one that can propose agreements during the first six months of the process.

only two courts for presenting bankruptcy and payment suspension lawsuits and two more for appealing these lawsuits in Mexico City. This number seems insufficient with respect to all the responsibilities, coming from the law[12], and all the discretionary powers, coming from the lack of rules for deciding whether the firm is to be restructured or liquidated, that the LBPS grants to the judge.

The average time period for concluding a bankruptcy trial is 28 months[13]. Delays tend to reduce the firm's assets value because they depreciate or become obsolescent. Assets can only be separated from the bankruptcy mass with the judges approval[14] and if the pertaining assets are essential for the firm[15], then it is unlikely that the judges approves its separation.

Besides that it is difficult to predict the duration of the trial, it can be even more difficult to predict the payment received by each creditor. We will abstract from the claim size computation regime and concentrate on three distribution rules for offsetting the claims

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[12]The competent judge's duties are: (1) authorize and intervene on all the acts for obtaining the firm's assets, books, and documents; (2) examine the firm's assets, books, and documents; (3) order measures for securing and conserving the assets; (4) convoque and chair any creditors' meeting set by the law or he considers opportune; (5) authorize, monitor, and remove the bankruptcy's receiver or any other legal figure necessary for the process; (6) resolve claims presented against the receiver's actions or omissions; (7) authorize any actions of the legal administrator that go beyond the ordinary conservation and management of the firm's assets; (8) examine the claims and the firm's statement of obligations to be presented at the creditors' meeting; and (9) in general, all attributions necessary to resolve any conflict that emerge until the bankruptcy is extinguished.

[13]Although empirical studies on the duration of bankruptcy under Chapter 11 vary in their findings, the most extensive studies suggest that the average duration of this process is 20-24 months (see White (1994) for a further discussion). However, recent modifications to the U. S. Bankruptcy Code allow for pre-packaged agreements which take considerably less court time to be solved.

[14]The receiver can sell without the judge's authorization only things that either cannot be conserved or with costly conservation compared to the revenue that they can yield.

[15]It is explicitly established the continuation of the firm's activities always that interruption may damage the creditors, by either reducing the value of the firm's component assets or by affecting viability of the firm.

which exacerbate uncertainty on the creditors' payments, even if their claims are guaranteed with physical assets.

Once that all claims have been quantified, the LBPS ranks the claims by degree and seniority. It also disposes that no claim belonging to a lower degree will be paid until all claims of the immediate higher degree are paid according to the seniority rule[16]. Creditors with physical guarantees have a higher probability of collecting payments than creditors without guarantees, except if the latter have singular privileges. Among unguaranteed creditors with singular privileges, wages of the firm's workers are prominent because their share of total revenues increases while the firm is active. This payment increases in conflict with the rest of the creditors, whose payment size is bounded by the guarantees' value. As a result, in addition to the potential antagonism among creditors trying to block competing claims, there is potential antagonism between creditors that prefer a short process and creditors that prefer a long one.

When a firm is declared bankrupted, the tax authority is summoned as any other creditor. But the tax authority's collecting of unpaid taxes (including workers' social security contributions) and fines has priority over the rest of the creditors, except when guaranteed claims are properly inscribed on the Public Register before the summon date.

Finally, the LBPS also recognizes as payable claims to be compensated with the bankruptcy revenues, before any creditor is, all the expenditures derived from (i) conserving and managing the firm; and (ii) common benefit judicial and non-judicial actions.[17]

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[16] Appendix.

[17] Estimates on the direct costs of bankruptcy suggest that reorganization of large firms under Chapter 11

The Payment Suspension Process

The LBPS permits that any debtor firm demand a payment suspension and that its creditors are summoned to settle an agreement that prevents bankruptcy, by requesting to delay and/or to reduce payments[18]. The payment suspension demand paralyzes all claims requesting a patrimonial obligation, except wages or guaranteed debts. In this process, the judge names a bankruptcy receiver to carry out all the duties connected to judicial actions[19], while the firm's administration keeps its managerial control of the firm's ordinary activities. Thus, under payment suspension the debtor firm continues its normal operations whereas under bankruptcy normal operation only continues if it maximizes creditors' payments.

Once that claims are recognized and ranked, the creditors decide upon the agreement which, in turn, is approved or disapproved by the judge[20]. If the judge disapproves the agreement, bankruptcy is declared by default. As before, sentences can be appealed and, in that case, the judge with higher authority determines whether bankruptcy occurs.

All these characteristics of the law suggest that, if any bankruptcy demand emerges, requesting payment suspension is a dominant strategy for the debtor. The disposition allowing the firm's administration to keep control during payment suspension is especially susceptible for abuses[21]. On the other hand, the process may be slow in presence of inex-

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consumes 3.1% of the assets.

[18]Nevertheless, proposed quantities must exceed by 5% what could be proposed in a bankruptcy agreement.

[19]The actions of summoning the creditors and convoking the creditors' meeting for recognizing and ranking claims are the same as in the bankruptcy process.

[20]The three judge's criteria for approving the agreement are: 1) no fraud against the creditors; ii) compensation quantities are not below the debtor's possibilities; and iii) guarantees suffice to fulfill the agreement.

[21]There are two general results from both theoretical and empirical work on Chapter 11 of the U. S.

act balance statements, large number of creditors and/or strategic actions from creditors objecting the claims' recognition. As a consequence, the payment suspension's objective of benefiting both the debtor and the creditors, for the sake of the society as a whole, is not kept accurately.

The small number of lawsuits presented at the Superior Court of Justice of Mexico City between 1989 and 1995 suggests that the bankruptcy and payment suspension processes are not important mechanisms for restructuring or liquidating firms.

Bankruptcy Code. First, a chapter 11 reorganization results in the maintenance of equity value. Equity holders receive valuable claims on the reorganized firm even though creditor claims are not satisfied in full. Second, management does not follow an investment policy (detrimental to debt holders) that maximizes equity value.

Table 2.1

Number of Lawsuits presented at the Superior Court of Justice of Mexico City

Year	Number of Lawsuits
1989	90
1990	111
1991	150
1992	147
1993	204
1994	194
1995	370*

*Preliminary Data

Source: Annual reports of the SCJMC, 1989-1995.

Notwithstanding that in practice payment default situations are seldom solved through the legal mechanism, this is no indication that the LBPS has no welfare effects[22]. First, the law's anti-creditor bias affects the private negotiations among the parties as well: in an off-court agreement the debtor has no incentive to pay his creditors more than he would in a court agreement.[23] Second, the bias is anticipated by the potential creditors, who

[22]White (1996) identifies various costs pertaining bankruptcy legislation and distinguishes three different points in time at which bankruptcy costs may occur: 1) before it is knows whether the firm will be financially distressed or not; 2) after the firm has become financially distressed, but before it files for bankruptcy; and 3) after the bankruptcy filing, if one occurs. Since the number of firms in bankruptcy is small relative to the total number of firms affected by bankruptcy policy, she concludes that if we evaluate bankruptcy policy based on how it treats firms already in bankruptcy we are allowing the tail to wag the dog.

[23]In the absence of utility penalties it is optimal for the debtor to choose the option with the lowest

in response offset the low default payments through higher interest rates and/or collateral requirements that increase credit's cost for any firm.

2.2.2 The Trust Reform to the Law of Credit Operations and Titles

Trust funds[24] are used in Mexico for multiple reasons that vary from selling assets to fulfilling wills. Through a guarantee trust, a debtor transfers his rights over the assets used as loan guarantees to a *trustee*[25] who, if the debtor is unable to pay, sells the goods and pays the creditor. Guarantee trusts ease collateral seizure and make the guarantee's value more certain than under the LBPS procedures because the assets cease to be part of the debtor firm's legal patrimony and, as a consequence, can be separated from the bankruptcy mass without judicial authorization[26].

The 1996 reform to the LCOT potentially reduces the costs of contracting trusts for commercial banking institutions[27]. It allows trustee institutions be beneficiaries of the trust funds serving to compensate unfulfilled obligations, when these obligations derive from

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payment for the creditors.

[24]The LCOT broadly defines the trust as an "affect on one's patrimony with a licit end, whose achievement is confided in a trustee".

[25]The law marks a difference between having proprietary rights and having *trustee rights* over a good. Proprietary rights allow the owner to freely enjoy the good within the legal ways and limits. In contrast, trustee rights do not allow the trustee to enjoy the good. First, because trustee rights are explicitly determined in the trust contract. Second, because the right to enjoy the good is usually reserved to the beneficiary which cannot be the trustee, except if the law explicitly permits so.

[26]The only exception to the principle that all the debtor firm's assets must be managed by the receiver once that bankrupty is declared is called *separation*. The separation is a creditor's right to withdraw from the bankruptcy mass any identifiable asset or right sold to the debtor firm whose property has not been transferred through a definite or irrevocable contract.

[27]The LCOT established that only institutions designated by the Law of Credit Instituitions (LCI) can be trustees. And according to the LCI, only national banking institutions can be trustees.

entrepreneurial loans granted by the institution itself. In turn, the banking institutions, whenever acting on their own behalf or as trustees, are allowed to cede their credits covered with mortage guarantees, without notifying the debtor or writing a property title, as long as the renderer keeps the credits' administration.

Under this reform granting loans with guarantee trusts becomes more viable for banks. As a consequence of better conditions for obtaining default payments[28], this institutions may offer better interest rates for debtor firms that are willing to use trust loans than for those that do not.

2.3 A Theoretical Framework

In this section we construct a general equilibrium model to analyze the welfare implications of introducing trust loans into the credit market. Our starting point is an economy similar to Geneakoplos, and Zame (1998) where there is imperfect enforcement of contracts and, as a consequence, collateral is used for guaranteeing the payment of loans[29]. We depart from their model in two ways that are crucial for our analysis' purpose: (1) there is production,

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[28]Obviously, if banks had to go to the court to enforce trust loans, there would not exist any clear advantage over non-trust loans. In the past, debtors have appeal to judges' resolving over guarantee trusts with the following arguments: (1) that execution of guarantees is not a licit end; (2) that trust funds do not transfer perpetual but temporary property rights from the debtor to the trustee and, thus, the trustee cannot sell the guarantees; and (3) that the trustee exceeds its rights when executing the guarantees as if it were a judicial authority, because it is not. Their objective is to obstruct the transfer of guarantees to the creditors. Nevertheless, the judges have sustained, in opposition to these claims that: (1) the objective of the guarantee trust is legal, according to the LCOT; (2) once that the trust fund is properly constituted the debtor loses his rights to use the trust's goods; and (3) the intervention of a judicial authority is not necessary for executing the guarantees. Hence, the trustee has all necessary rights for executing guarantee trusts when is necessary, without having to wait for a court's resolution.

[29]Other models, for example Dubey, Geanokoplos, and Shubik (1990) assume that payment of loans is guaranteed through utility penalties. We prefer to concentrate on collateral because Mexico's LCOT reform concerns only with the form in which creditors can execute guarantees.

and (2) there is asymmetric information.

2.3.1 Description of the economy

Time and states of nature

There are two periods: $t = 0$ and $t = 1$. At $t = 0$ there is one possible state of nature only. At $t = 1$ there are two possible states, $s = 1$ and $s = 2$. The probability that state $s = 1$ ($s = 2$) occurs is μ $(1 - \mu)$. We assume $\mu = 1/2$.

Commodities and technology

In the economy there is only one commodity that serves both as a consumption good and as a production input. If the commodity is consumed at $t = 0$ then nothing is left for the next period. In contrast, if the commodity is used as input at $t = 0$ it transforms into additional units of the commodity that can be consumed at $t = 1$, according to the production technology.

We make three assumptions about the production technology: First, production technologies are specific to each consumer; that is, we are going to think of the production technology as an investment project that can only yield returns with its owner's participation. Second, each investment project requires the same amount of input to produce and output generated varies from project to project and from state to state. If the state is good output is high and if it is bad output is low. Third, output is divisible and verifiable by all agents, so that it is feasible to contract upon it[30]. In particular, for each consumer h:

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[30] In an earlier version of this model we assume that, besides output, each investment project generates

$$F^h\left(i^h\right) = y + \varepsilon_s^h, s = 1, 2 \quad (1)$$

where $i^h = i$ represents the input requirement and $\varepsilon_s^h = +\varepsilon^h$ and $\varepsilon_s^h = -\varepsilon^h$ is the (consumer h specific) shock at state s. We further assume that $i = 1$.

Financial Assets

To specify the financial assets we follow the notation from Geneakoplos and Zame (1998). There are J real financial assets and each asset j is characterized by its nominal value or payment promise A_j in each state of nature ($A_j(s)$ if the payment promise varies across states), denominated in units of the consumption good, and by its collateral requirement C_j ($Cj(s)$ if the collateral requirement varies across states).

We assume that the only financial assets that are traded in this economy are bank loans: at $t = 0$ a bank lends a unit of the consumption good to a consumer, who at $t = 1$ agrees to pay back the loan along with the interests accrued to it or, if he defaults, to render the collateral. In particular, loan j specifies a fixed interest rate $A_j = (1 + r_j)$ at $t = 1$ and a fraction of the output from consumer $h's$ project at state s as collateral $C_j = \gamma_j$. We denominate the fraction of output received by the bank of a non-trust loan γ_{nt} and of a trust loan γ_t. For our analysis, it is useful to think of these fractions as exogenously determined

(more precisely, leaves as a production residual) machinery and equipement with high or low value. Output is not verifiable but machinery and equipement is, so that it is the latter upon which contracts are written and collateral requirements are foreclosed. The most salient feature of such formulation is that banks and consumers potentially differ on their perception of what is a profitable investment project. Despite this has a moral hazard flavor, perhaps more appealing for bankruptcy analysis (Hart and Moore, 1997), the present formulation is simpler and, since its key predictions easily carry through the other one, serves presentation and clearness goals better.

by the legal framework[31]. Mexico's legal framework suggests that the fraction of output that banks collect if a consumer defaults is higher through trust loans that through the bankruptcy and payment suspension processes. Thus, we assume:

$$0 < \gamma_{nt} < \gamma_t < 1 \tag{2}$$

Optimality implies that the amount that a type h consumer delivers to the bank per each unit of asset j at state s , D^h_{js}, is the minimum between the value of the payment promise and the value of the collateral required[32]:

$$D^h_{js} = \min\left\{(1+r_j), \gamma_j\left(y+\eta^h_s\right)\right\}, \forall j = nt, t \tag{3}$$

On the other hand, notice that implicit on this asset formulation is the assumption that collateral seizure is the only punishment available in the economy for enforcing loan payment. We choose to leave out the possibility that utility penalties because Mexico's LCOT reform concerns only with the form in which creditors can execute guarantees.[33]

[31]The other possibility is that the fractions of collateral associated to each asset are determined in equilibrium. While determining whether the economy attains equilibria with optimal collateral requirements is interesting in itself, this issue is beyond our present investigation.

[32]Quigley and Van Order (1995) and Deng, Quigley, and Van Order (1995) construct mortage pricing models to analyze the behavior of homeowners who may choose to exercise their options to default or to prepay.

[33]The LBPS distinguishes three kinds of bankruptcies with different legal consequences that can be interpreted as utility penalties (for example, prison if the bankruptcy is fraudulent) but the LCOT does not. Without empirical evidence that permits acknowledging for different utility costs associated to default stigma and to corporal penalties and how each of them varies across the assets we model, we choose to abstract from hese considerations altogether.

Information Structure

We assume that the population distribution, the state probability distribution, the consumers' preferences, endowments, and returns of investment project, as well as the loan contracts offered by each bank, are public information. But each consumer's type is private information.

Economic agents

The economy is populated by two kinds of economic agents: consumers-entrepreneurs and banks. There is a continuum of consumers that can be divided into two different types $h = 1, 2$. The mass of each consumer of type h is $M^h > 0$. There is a continuum of banks of the same type, whose mass is $N > 0$. We will assume that $M^1 + M^2 < N$.

Consumers Each consumer is characterized by his utility function, his commodity endowment, and his investment project. We assume that consumers have the same utility function and commodity endowment but, as suggested before, each consumer has a different investment project. Thus, the kind of investment projects available to a consumer completely determines his type.

Consumer $h's$ utility function is:

$$u^h \left(c^h\right) = c_0^h + \beta \left[\mu c_1^h + (1-\mu) c_2^h\right] \tag{4}$$

where c_s^h is consumption of the good at date s and β is the intertemporal discount rate.

According to equation (2), the consumers of this economy are risk neutral.[34]

The consumers' commodity endowment at each date is:

$$e_s^h = e_s >> 0 \tag{5}$$

We know from a previous section that product generated by investment projects vary by consumer type and by state of nature according to equation 1. We assume that:

$$0 < \varepsilon^1 < \varepsilon^2 < y \tag{6}$$

For $\mu = 1/2$ both projects have the same expected return and the project of type 2 consumers is a mean preserving spread of the project of type 1 consumers. That is, the project of a type 1 consumer is less risky than the project of a type 2 consumer.

At $t = 0$ each consumer must decide how much to consume, how much to produce and how much to borrow from the banks through any of the loan contracts offered. However, under our assumptions the production decision consists on undertaking or not the investment project. Additionally, we assume that $e_0 < 1$; that is, the consumers are credit constrained and, as a consequence, to undertake the investment project require borrowing[35]. At $t = 1$ each consumer consumes the commodity and pays the loan according to equation 3. Under

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[34] Although any utility function satisfying the properties that Dubey, Geanakoplos, and Zame (1997) state, we choose linear utility functions for simplicity.

[35] This assumption's objective is that there are economic gains of using the credit market. If consumers owned enough resources to carry out the investment we would require that the opportunity costs from investing own funds and from borrowing banks' funds are different; for example, because consumers and bank have different intertemporal discount rates. Nonetheless, consumers' need of loanable funds is an implicit assumption on credit rationing models like Stiglitz and Weiss (1981), Bester (1985), and Milhe and Riley (1988).

these set of conditions each type h consumer faces the following options:

not produce

$$\begin{aligned} c_0^h &= e_0 \\ c_1^h &= e_1 \\ c_2^h &= e_2 \end{aligned} \tag{s}$$

produce and borrow a non-trust loan

$$\begin{aligned} c_0^h &= e_0 \\ c_1^h &= e_1 + y + \varepsilon^h - D_{nt,1}^h \\ c_2^h &= e_2 + y - \varepsilon^h - D_{nt,2}^h \end{aligned} \tag{nt}$$

or produce and borrow a trust loan

$$\begin{aligned} c_0^h &= e_0 \\ c_1^h &= e_1 + y + \varepsilon^h - D_{t,1}^h \\ c_2^h &= e_2 + y - \varepsilon^h - D_{t,2}^h \end{aligned} \tag{t}$$

Therefore, each consumer's optimization problem is reduced to choosing the option $\{s, nt, t\}$ that maximizes equation 4.

Banks Each bank has a unit of the commodity that it can lend at $t = 0$ through any of the loan contracts available in the economy, taking as given interest rates and collateral requirements; discounts the payments that it collects at $t = 1$ with the same rate consumers do; and if does not lend, consumes its resources at $t = 0$. We also assume that banks use rational expectations for computing expected profits of any loan contract. That is, the probabilities associated to a contract's payout in each possible state coincide with the population fractions that demand such contract. As a result, the banks' equilibrium profits depend basically on which consumers are demanding the contracts.

Profits obtained from a loan contract A_j demanded by all consumers are:

$$\pi_j \left(1 + r_j, \gamma_j\right) = \frac{\beta}{2} \sum_{h=1}^{2} \theta^h \left[D_{j,1}^h + D_{j,2}^h\right] - 1$$

where $\theta^1 = M^1 / \left(M^1 + M^2\right)$ and $\theta^2 = 1 - M^1 / \left(M^1 + M^2\right)$.

For a contract A_j to be demanded by all consumers it must hold that it is *individually rational* to demand contract Aj for every type h consumer; that is, consumer $h's$ utility from demanding contract A_j must exceed his utility from not producing[36]. Our assumptions on the consumers' choice space imply that individual rationality constraints are satisfied if:

$$\frac{1}{2} \left[D_{j,1}^1 + D_{j,2}^1\right] \leq y \tag{ir-1}$$

[36] That is, $e_0 + \beta \left[\frac{e_1 + y + \epsilon^h - D_{j,1}^h}{2} + \frac{e_2 + y - \epsilon^h - D_{j,1}^h}{2}\right] > e_0 + \beta \left[\frac{e_1}{2} + \frac{e2}{2}\right]$ for each $h = 1, 2$. Simplification gives ir-1 and ir-2.

$$\frac{1}{2}\left[D^2_{j,1} + D^2_{j,2}\right] \leq y \tag{ir-2}$$

In contrast, if loan contract A_j is demanded by a sole consumer type, then profits obtained are:

$$\pi_j\left(1 + r_j, \gamma_j\right) = \frac{\beta}{2}\left[D^h_{j,1} + D^h_{j,2}\right] - 1$$

For a contract A_j offered to type 1 consumers to be demanded only by this type it must hold, in addition to the corresponding individual rationality constraint, that for type 1 consumers it is *incentive compatible* to demand contract A_j and not any other contract A_k; in effect, that type 1 consumers' utility from demanding contract A_j exceeds his utility of demanding from demanding any other contract A_k[37]. Under our assumptions, type 1's incentive compatibility constraint is satisfied if:

$$D^1_{j,1} + D^1_{j,2} \leq D^1_{k,1} + D^1_{k,2} \tag{ic-1}$$

Similarly[38],

$$D^2_{k,1} + D^2_{k,2} \leq D^2_{j,1} + D^2_{j,2} \tag{ic-2}$$

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[37]That is, $e_0 + \beta\left[\frac{e_1+y+\varepsilon^1-D^1_{j,1}}{2} + \frac{e_2+y-\varepsilon^1-D^1_{j,1}}{2}\right] > e_0 + \beta\left[\frac{e_1+y+\varepsilon^1-D^h_{k,1}}{2} + \frac{e_2+y-\varepsilon^1-D^1_{k,1}}{2}\right]$. Simplification gives ic-1.

[38]See previous note.

If these conditions are satisfied, then loan contracts A_j and A_k separate both consumer types.

Finally, it is worth to emphasize that in the formulation of the economic agents' optimization problems we assume that collateral has the same value for both consumers and banks so that each unit lost by one party is gained by the other. This assumption is consistent with the fact that a debtor firm can request a payment suspension before it is declared bankrupted and, in that case, keeps its managerial rights on the firm's assets until its debts are extinguished, either by payment or by rendering collateral.[39]

2.3.2 Market Equilibrium

For consumers' and banks' decisions constituting a collateral equilibrium we require that consumption plans are feasible and optimal for the consumers[40], banks maximize profits subject to the legal framework, and commodity and credit markets clear[41].

It will be useful for our comparative statics exercises to label an economy in which only the non-trust loan $A_{nt} = \{(1 + r_{nt}), \gamma_{nt}\}$ is available as E_0. An economy in which both the non-trust loan $A_{nt} = \{(1 + r_{nt}), \gamma_{nt}\}$ and the trust loan $A_t = \{(1 + r_t), \gamma_t\}$ are available is labeled as E_1.

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[39]Two different stories are consistent with the assumption that collateral is more valuable to the consumers than to the banks. The first story is that the consumer loses control of his assets (which happens if his bankruptcy is requested and he does not demand payment suspension) but the seizure cost for the banks are different because with guarantee trusts they do not incur judicial costs. The second story is asset specificity; in effect, that assets are more productive if they are used in the consumer's project than elsewhere.

[40]We can abstract from production and borrowing decisions because our assumptions about preferences, endowments, and technologies reduce the consumers' decision space considerably.

[41]Both the loans and the delivery promises are specified in units of the commodity.

At E_0 a collateral equilibrium is a vector of consumption plans $(\bar{c}^h)$ and an interest rate $((1+\bar{r}_{nt}))$ such that:

(I) $(\bar{c}^h)$ maximizes $u^h(c^h)$ s.t. $\bar{c}^h = \{s, nt\}\, \forall h = 1, 2$;

(II) $\pi_{nt}(1 + r_{nt}, \gamma_{nt}) \geq 0$;

(III) the banks' expectations are rational;

(IV) $\sum_{h=1}^{2} M^h (\bar{c}^h + i - e_0^h) \leq N, t = 0$, and $\sum_{h=1}^{2} M^h (\bar{c}^h + D_{nt,s}^h - e_s^h) \leq 0, \forall s = 1, 2$.

If it is profitable for the banks to offer non-trust loans[42], there are two different kinds of potential collateral equilibria at E_0: (a) only type 2 consumers borrow and (b) both consumer types borrow.

On the other hand, at E_1 a collateral equilibrium is a vector of consumption plans $(\bar{c}^h)$ and a pair of interest rates $(1+\bar{r}_{nt}), (1+\bar{r}_t)$ such that:

(I) $(\bar{c}^h)$ maximizes $u^h(c^h)$ s.t. $\bar{c}^h = \{s, nt, t\}\, \forall h = 1, 2$;

(II) $\pi_{nt}(1 + r_{nt}, \gamma_{nt}) \geq 0$ and $\pi_t(1 + r_t, \gamma_t) \geq 0$, and $\pi_{nt} = \pi_t$ when both loan contracts are offered;

(III) the banks' expectations are rational;

(IV) $\sum_{h=1}^{2} M^h (\bar{c}^h + i - e_0^h) \leq N, t = 0$, and $\sum_{h=1}^{2} M^h (\bar{c}^h + D_{nt,s}^h + D_{t,s}^h - e_s^h) \leq 0, \forall s = 1, 2$

.

Similar analysis of the E_1 economy indicates the following potential collateral equilibria: (a) only type 2 consumers demand either non-trust loans or trust loans (b) both consumer types demand either non-trust loans or trust loans, and (c) type 1 consumers demand trust

[42]The banks' zero profit condition indicates that the expected restitution from any loan contract equals $1/\beta$. If $y < 1/\beta$ it is not profitable that banks lend: even for $\delta = 1$ the expected restitution is less than their funds' cost. Moreover, this condition implies that consumers are not willing to invest their own funds either, even if they had them (in effect, if $e_0 > 1$).

loans and type 2 consumers demand non-trust loans[43].

With this characterization of the potential equilibria at each economy, we can analyze the effects on welfare and on default from introducing trust loans as changes from a particular equilibrium of the E_0 economy to another one of the E_1 economy. We conclude this section with two remarks. Since we assume that the mass of banks is greater than the mass of consumers and that banks are price-takers, every loan contract generates zero profits in equilibrium. Thus, welfare gains and losses are accrued to consumers only.

On the other hand, before proceeding it is important that we define what is payment default. From now on we will identify "payment default" with "rendering the collateral" to the banks. Notice that, in general, payment default not necessarily implies "contract default". In a world with contingent contract in kind payments at certain states of nature could be admissible; so "rendering the collateral" to the bank is a valid way to comply with the contract terms. Nevertheless, this does not imply that "defaulting" has no welfare effects: since $\varepsilon^2 > \varepsilon^1$, the amount of collateral that each consumer type renders to the banks in case of default is different. If at an equilibrium both consumer types borrow the same loan and default occurs, type 1 consumers end up paying more than type 2 consumers: there is a crossed-subsidy from consumers with safe projects to consumers with risky projects.

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[43] This equilibruim is proved on Proposition 2.

2.4 Results

In this section we use the model described previously to determine under what conditions, if trust loans are introduced into the economy: (1) there is a Pareto improvement; and (2) the economy's payment default rate decreases. We show that the introduction of trust loans produces a Pareto improvement and decreases the economy's default rate only if at the initial equilibrium non-trust loans are demanded solely by type 2 consumers. In contrast, whenever at the initial equilibrium both consumer types demand non-trust loans, the availability of trust loans does not produce a Pareto improvement and the economy's default rate may not be reduced. If the default rate falls, type 1 consumers are better off and type 2 consumers are worse off. This welfare effects are reversed if the default rate remains constant or increases.

To develop these results it is useful to narrow the set of economies and equilibria that we consider for our analysis. We restrict our attention to economies in which there is payment default at the initial equilibria, given the collateral requirement γ_{nt}[44]:

Proposition 1. $\gamma_{nt}\left(y-\varepsilon^2\right) \geq \frac{1}{\beta} \Leftrightarrow \nexists$ *payment default.*

Proof. (i) $\gamma_{nt}\left(y-\varepsilon^2\right) \geq \frac{1}{\beta} \Rightarrow \nexists$ payment default.

Equivalent to: payment default$\Rightarrow \gamma_{nt}\left(y-\varepsilon^2\right) < \frac{1}{\beta}$. Since $\varepsilon^2 > \varepsilon^1$equation 3 indicates that if there is default the minimum restitution that the banks collect is $\gamma_{nt}\left(y-\varepsilon^2\right) < (1+r_{nt})$. Banks' zero profit condition indicates that $\alpha x + (1-\alpha)\gamma_{nt}\left(y-\varepsilon^2\right) = \frac{1}{\beta}$, where

[44]Mexico's legal framework suggests that the only reason for the banks to be willing to request lower interest rates on trust loans than on non-trust loans is, precisely, that there is payment deafault and that, in such case, the loan guarantees put in trust fund can be foreclosed more expeditely than those that must be obtained through bankruptcy and payment suspension processes.

$x > \gamma_{nt}\left(y-\varepsilon^2\right)$is the average of all payments different from $\gamma_{nt}\left(y-\varepsilon^2\right)$and $0 < \alpha < 1$. Therefore, $\gamma_{nt}\left(y-\varepsilon^2\right) < \frac{1}{\beta}$.

(ii) $\nexists$ payment default$\Rightarrow \gamma_{nt}\left(y-\varepsilon^2\right) \geq \frac{1}{\beta}$.

Since $\varepsilon^2 > \varepsilon^1$ equation 3 indicates that if there is no default the minimum payment that the banks collect is $(1+r_{nt}) < \gamma_{nt}\left(y-\varepsilon^2\right)$. Banks' zero profit conditions implies that if all consumers pay then $(1+r_{nt}) = \frac{1}{\beta}$. Therefore, $\gamma_{nt}\left(y-\varepsilon^2\right) \geq \frac{1}{\beta}$. ■

This proposition is a necessary and sufficient condition for payment default to occur in the economy. Since if for some γ_{nt} there is no payment default at the initial equilibrium, introducing trust loans with a higher γ_t cannot reduce this phenomenon or generate welfare gains for the consumers, from now on we concentrate on economies in which $\gamma_{nt}\left(y-\varepsilon^2\right) < \frac{1}{\beta}$.

Default considerations give rise to a rich classification of the potential pooling equilibria. When both consumer types demand the same loan there are five possible realizations: (i) both types pay the interest rate at both states of nature, (ii) both types pay at state 1, but only type 1 pays at state 2 (iii) both consumer types pay at state 1 and default at state 2, (iv) both types default at state 2, but only type 2 pays at state 1, and (v) both types default at both states. Since in the latter two cases the banks in a sense are buying a share γ of the investment projects, from now on we exclude them from our analysis.

Using these criteria, we can determine which potential equilibria are feasible at the E_0 economies according to investment's expected productivity (table 2.2). When productivity is relatively low only type 2 consumers borrow non-trust loans and when productivity is relatively high both consumer types demand non-trust loans. There is also an intermediate productivity range where both kinds of equilibria exist.[45]

Table 2.2

Potential Equilibria of an E_0 Economy with $\gamma_{nt} \cdot (y - \varepsilon^2) < \frac{1}{\beta}$.

Expected productivity of investment	Consumer types that borrow
Low $\left(\frac{1}{\beta} \leq y < \frac{1}{\beta} + \frac{\gamma_{nt}(\varepsilon^2 - \varepsilon^1)}{2}\right)$	2
High $\left(\frac{1}{\beta} + \frac{\gamma_{nt}\theta^2(\varepsilon^2 - \varepsilon^1)}{2} \leq y\right)$	1 and 2

On figures 2.1, 2.2, and 2.3 we show, for different combinations of parameter values ($\varepsilon_1, \varepsilon_2, \theta_1, \theta_2, \gamma_{nt}$, and β), the profit maximizing interest rates of the potential pooling equilibria where both type 1 and type 2 consumers borrow -(i),(ii) and (iii) (which are labeled in the figures as $rt**$, $rnt(1pays)$, and $rnt(1def)$, respectively)- and of the initial equilibrium where only type 2 consumers borrow. Notice that the region at which pooling equilibria coexist with the "adverse selection" equilibrium is affected by the size of the difference between ε_1 and ε_2 and by γ_{nt}. On the other hand, it is also worth noting that when γ_{nt} is low default may occur even when investment productivity is relatively high.

[45]Notice that this presence of multiple equilibria calls for a voting mechanism or a benevolent social planner for selecting a Pareto optimal equilibrium.

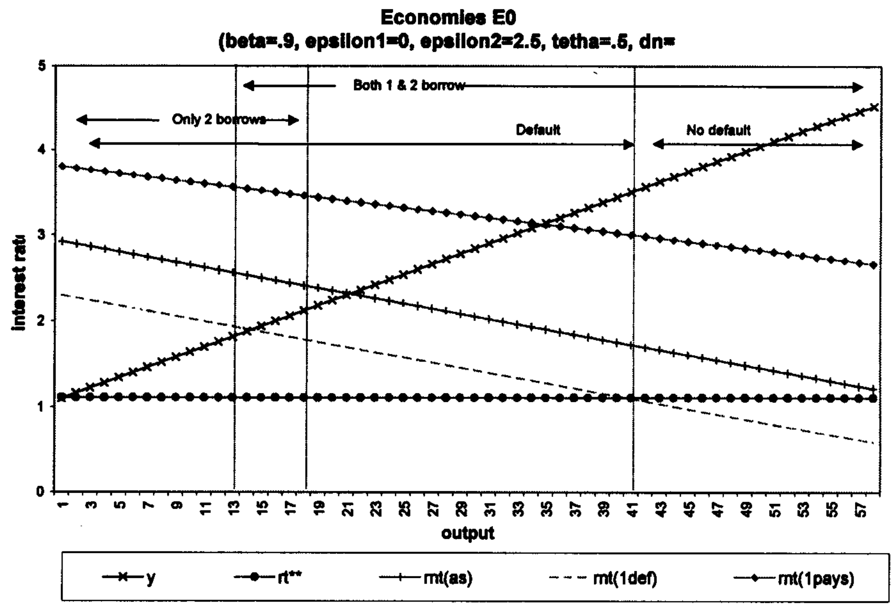

Figure 2-1: Characterization of equlibria when only non-trust loans are available I.

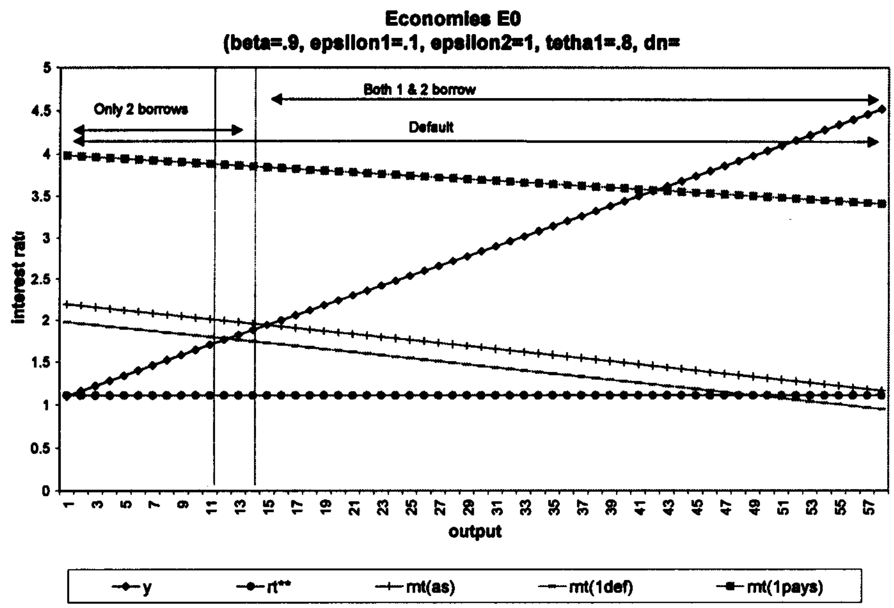

Figure 2-2: Characterization of equilibria when only non-trust loans are available II.

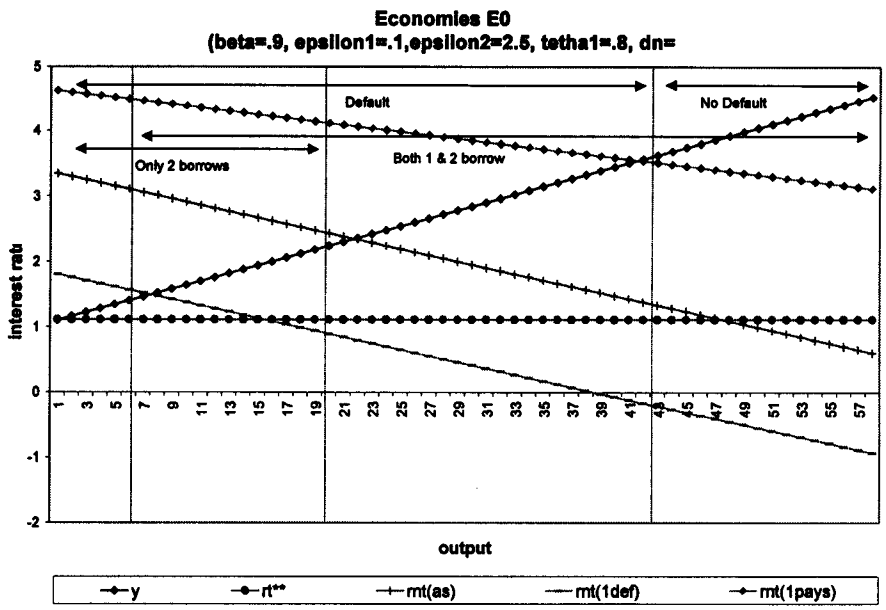

Figure 2-3: Characterization of equilibria when only non-trust loans are available III.

2.4.1 When the introduction of trust loans produces a Pareto improvement and reduces default?

The fact that at any equilibrium of the E_0 economy with positive borrowing and default type 1 consumers either do not borrow or, as we mention before, if they borrow they transfer more resources to the banks than type 2 consumers suggests a potential equilibrium of the E_1 economy in which type 2 consumers continue demanding non-trust loans and type 1 consumers demand the trust loans. Proposition 2 characterizes such separating equilibrium.

Proposition 2. *In an economy E_1 where $\gamma_{nt}\left(y-\varepsilon^2\right) < \frac{1}{\beta}$, $\gamma_t > \gamma_{nt}$, and $\varepsilon^2 > \varepsilon^1$, if the loan contracts $A_{nt} = \{(1+r_{nt}), \gamma_{nt}\}$ and $A_t = \{(1+r_t), \gamma_t\}$ constitute a separating equilibrium then:*

(i) $(1+r_{nt}) = \frac{2}{\beta} - \gamma_{nt}\left(y-\varepsilon^2\right)$ *and* $(1+r_t) = \frac{1}{\beta}$;

(ii) $\gamma_t\left(y-\varepsilon^2\right) \geq \frac{1}{\beta}$.

Proof. *(i) If $A_{nt} = \{(1+r_{nt}), \gamma_{nt}\}$ and $A_t = \{(1+r_t), \gamma_t\}$ constitute a separating equilibrium then $(1+r_{nt}) = \frac{2}{\beta} - \gamma_{nt}\left(y-\varepsilon^2\right)$ and $(1+r_t) = \frac{1}{\beta}$.*

The cases we need to verify are the following:

1) $(1+r_{nt}) < (1+r_t)$. This cannot be a separating equilibrium since $\gamma_t > \gamma_{nt}$ implies that A_{nt} is strictly preferable than A_t for both consumer types.

2) $(1+r_{nt}) = (1+r_t)$. This cannot be a separating equilibrium since $\gamma_t > \gamma_{nt}$, $\varepsilon^2 > \varepsilon^1$, and $\gamma_{nt}\left(y-\varepsilon^2\right) < \frac{1}{\beta}$ imply that $\gamma_{nt}\left(y-\varepsilon^1\right) = \gamma_t\left(y-\varepsilon^2\right)$ and in such case type 2 consumers will be better off choosing A_{nt} as well.

3)$(1+r_{nt}) > (1+r_t)$. There are four possible combinations of contracts where only one type of consumer demands trust loans and the other demands non-trust loans:

(a) $(1+r_{nt}) = \frac{2}{\beta} - \gamma_{nt}\left(y-\varepsilon^1\right)$ and $(1+r_t) = \frac{2}{\beta} - \gamma_t\left(y-\varepsilon^2\right)$ is a separating equilibrium $\Longleftrightarrow$ $\frac{1}{\beta} \leq y$ (ir-1, ir-2), $\varepsilon^1 \leq \varepsilon^2$ (ic-1), and $\varepsilon^1 \geq \varepsilon^2$ (ic-2). But ic-2 contradicts $\varepsilon^2 > \varepsilon^1$, hence (a) is not an equilibrium.

(b) $(1+r_{nt}) = \frac{2}{\beta} - \gamma_{nt}\left(y-\varepsilon^1\right)$ and $(1+r_t) = \frac{1}{\beta}$ is a separating equilibrium $\Longleftrightarrow$ $\frac{1}{\beta} \leq y$ (ir-1, ir-2), $\frac{1}{\beta} \leq \frac{1}{\beta}$ (ic-1), and $\varepsilon^1 \geq \varepsilon^2$ (ic-2). But ic-2 contradicts $\varepsilon^2 > \varepsilon^1$, hence (b) is not an equilibrium.

(c) $(1+r_{nt}) = \frac{2}{\beta} - \gamma_{nt}\left(y-\varepsilon^2\right)$ and $(1+r_t) = \frac{2}{\beta} - \gamma_t\left(y-\varepsilon^1\right)$ is a separating equilibrium $\Longleftrightarrow$ $\frac{1}{\beta} \leq y$ (ir-1, ir-2), $\varepsilon^1 \leq \varepsilon^2$ (ic-1), and $\varepsilon^1 \geq \varepsilon^2$ (ic-2). But ic-2 contradicts $\varepsilon^2 > \varepsilon^1$, hence (c) is not an equilibrium.

(d) $(1+r_{nt}) = \frac{2}{\beta} - \gamma_{nt}\left(y-\varepsilon^2\right)$ and $(1+r_t) = \frac{1}{\beta}$ is a separating equilibrium $\Longleftrightarrow$ $\frac{1}{\beta} \leq y$ (ir-1, ir-2), $\varepsilon^1 \leq \varepsilon^2$ (ic-1) , and $\frac{1}{\beta} \leq \frac{1}{\beta}$ (ic-2). Therefore, (d) is a separating equilibrium.

(ii) If $A_{nt} = \{(1+r_{nt}), \gamma_{nt}\}$ and $A_t = \{(1+r_t), \gamma_t\}$ constitute a separating equilibrium then $\gamma_t\left(y-\varepsilon^2\right) \geq \frac{1}{\beta}$.

Suppose that $(1+r_{nt}) = \frac{2}{\beta} - \gamma_{nt}\left(y-\varepsilon^2\right)$, $(1+r_t) = \frac{1}{\beta}$ and $\gamma_{nt}\left(y-\varepsilon^2\right) \geq \frac{1}{\beta} \geq \gamma_t\left(y-\varepsilon^2\right)$. Banks can separate the different consumer types through these interest rates $\Longleftrightarrow$ $\frac{1}{\beta} \leq y$ (ir-1, ir-2), $\varepsilon^1 \leq \varepsilon^2$ (ic-1), and $\frac{1}{\beta} \leq \gamma_t\left(y-\varepsilon^2\right)$(ic-2). But ic-2 contradicts the assumption that $\gamma_{nt}\left(y-\varepsilon^2\right) \geq \frac{1}{\beta} \geq \gamma_t\left(y-\varepsilon^2\right)$. ■

It is worth noting that this proposition also establishes that the trust loan interest rate of the separating equilibrium is lower than the collateral that any consumer type would give to the banks in case of deciding to commit default (part ii). Thus, to induce separation the trust loan interest rate must be low enough that any consumer type that demands such loan chooses to pay it. This is what generates trust loans' potential for reducing the overall economy's default rate.

The next proposition proves that the introduction of trust loans produces a Pareto improvement and reduces the economy's default rate when there is adverse selection at the initial equilibrium; that is, when only consumers with risky projects participate in the credit market.

Proposition 3. *In an economy E_0 where $A_{nt} = \{(1 + r_{nt}), \gamma_{nt}\}$ is the only loan contract and $\{c_s^1, c_{nt}^2, 1 + r_{nt}\}$ is an equilibrium, if when another loan contract $A_t = \{(1 + r_{nt}), \gamma_t\}$ is introduced $\{c_t^1, c_{nt}^2, 1 + r_t, 1 + r_{nt}\}$ is the separating equilibrium of the economy E_1 then:*

(i) the separating equilibrium represents a Pareto improvement;

(ii) the economy's default rate is reduced.

Proof. Let us consider the interest rate at which, being available non-trust loans only, type 2 consumers are the only participants in the market and default at state 2:

$$(1 + r_{nt}^*) = \frac{2}{\beta} - \gamma_{nt}\left(y - \varepsilon^2\right)$$

This interest rate is an equilibrium if type 2 consumers prefer borrowing rather than not borrowing:

$$\frac{1}{\beta} \leq y \tag{ir-2}$$

and no type 1 consumer does; that is, no type 1 consumer is willing to borrow and pay $1 + r_{nt}^*$ at both states,

$$\frac{1}{(1+\gamma_{nt})}\left(\frac{2}{\beta}+\gamma_{nt}\varepsilon^{2}\right) > y$$

or to borrow and pay $1 + r^*_{nt}$ at state 1 and default at state 2,

$$\frac{1}{\beta}+\frac{\gamma_{nt}\left(\varepsilon^{2}-\varepsilon^{1}\right)}{2} > y$$

The reason is that the expected yield of the project is too low to compensate type 1 consumers for implicitly subsidizing type 2 consumers, given that $\varepsilon_2 > \varepsilon_1$ implies that banks seize more collateral from type 1 consumers.

Once that both non-trust and trust loan contracts are available in the economy, it becomes possible for the banks to separate the consumer types by offering a different contract to each type. In the separating equilibrium (see proposition 2) type 2 consumers demand the non-trust loan and pay the interest rate:

$$(1+r^{**}_{nt}) = \frac{2}{\beta} - \gamma_{nt}\left(y-\varepsilon^{2}\right)$$

and type 1 consumers demand the trust loans and pay the interest rate:

$$(1+r^{**}_{t}) = \frac{1}{\beta}$$

The following conditions must be satisfied if each consumer type is to be choosing the specific loan contract that the banks offers to each one:

$$\frac{1}{\beta} \leq y \tag{ir-1, ir-2}$$

$$\varepsilon^1 \leq \varepsilon^2 \tag{ic-1}$$

$$\frac{1}{\beta} \leq \frac{1}{\beta} \tag{ic-2}$$

The individual rationality constraints indicate that, for the consumers to be willing to demand the loan contracts at the specified interest rates, it is necessary that the projects return is greater than the intertemporal discount rate. The incentive compatibility constraint for type 1 consumers suggests that since $\varepsilon^1 < \varepsilon^2$ they strictly prefer the trust loan over the non-trust loan. Finally, the incentive compatibility constraint for type 2 consumers tells that these consumers are indifferent among both loan contracts.

At the separating equilibrium type 1 consumers do not default at any state and type 2 consumers continue to default at state 2. Consequently, the economy's overall default rate falls. ■

The separating equilibrium represents a Pareto improvement because when trust loans are introduced the non-trust loan interest rate remains unchanged, making type 2 consumers indifferent between both loans, and type 1 consumers enter the market to demand trust loans. In addition, as type 1 consumers enter the market the economy's default rate falls, given that it is optimal for them to always pay the stipulated interest rate.

It is worth noting that, in contrast, increasing the economy's collateral requirement through the trust loans would imply increasing the subsidy size at any pooling equilibrium in which type 2 consumers default, making market participation even less attractive for type 1 consumers. Therefore, we can assert that starting from an initial equilibrium with adverse selection it is not possible to reach such pooling equilibria; but the weak inequality of on condition ic-2 indicates that it is possible to reach a pooling equilibria in which neither type 1 or type 2 consumers default.[46]

2.4.2 When the introduction of trust loans does not produce a Pareto improvement?

If both consumers demand non-trust loans at the initial equilibrium, introducing trust loans does not generate additional trading gains, but only redistributes these gains between the consumers. Who gains and who losses from the reform depends on whether at the new equilibrium each consumer type demands a different loan; but also on whether the economy's default rate falls.

Separating Equilibria

Proposition 4. *In an E_0 economy where $A_{nt} = \{(1+r_{nt}), \gamma_{nt}\}$ is the only loan contract and $\{(c^1_{nt}, c^2_{nt}, 1+r_{nt}\}$ is a pooling equilibrium, if when another loan contract $A_t = \{(1+r_t), \gamma_t\}$ is introduced $\{c^1_t, c^2_{nt}, 1+r_t, 1+r_{nt}\}$ is a separating equilibrium in the E_1*

[46] If the banks' contracting costs are higher in order to offer trust loans than to offer non-trust loans then type 2 consumers strictly prefer the non-trust loans. This possibility is perfectly congruent with Mexico's trust reform.

economy then:

(i) type 1 (2) consumers are better (worse) off;

(ii) the economy's default rate is not greater than before.

Proof. There are two potential pooling equilibria in which both consumer types borrow. In the first equilibrium, call it A, both consumer types pay the interest rate $1+r_t^*$ at state 1 and default at state 2, so banks' expected profit is

$$\begin{aligned}\pi_j^A\left(1+r_{nt}^*,\gamma_{nt}\right) &= \beta\left[\frac{\theta^1\left(\left(1+r_{nt}^*\right)+\gamma_{nt}\left(y-\varepsilon^1\right)\right)}{2}+\frac{\theta^2\left(\left(1+r_{nt}^*\right)+\gamma_{nt}\left(y-\varepsilon^2\right)\right)}{2}\right]-1\\ &= \beta\left(\frac{1}{2}\left(1+r_{nt}^*\right)+\frac{1}{2}\left(\theta^1\gamma_{nt}\left(y-\varepsilon^1\right)+\theta^2\gamma_{nt}\left(y-\varepsilon^2\right)\right)\right)-1\end{aligned}$$

In the second equilibrium, call it B, type 1 pays the interest rate $1+r_t^*$ at both states and type 2 pays $1+r_t^*$ at state 1 and defaults at state 2, so the banks' expected profit is

$$\begin{aligned}\pi_j^B\left(1+r_{nt}^*,\gamma_{nt}\right) &= \beta\left[\theta^1\left(1+r_{nt}^*\right)+\theta^2\left(\frac{\left(1+r_{nt}^*\right)+\gamma_{nt}\left(y-\varepsilon^2\right)}{2}\right)\right]-1\\ &= \beta\left(\left(\frac{2\theta^1+\theta^2}{2}\right)\left(1+r_{nt}^*\right)+\left(\frac{\theta^2}{2}\right)\gamma_{nt}\left(y-\varepsilon^2\right)\right)-1\end{aligned}$$

On the other hand, in the separating equilibrium type 2 consumers demand the non-trust loan and pay the interest rate $1+r_{nt}^{**}$ at state 1 and default at state 2, while type 1 consumers demand the trust loans and pay the interest rate $1+r_t^{**}$ at both states. The banks' profit from each of these loans are, respectively:

$$\pi_j\left(1+r_{nt}^{**},\gamma_{nt}\right)=\beta\left(\left(\frac{1}{2}\right)\left(1+r_{nt}^{**}\right)+\left(\frac{1}{2}\right)\gamma_{nt}\left(y-\varepsilon^2\right)\right)-1$$

and

$$\pi_j\left(1+r_t^{**},\gamma_t\right)=\beta\left(1+r_t^{**}\right)-1$$

Given that in equilibrium all contracts generate zero profits and $(1+r)>\gamma_{nt}\left(y-\varepsilon^h\right)$ if type h defaults (equation 3), inspection of the above equations reveals that for both equilibria A and B it holds that

$$\left(1+r_t^{**}\right)<\left(1+r_{nt}^{*}\right)<\left(1+r_{nt}^{**}\right)$$

In regard to the welfare effects, since banks earn zero profits and the gains from trade are unchanged (both consumer types already participate at the initial equilibrium), the above inequality indicates that at the separating equilibrium type 1 consumers are better off and type 2 consumers are worse off than before (part i). Type 1 consumers gain because at the separating equilibrium the interest rate that they pay no longer subsidizes the other type's default, even though choosing the trust fund implies surrendering a higher collateral to the banks.

In regard to the effects on the economy's default rate, if the initial pooling equilibrium is B then the economy's default rate is lower at the new equilibrium. If the initial pooling equilibrium is A the economy's default rate stays constant. Therefore, the economy's default rate is not higher than before (part ii). ∎

Pooling Equilibria

Besides that, in general, changes from one pooling equilibrium to another do not represent Pareto improvements, conclusions of the trust's default reducing effect depend on which is the starting equilibrium. There are two initial pooling equilibria with different default rates. The first one is the equilibrium where both consumer types demand non-trust loans and default at state 2. If once that trust loans are available the economy changes to another pooling equilibrium then default is not higher than before. The second possibility is the equilibrium where both consumer types demand non-trust loans and only type 2 consumers default at state 2. In this case, once that trust loans are available if the economy changes to another pooling equilibrium then default is not lower than before.

Proposition 5. *In an E_0 economy where only $A_{nt} = \{(1+r_{nt}), \gamma_{nt}\}$ is available and $\{(c^1_{nt}, c^2_{nt}, 1+r_{nt}\}$ constitutes an initial pooling equilibrium with both consumer types defaulting at state 2, and when $A_t = \{(1+r_t), \gamma_t\}$ becomes available $\{(c^1_t, c^2_t, 1+r_t\}$ constitute a pooling equilibrium of the E_1 economy:*

(i) if $\gamma_t \cdot (y - \varepsilon^2) \geq \frac{1}{\beta} \Rightarrow$default is less than before.

(ii) if $\gamma_t \cdot (y - \varepsilon^2) < \frac{1}{\beta} \Rightarrow$default is not greater than before.

(iii) the equilibrium change is not a Pareto improvement.

Proof. Let us consider the initial equilibrium in which both consumer types borrow the non-trust loan and default in state 2; that is:

$$\gamma_{nt}\left(y-\varepsilon^{1}\right)<\left(1+r_{nt}\right)<\gamma_{t}\left(y+\varepsilon^{1}\right)$$

The banks' zero profit condition (see π_j^A) implies that the interest rate corresponding to this equilibrium is:

$$\left(1+r_{nt}^{*}\right)=\frac{2}{\beta}-\gamma_{nt}\cdot\left(y-\theta^{1}\varepsilon^{1}-\theta^{2}\varepsilon^{2}\right)$$

From this equation it is worth noting that the interest rate is a decreasing function of the fraction of collateral that the banks obtain when consumers default, for a sufficient amount of output, and a decreasing (increasing) function of the proportion of the consumer population with low (high) risk projects..

In order that both consumer types are willing to borrow at this interest rate, for each type must be individually rational to pay $(1+r_{nt}^{*})$ at state 1 and to let the banks foreclose the collateral at state 2; that is:

$$\frac{1}{\beta}+\frac{\gamma_{nt}\theta^{2}\left(\varepsilon^{2}-\varepsilon^{1}\right)}{2}\leq y \tag{ir-1}$$

$$\frac{1}{\beta}-\frac{\gamma_{nt}\theta^{1}\left(\varepsilon^{2}-\varepsilon^{1}\right)}{2}\leq y \tag{ir-2}$$

Since $\varepsilon^2>\varepsilon^1$ if condition ir-1 is satisfied then condition ir-2 is also satisfied. Therefore, consumers with riskier projects "enter first" in the market[47]. This is due to the fact that type 1 consumers know that on average they transfer more resources to the banks than type 2 consumers: they pay the same interest rate at the good state and their project generates more collateral that can be foreclosed in the bad state.

Once that trust loans are available, if $\gamma_t \left(y - \varepsilon^2\right) \geq \frac{1}{\beta}$, the interest rate that the banks will set on the trust loans is

$$(1 + r_t^*) = \frac{1}{\beta}$$

That is, the loan interest rate is equal to the intertemporal discount rate. On the other hand, consumers will borrow at this interest rate and will pay in both states of nature if

$$\frac{1}{\beta} \leq y \qquad \text{(ir-1, ir-2)}$$

This individual rationality constraints suggest that at the new equilibrium both consumer types are willing to borrow as long as the project's yield exceeds the intertemporal discount rate[48]: there no longer is a cross subsidy between consumers. Moreover, since at any state the interest rate is lower than or equal to the collateral that the consumers would have to give to the banks if they decide to default, in this pooling equilibrium[49] default

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[47]Like in Akerlof (1970)'s lemon market.

[48]It is worth noting that this condition must be satisfied for the consumers to be willing to invest their own funds, when available, on the proyect as well.

[49]Strictly, for each δ_t there exists a family of pooling equilibria in which the trust-loan interest rate that the banks set $(1 + r_t^*) = \frac{1}{\beta}$. Each equilibrium differs with respect to the banks' out of equilibrium beliefs; that is, if any consumer asks for a non trust loan. It is evident that it is possible to reduce the number of

becomes zero.

About the potential welfare effects, we know that both types of consumer pay lower interest rates at state 1, given that they would have to cede more collateral at state 2, because banks obtain the same expected profits. That the banks profit is unchanged and all consumers participate in the market means that the gains from trade among banks and consumers are also unchanged. On the other hand, at the new equilibrium type 1 consumers no longer subsidize type 2 consumers. In consequence, we can assert that type 1 consumers will be better off and type 2 consumers worse off at the new equilibrium.

If $\gamma_t \left(y - \varepsilon^2\right) < \frac{1}{\beta}$ there are two possible cases. In the first case the interest rate that the banks charge is:

$$(1 + r_t^*) = \frac{2}{\beta} - \gamma_t \left(y - \theta^1 \varepsilon^1 - \theta^2 \varepsilon^2\right)$$

Both consumer types are willing to demand trust loans at this interest rate if:

$$\frac{1}{\beta} + \frac{\gamma_t \theta^2 \left(\varepsilon^2 - \varepsilon^1\right)}{2} \leq y \qquad \text{(ir-1)}$$

$$\frac{1}{\beta} - \frac{\gamma_t \theta^1 \left(\varepsilon^2 - \varepsilon^1\right)}{2} \leq y \qquad \text{(ir-2)}$$

At this equilibrium both types of consumer continue defaulting at state 2, so economy's default level is unaltered with respect to the original situation. To infer the welfare effects

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equilibria by adding assumptions on the banks' beliefs.

of this case we can apply the following arguments. Banks perceive the same profits and, if both consumer types participate in the new equilibrium, the gains from trade among banks and consumers will be the same as well. Total transfers from type 1 consumers to the banks are higher at the new equilibrium if:

$$\begin{aligned}
\frac{\frac{2}{\beta} - \gamma_t \left(y - \theta^1 \varepsilon^1 - \theta^2 \varepsilon^2\right) + \gamma_t \left(y - \varepsilon^1\right)}{2} &> \frac{\frac{2}{\beta} - \gamma_{nt} \left(y - \theta^1 \varepsilon^1 - \theta^2 \varepsilon^2\right) + \gamma_{nt} \left(y - \varepsilon^1\right)}{2} \\
\gamma_t \theta^2 \left(\varepsilon^2 - \varepsilon^1\right) &> \gamma_{nt} \theta^2 \left(\varepsilon^2 - \varepsilon^1\right) \\
\gamma_t &> \gamma_{nt}
\end{aligned}$$

Total transfers from type 2 consumers to the banks are lower at the new equilibrium if

$$\begin{aligned}
\frac{\frac{2}{\beta} - \gamma_t \left(y - \theta^1 \varepsilon^1 - \theta^2 \varepsilon^2\right) + \gamma_t \left(y - \varepsilon^2\right)}{2} &< \frac{\frac{2}{\beta} - \gamma_{nt} \left(y - \theta^1 \varepsilon^1 - \theta^2 \varepsilon^2\right) + \gamma_{nt} \left(y - \varepsilon^1\right)}{2} \\
\gamma_t \theta^1 \left(\varepsilon^1 - \varepsilon^2\right) &< \gamma_{nt} \theta^1 \left(\varepsilon^1 - \varepsilon^2\right) \\
\gamma_t &> \gamma_{nt}
\end{aligned}$$

Hence, type 1 (type 2) consumers are worse (better) off at the new equilibrium.

In the second case the interest rate that the banks charge (see π_j^B) is:

$$(1 + r_t^*) = \frac{2}{\beta \left(2\theta_1 + \theta_2\right)} - \frac{\gamma_t \theta^2 \left(y - \varepsilon^2\right)}{2\theta_1 + \theta_2}$$

Both consumer types are willing to demand trust loans at this interest rate if:

$$\left(\frac{1}{2-\theta^2(1-\gamma_t)}\right)\left(\frac{2}{\beta}+\gamma_t\theta^2\varepsilon^2\right)\leq y \tag{ir-1}$$

$$\left(\frac{1}{2\left(2-\theta^2(1-\gamma_t)-\gamma_t\right)}\right)\left(\frac{2}{\beta}-2\gamma_t\theta^1\varepsilon^2\right)\leq y \tag{ir-2}$$

At this equilibrium type 1 consumers pay the interest rate at both states and type 2 consumers at state 1 only. Therefore, the economy's default level is reduced.

To determine the welfare effects, since both the banks' profit and the gains from trade remain unchanged we can apply similar arguments as before: if one type gains the other loses. Suppose that type 1 consumers lose at the new equilibrium and type 2 consumers gain. This implies that transfers of type 1 consumers to the banks are higher and that those of type 2 consumers are lower at the new equilibrium; in particular:

$$\begin{aligned}
\frac{\frac{2}{\beta}-\gamma_{nt}\left(y-\theta^1\varepsilon^1-\theta^2\varepsilon^2\right)+\gamma_{nt}\left(y-\varepsilon^1\right)}{2} &< \frac{2}{\beta\left(2\theta^1+\theta^2\right)}-\frac{\gamma_t\theta^2\left(y-\varepsilon^2\right)}{\left(2\theta^1+\theta^2\right)}\\
\frac{\frac{2}{\beta}+\gamma_{nt}\theta^2\left(\varepsilon^2-\varepsilon^1\right)}{\frac{2}{\beta}-\gamma_t\theta^2\left(y-\varepsilon^2\right)} &< \frac{2}{2\theta^1+\theta^2}
\end{aligned}$$

and:

$$\begin{aligned}
\frac{\frac{2}{\beta}-\gamma_{nt}\left(y-\theta^1\varepsilon^1-\theta^2\varepsilon^2\right)+\gamma_{nt}\left(y-\varepsilon^2\right)}{2} &> \frac{2}{\beta\left(2\theta^1+\theta^2\right)}-\frac{\gamma_t\theta^2\left(y-\varepsilon^2\right)}{\left(2\theta^1+\theta^2\right)}\\
\frac{\frac{2}{\beta}-\gamma_{nt}\theta^1\left(\varepsilon^2-\varepsilon^1\right)}{\frac{2}{\beta}-\gamma_t\theta^2\left(y-\varepsilon^2\right)} &> \frac{2}{2\theta^1+\theta^2}
\end{aligned}$$

But $\frac{2}{\beta}+\gamma_{nt}\theta^2\left(\varepsilon^2-\varepsilon^1\right)>\frac{2}{\beta}-\gamma_{nt}\theta^1\left(\varepsilon^2-\varepsilon^1\right)$ implies that these inequalities do not hold at the same time. Then transfers from type 1 consumers do not exceed those from type 2 consumers at the new equilibrium. Therefore, either type 1 consumers are better off and type 2 consumers are worse off at the new equilibrium, or both types are indifferent between them. ■

Proposition 6. *In an E_0 economy where only $A_{nt} = \{(1+r_{nt}), \gamma_{nt}\}$ is available and $\{(c^1_{nt}, c^2_{nt}, 1+r_{nt}\}$ constitutes an initial pooling equilibrium with only type 2 consumers defaulting at state 2, and when $A_t = \{(1+r_t), \gamma_t\}$ becomes available $\{(c^1_t, c^2_t, 1+r_t\}$ constitute a pooling equilibrium of the E_1* economy*:*

(i) if $\gamma_t \cdot (y - \varepsilon^2) \geq \frac{1}{\beta}$ ⇒default is lower than before.

(ii) if $\gamma_t \cdot (y - \varepsilon^2) < \frac{1}{\beta}$ ⇒default is not lower than before.

(iii) the equilibrium change is not a Pareto improvement.

Proof. Let us consider the initial pooling at which type 1 pays the interest rate $1 + r^*_t$ at both states and type 2 pays $1 + r^*_t$ at state 1 and defaults at state 2; that is,

$$\gamma_{nt} \left(y - \varepsilon^2\right) < (1 + r_{nt}) < \gamma_t \left(y - \varepsilon^1\right)$$

The interest rate that banks charge at this equilibrium is:

$$(1 + r^*_{nt}) = \frac{2}{\beta (2\theta_1 + \theta_2)} - \frac{\gamma_t \theta^2 \left(y - \varepsilon^2\right)}{2\theta_1 + \theta_2}$$

The incentive compatibility constraints that sustain this pooling equilibrium are:

$$\left(\frac{1}{2 - \theta^2 (1 - \gamma_{nt})}\right) \left(\frac{2}{\beta} + \gamma_{nt} \theta^2 \varepsilon^2\right) \leq y \qquad \text{(ir-1)}$$

$$\left(\frac{1}{2\left(2-\theta^2(1-\gamma_{nt})-\gamma_{nt}\right)}\right)\left(\frac{2}{\beta}-2\gamma_{nt}\theta^1\varepsilon^2\right)\leq y \qquad \text{(ir-2)}$$

Once that trust loans are available, if $\gamma_t\left(y-\varepsilon^2\right)\geq\frac{1}{\beta}$ the same arguments of proposition 5 prove that at the new pooling equilibrium there is no default and type 1 (type 2) consumers will be better (worse) off.

If $\gamma_t\cdot\left(y-\varepsilon^2\right)<\frac{1}{\beta}$, the two possible cases of proposition 5 may occur. If the interest rate that the banks charge is:

$$(1+r_t^*)=\frac{2}{\beta}-\gamma_t\left(y-\theta^1\varepsilon^1-\theta^2\varepsilon^2\right)$$

then both consumer types default at state 2, so economy's default rate increases with respect to the original situation (given that the individual rationality constraints of proposition 5 hold). To determine the welfare changes let us consider the following inequality:

$$\gamma_{nt}\cdot\left(y-\varepsilon^2\right)<(1+r_{nt}^*)<\gamma_{nt}\cdot\left(y-\varepsilon^1\right)<\gamma_t\cdot\left(y-\varepsilon^1\right)<(1+r_t^*)<\gamma_t\cdot\left(y+\varepsilon^1\right)$$

This inequality indicates that trust loans' interest rate and collateral requirement exceed those of the non-trust loans. Type 1 consumers are worse off at the new equilibrium because they end up transferring more resources to the banks in both states. Since payment to the banks and gains from trade remain unchanged, then type 2 consumers are better off at the new equilibrium.

If the interest rate that the banks charge (see π_j^B) is:

$$(1+r_t^*) = \frac{2}{\beta\left(2\theta_1+\theta_2\right)} - \frac{\gamma_t \theta^2\left(y-\varepsilon^2\right)}{2\theta_1+\theta_2}$$

then, exactly as at the initial equilibrium, type 1 continue pay the interest rate at both states and type 2 consumers only at state 1 (given that the individual rationality constraints of proposition 5 hold). Therefore, the economy's default level is unchanged.

To determine the welfare changes let us look at the total transfers from each consumer type to the banks at each equilibrium. Total transfers to the banks of type 1 consumers at $(1+r_t^*)$ are less than at $(1+r_{nt}^*)$if:

$$\begin{aligned} \frac{2}{\beta\left(2\theta_1+\theta_2\right)} - \frac{\gamma_{nt} \theta^2\left(y-\varepsilon^2\right)}{2\theta_1+\theta_2} &> \frac{2}{\beta\left(2\theta_1+\theta_2\right)} - \frac{\gamma_t \theta^2\left(y-\varepsilon^2\right)}{2\theta_1+\theta_2} \\ \gamma_{nt} &< \gamma_t \end{aligned}$$

Total transfers to the banks of type 2 at $(1+r_t^*)$are higher than at $(1+r_{nt}^*)$ if:

$$\begin{aligned} \frac{\left(\frac{2}{\beta(2\theta_1+\theta_2)} - \frac{\gamma_{nt}\theta^2(y-\varepsilon^2)}{2\theta_1+\theta_2} + \gamma_{nt}\left(y-\varepsilon^2\right)\right)}{2} &< \frac{\left(\frac{2}{\beta(2\theta_1+\theta_2)} - \frac{\gamma_t\theta^2(y-\varepsilon^2)}{2\theta_1+\theta_2} + \gamma_t\left(y-\varepsilon^2\right)\right)}{2} \\ \gamma_{nt} &< \gamma_t \end{aligned}$$

Thus, type 1 consumers are better off and type 2 consumers are worse off at the new equilibrium ■

Summarizing the results of propositions 4, 5, and 6 (table 2.3), we can derive the following corollaries regarding the implications of introducing trust loans when there is no adverse selection in the market:

Corollary 1. *If both consumer types borrow at the initial equilibrium increasing loans' collateral requirements may not reduce the economy's default rate.*

Corollary 2. *If both consumer types borrow at the initial equilibrium lower default*$\nrightarrow$Pareto improvement (*type 1 (2) consumers may be better (worse) off)* .

Corollary 3. *If both consumer types borrow at the initial equilibrium higher default*$\nrightarrow$Pareto improvement: *type 1 (2) consumers may be worse (better) off.*

Table 2.3

Summary of Propositions 4, 5, and 6

Equilibrium at E_0	Equilibrium at E_1	Effect on Welfare	Effect on Default
A	Separating	1 ↑, 2 ↓	↓
A	C	1 ↑, 2 ↓	↓
A	A	1 ↓, 2 ↑	=
A	B	Either 1 ↑, 2 ↓ or =	↓
B	Separating	1 ↑, 2 ↓	=
B	C	1 ↑, 2 ↓	↓
B	A	1 ↓, 2 ↑	↑
B	B	1 ↑, 2 ↓	=

A = pooling equilibrium with both consumer types defaulting at state 2, B = pooling equilibrium with only type 2 consumers defaulting at state 2, C= pooling equilibrium with no default.

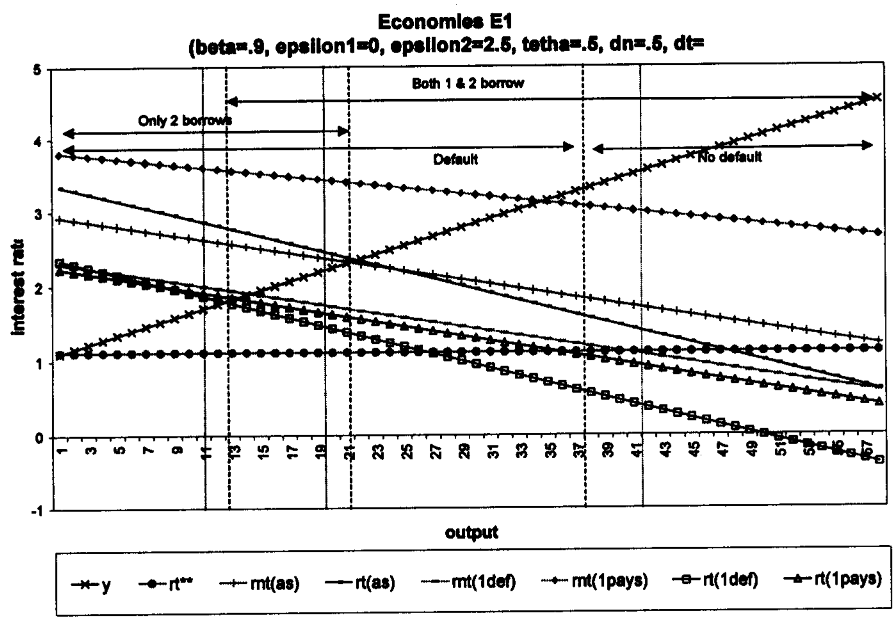

Figure 2-4: Characterization of equilibria once when non-trust loans and trust loans are available.

2.5 Extensions and Conclusions

2.5.1 Extensions

Since Mexico's case suggests that banks incur in higher administration and legal costs for offering trust loans than the traditional loans, the most immediate extension consists on allowing different contracting costs associated to each loan. Our preliminary work in that area indicates that (1) the presence of costs permits to separate strictly the different consumer types, and (2) there is no pooling equilibrium in which trust loans substitute non-trust loans and all consumers always pay.

Other possible extensions consist on increasing the number of consumer or bank types in the economy. In this area, our advances for the case with a finite number of consumer types suggest that if there are multiple types and trust loans are introduced, the intermediate groups always pool together with the low risk type. This would tend to exacerbate any effect over the economy's default level and welfare that trusts might have.

Regarding the banks, possible extensions may include varying the mass of banks or increasing the number of bank types. If there is only one type of bank and the mass of banks is smaller than the mass of consumers, banks will make positive profits and at least one type of consumer would always be indifferent between borrowing and not borrowing[50]. However, these gains would not provide any additional insights for banks preferring some contracts to others or different welfare implications. The option of allowing for multiple types of banks, or of creditors in general, would provide richer welfare effects which may

[50]Schmidt-Mohr (1997).

relevant for the case of Mexico. This is due to the fact that the reform to the LCOT only reduces the costs of contracting trust for the commercial banking institutions. While our welfare conclusions are based on the fact that all the banks can offer the most profitable contract available, which in equilibrium generates zero profits, this may no longer be the case when there are multiple types of creditors differing on their cost of providing the trust loan. For this reason, a particular creditor may increase his market participation and his profits at the expense of others' through his advantages for offering trust loans. In practice, trusts permit creditors to separate and foreclose their guarantee assets more expeditely and profitably and, as consequence, offer better interest rates or larger loans to the debtor using the same guarantees. But separating and foreclosing essential assets for the debtor firm's operation may reduce the compensations for creditors without explicit guarantees who, as consequence, offer higher interest rates or smaller loans.

On the other hand, the present model draws three ways to measure the welfare effects of the LCOT reform: (1) reductions of the economy's default rate, (2) increases on the interest rates differential between trust loans and non-trust loans, and (3) bringing to the loan market new groups of consumers or firms.

2.5.2 Conclusions

When there is perfect contract enforcement, either because all parties honor their promises voluntarily or because there is a judicial authority that monitors and imposes by force the contract terms, creditors always obtain the payments initially established. However, if there is imperfect contract enforcement creditors will only collect whatever debtors willingly deliver or the authorities oblige debtors to pay.

In Mexico, after the 1994 economic crisis, several groups have pointed out the need for a new LBPS. But even among those in favor of a reform there is no consensus upon what reforms to make because, ex-ante, neither all liquidation is efficient or all negotiation is inefficient. So there are no strong arguments for giving more control either to debtors or to creditors, especially when there are no extensive empirical studies for Mexico regarding (a) who and how much creditors gain in bankruptcy negotiations, (b) how much resources are squandered, (b) how successfully is bankruptcy avoided through the payment suspension process, and (c) to how much do judicial costs amount. Nevertheless, even without the laws' bias in favor of any party there are several aspects, like the multiple articles ruling the same precepts or the slowness with which the laws are applied, over which both the direction of the reform and the sign of the welfare effects may be clearer: a simpler laws that make the LBPS processes more accessible when these are needed and shorter waiting periods that reduce the value of the economic resources are desirable for everyone.

In the meantime, there may exist net gains of adding new credit instruments to the market. However, our investigation on the trust loans' welfare effects suggests that it is more likely that with new contracts the existing gains are redistributed than more gains are generated unless that new groups incorporate into the market: when trust loans substitute non-trust loans, debtors that do not pay win in detriment of those who do and, when both loans are demanded by different groups, debtors that do not pay lose. Moreover, even if new contracts have the potential of yielding certain effects desirable for the economy, in the presence of multiple outcomes additional measures or mechanisms may be required to ensure that the economy attains the optimal outcome.

2.6 Appendix

Table A.1

Actions of the Bankruptcy Process on Mexico's LBPS

Action	Maximum Execution Time
1. The judge names a bankrupty's receiver to carry out any measures needed to preserve, manage, and sell the firm's assets.	0
2. The receiver takes possession of all the firm's assets of which the debtor is precluded.	0
3. Inventory of assets and formulation of balance statements.	24 hours (if these were not presented with the suit)
4. Summon all the creditors.	45 days (after the judge sentences the firm bankrupt)
5. Convocation a creditors' meeting for recognizing and ranking, by degree and seniority, all their claims.	90 days (after the summon)
6. Sentence of recognition and ranking of the creditors' claims.	3 days (after the creditors' meeting ends)
7. Sale of the assets	None (decided by the judge)
8. Entinction of the bankruptcy	None (decided by the judge)

Table A.2

Degree and Seniority of Claims on Mexico's LBPS

Degree	Creditor Type	Seniority Rule
I	with singular privileges	death expenditures sickness expenditures wages
II	with mortages	first in time is first in right
III	with special privileges	first in time is first in right; if there are many claims pertaining the same date or the same asset, each receives a proportional payment
IV	common claims from commerce operations	proportional payment without date distinctions
V	common claims from civil rights	proportional payment without date distinctions

2.7 Bibliography

1. Aarum Tame, E. (1985), "Ideas sobre reformas en la materia de quiebras y suspensión de pagos", en *La reforma de la legislación mercantil*, México, Editorial Porrúa, 1985.

2. Aghion, P., Hart, O., and Moore, J. (1992), "The Economics of Bankruptcy Reform", National Bureau of Economic Research, Cambridge, Mass., 1992.

3. Akerlof, G. (1970), "The Market for Lemons: Qualitative Uncertainty and the Market Mechanism", *Quarterly Journal of Economics* 84,488-500.

4. Baird, D. G. (1987), "A world without bankruptcy", in *Corporate Bankruptcy. Economic and Legal Perspectives*, J. S. Bandari and L. A. White (ed.), Cambridge University Press, 1996, 29-38.

5. Baird, D. G. (1987a), "Loss distribution, forum shopping, and bankruptcy: A reply to Warren", in *Corporate Bankruptcy. Economic and Legal Perspectives*, J. S. Bandari and L. A. White (ed.), Cambridge University Press, 1996, 95-108.

6. Bester, H (1985), "The role of collateral in credit markets with imperfect information," *American Economic Review* 75, 850-855.

7. Dávalos, C. (1991), *Títulos y Contratos de Crédito, Quiebras, Tomos II y III*, Mexico, Editorial Harla, 1991.

8. Deng, Y., Quigley, J. M., and Van Order, R. (1995), "Mortage Terminations", *University of California at Berkeley Center for Real Estate and Urban Economics*, Working Paper No. 95-320.

9. *Diario Oficial*, Mexico, viernes 24 de mayo de 1996.

10. Geanakoplos, J., and Shubik, M. (1990), "Default and Efficiency in a General Equilibrium Model with Incomplete Markets", *Cowles Foundation Discussion Paper.*

11. Geanakoplos, J., and Zame, W. (1997), "Collateral, Default and Market Crashes", University of California at Los Angeles Working Paper.

12. Franks, J. R. and Torous, W. N. (1993), "Lessons from a comparison of U. S. and U. K. insolvency codes", in *Corporate Bankruptcy. Economic and Legal Perspectives*, J. S. Bandari and L. A. White (ed.), Cambridge University Press, 1996, 450-466.

13. Gale, D. (1992), "A Walrasian Theory of Markets with Adverse Selection", *Review of Economic Studies* 59, 229-255.

14. Hart, O. (1995), *Firms, Contracts, and Financial Structure*, Clarendon Lectures in Economics, Oxford University Press

15. Hart, O. and Moore, J. (1997), "Default and Renegotiation: A Dynamic Model of Debt", LSE/STICERD Discussion paper No. TE/97/321.

16. Hirshleifer, J. and Riley, J. G. (1992), *The Analytics of Uncertainty and Information*, Cambridge surveys of economic literature, Cambridge University Press.

17. Jackson, T. H. (1985), "Translating assets and liabilities to the bankruptcy forum", in *Corporate Bankruptcy. Economic and Legal Perspectives*, J. S. Bandari and L. A. White (ed.), Cambridge University Press, 1996, 58-72.

18. *Ley de Quiebras y Suspensión de Pagos*, México, Ediciones Delma, decimoquinta edición, 1997.

19. *Ley General de Títulos y Operaciones de Crédito*, México, Ediciones Delma, octava edición, 1997.

20. Milde, H. and Riley, J. G. (1988), "Signaling in credit markets", *Quarterly Journal of Economics* 103, 101-130.

21. Mooradian, R. M. (1994), "The Effect of Bankruptcy Protection on Investment: Chapter 11 as a Screening Device", *The Journal of Finance*, Vol. XLIX, 1403-1430.

22. Quigley, J. M. and Van Order, R. (1995), "Explicit tests of contingent claims models of mortage default", *University of California at Berkeley Center for Real Estate and Urban Economics*, Reprint No. 105.

23. Rothschild, M. and Stiglitz, J.E. (1976), "Equilibrium in competitive insurance markets: An essay in the economics of imperfect information", *Quarterly Journal of Economics* 90, 629-650.

24. Schmidt-Mohr, U. (1997), "Rationing versus collateralization in competitive and monopolistic credit markets with asymmetric information", *European Economic Review* 41, 1321-1342.

25. Stiglitz, J. E. and Weiss, A. (1981), "Credit rationing in markets with imperfect information", *American Economic Review* 71, 393-410.

26. Warren, E. (1987), "Bankruptcy policy", in *Corporate Bankruptcy. Economic and*

Legal Perspectives, J. S. Bandari and L. A. White (ed.), Cambridge University Press, 1996, 73-94.

27. White, M. (1996), "The costs of corporate bankruptcy: a U. S..-European comparison", in *Corporate Bankruptcy. Economic and Legal Perspectives*, J. S. Bandari and L. A. White (ed.), Cambridge University Press, 1996, 467-500.