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ABSTRACT

Risk and Intermediation in a Dual Financial Market Model*

This Paper investigates the relationship between risk in productive activity and the degree of financial intermediation in a model with moral hazard. Entrepreneurs can simultaneously get credit from two types of competing institutions: 'financial intermediaries' and 'local lenders'. The former are competitive firms with a comparative advantage in diversifying credit risks, and the latter have superior information about the investment returns of a 'nearby' entrepreneur. This information advantage allows local lenders to save on intermediation costs that are otherwise related to lending activity. By diversifying risks, financial intermediaries are able to offer a safe asset to local lenders and, because of intermediation costs, the latter are willing to diversify their portfolio by offering some direct lending to the nearby entrepreneur (incomplete insurance). We show that, in some cases, a fall in intermediation costs, by inducing local lenders to choose a safer portfolio, reduces entrepreneurs' effort and increases the probability of default.

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1 Introduction

Financial market imperfections play a significant role in explaining capital accumulation and growth performance in developing countries. A number of empirical studies (e.g., Levine (1997)) have shown that the development of "formal" financial market institutions (banks, financial intermediaries, stock markets) may be a key element in promoting economic growth. In particular, financial development reduces transaction costs that are responsible for excessive risk taking and it allows for better risk sharing and increasing liquidity so as to decrease the costs of raising funds and induce entrepreneurs to undertake more productive investments. These arguments justify the view that controlling international capital flows and taxing financial intermediaries is generally undesirable (McKinnon (1973)).

However, there is a large body of evidence showing that "formal" financial markets face serious informational problems and high default rates, especially in developing economies. These are typically characterized by an extensive resort to internal finance by entrepreneurs and a large informal sector for credit and risk sharing. Financial institutions face moral hazard problems and they are, to a large extent, unable to monitor firms' behavior. Hence, the question one may raise is whether informal market institutions may at least partially solve the incentive and informational problems that financial markets are unable to cope with.

The possibility that non-market financial institutions may have a positive role in developing economies has been extensively explored. In general, this possibility can be a consequence of assuming that some contractual arrangements cannot be legally enforced and informal markets for lending and insurance may have a comparative advantage in monitoring and enforcing contracts. This is, for instance, the assumption on which Stiglitz (1990) and Arnott and Stiglitz (1990) base their analysis of market and non-market insurance provision ("peer monitoring view").

In Arnott and Stiglitz (1990) there is a market for insurance with moral hazard where exclusive contracts are not enforceable. Moral hazard implies that the optimal incentive scheme is characterized by partial insurance. However, intermediaries operating in the formal market are unable to implement this contract since agents have the ability to seek additional unobservable insurance from some informal institutions. If these have no superior information, the resulting allocation may be inefficient. If (as assumed by Arnott and Stiglitz) informal institutions are unable to diversify risks as much as the formal institutions, non exclusive contracts have the additional effect of reducing the extent of risk sharing. However, if insurers operating in the nonmarket environment have more information and monitoring capabilities on the individuals' effort decisions, nonmarket insurance may be beneficial. Then, the interaction of market and nonmarket institutions have ambiguous effects on agents' welfare in the presence of incentive problems.

In this paper we set up a model of a loan market with moral hazard where there are two type of financial institutions: formal intermediaries operating in a competitive environment (financial intermediaries) and informal lenders operating in a local, less competitive environment (local lenders). Our objective is to see how a small information advantage of the local lenders (i.e., some intermediation costs faced by intermediaries) can be important to understand why financial development may sometimes fail to be beneficial for economic growth and default risks faced by entrepreneurs. As in Arnott and Stiglitz (1990), we have a model where agents can simultaneously get contracts from competing institutions. However, we do not impose that agents' informal contractual arrangements are unobservable. In our model local lenders have the option to impose exclusivity on their contracts. However, this option will not be exercised in equilibrium (and it is not desirable from a welfare point of view) since these competing institutions differ with respect to information, market power and attitude toward risk.

We consider a productive economy with a continuum of identical risk neutral entrepreneurs operating investment projects with stochastic returns where moral hazard has two different forms. Entrepreneurs can hide the realizations of their own project returns and they can affect the probability distribution of these returns by making non-observable effort decisions. The realizations of the investment returns of any specific project can be freely observed "locally" (i.e., by a local lender who lives where the project takes place) and they can be observed by anyone else in the economy at some cost (arising from a monitoring technology). Hence, entrepreneurs may get loans from local lenders and/or from "outside" investors, provided that the latter are willing to pay monitoring costs.

It is assumed that monitoring is only performed by financial intermediaries. These are a large set of competitive firms engaged in credit risk diversification. Since there is no aggregate uncertainty, intermediaries, by pooling credit risks, are able to offer their liabilities as a safe asset to local lenders. The latter are assumed to be risk averse individuals endowed with a fixed amount of loanable funds. One way to characterize our assumptions is to imagine that the economy is composed of a large number (a continuum) of small villages, each one populated by a local lender and an entrepreneur.

Since diversification of credit risks is costly, the rate of return on deposits is lower than the expected return on any given investment project and local lenders are willing to provide direct financing to entrepreneurs, i.e., not all loanable funds are intermediated.

Both local lenders and intermediaries offer limited liability contracts to entrepreneurs. However, the nature of these contracts differ for a number of reasons. Intermediaries are assumed to be price taking and entrepreneurs can borrow as much as they want from them at the market rate. On the contrary, the contractual relation between a local lender and an entrepreneur is modeled as a principal agent relation where the local lender maximizes his own expected utility subject to the incentive compatibility constraint (arising from the nonobservability of effort) and a participation constraint (the entrepreneur may refuse the local lender's contract and get outside finance only). Local lenders are assumed to observe the entrepreneur's borrowing relations with outside parties. Hence, they can make their loan contract contingent on the entrepreneur's balance sheet position. A relevant feature of our model is that, despite this assumption, local lenders may find it in their own interest to allow entrepreneurs to borrow from multiple sources.

A competitive equilibrium in our economy is a set of contracts from local lenders, an interest rate on loans from intermediaries and an interest rate on deposits such that demand and supply of loanable funds are equalized. Nontrivial equilibria (i.e., equilibria where local lenders and intermediaries are both active) are shown to exist, by an appropriate convexification over local lenders' optimal contracts. These equilibria are characterized by two relevant conditions. Namely, the marginal product of capital is equal to the rate on loans offered by intermediaries and this cannot be lower than the repayment *per* unit of loan to a local lender.

When the costs of intermediation are sufficiently high, the repayment rate to a local lender may be strictly lower than the marginal product of capital, i.e., local lenders may be induced to offer credit at better conditions than intermediaries in order to increase the entrepreneur's effort (the probability of success of the project). It follows that entrepreneurs are rationed with respect to a loan offered by the local lender whereas they are not rationed with respect to a loan offered by intermediaries (whose repayment rate is equal to the marginal product of capital). This implies that entrepreneurs' effort is increasing in the share of total credit offered by local lenders.

Hence, in our model a higher amount of direct finance from a local lender may reduce the moral hazard problem. This result can be viewed as a version of a standard trade-off between the degrees of insurance and moral hazard. The more are local lenders insured against risk arising from direct investment, the less is the effort of the borrower in reducing risk implied by the contract.

From a general equilibrium perspective, the size of a local lender's direct loan to a nearby entrepreneur is a function of intermediation costs, since these costs are affecting the opportunity cost of direct lending ("risk premium"). It follows that a higher intermediation cost may increase the local lender's direct investment and raise the entrepreneur's effort to reduce the probability of default.

In other words, we have shown an instance in which a fall in intermediation costs, i.e., an increase in financial development (a rising share of intermediated funds) may go along with an increase in the risk of default.

One may ask if our results are mainly a byproduct of intermediaries' price taking behavior. As an alternative specification, intermediaries could be assumed to pick the loan rate so as to maximize entrepreneurs' payoff for a given opportunity cost of lending (Bertrand competition in the market for loans and price taking behavior on the deposit side). One can easily show that the competitive equilibria in this economy (when they exist) are competitive equilibria of the original economy. Hence, our results carry over to the case in which intermediaries have strategic behavior.

In the final section of the paper we discuss the policy implications of the model and show that the presence of a tax rate on intermediaries' profits may be beneficial when this implies a rise in the entrepreneurs' effort. The possibility of a rise in effort as a consequence of a tax on financial intermediation cannot be ruled out for the same reasons that explain the positive effect on effort of a rise in intermediation costs.

2 The Model

Agents and technologies. We consider a one good overlapping generations economy populated by three types of agents: local lenders, entrepreneurs (also called borrowers) and financial intermediaries. Local lenders and entrepreneurs are two-period lived and they are a continuum indexed by i and uniformly distributed over the unit interval.

One way to interpret our model is to assume that there is continuum of identical villages, indexed by i, each village being populated by one entrepreneur i and one local lender i.

Local lenders are endowed with an amount $w > 0$ of the consumption good in the first period of life, they only consume when old and they are risk averse. A local lender i faces two investment opportunities: deposits $d \geq 0$, yielding a safe gross return $\rho \geq 0$, and a loan $c = (b, z) \geq 0$ to entrepreneur i (the one operating in his own village).

Entrepreneurs are risk neutral, they have no physical endowment but they have the ability to run a given investment project. A project activated by an entrepreneur i is a technology transforming $k \geq 0$ units of the good in a given period into $\tilde{\theta} f(k) \geq 0$ units of the same good in the next period, where $\tilde{\theta}$ is a random variable. The technology is assumed to have the following properties.

Assumption 1 (Production) *The technology $f : \mathbb{R}_+ \to \mathbb{R}_+$ is bounded, smooth, strictly increasing and strictly concave, with boundary conditions:*

$$f(0) = 0, \qquad \lim_{k \to 0} f'(k) = \infty.$$

Assumption 2 (Risk) *The random variable $\tilde{\theta}$ is identically and independently distributed across entrepreneurs with support $\{0, 1\}$. The probability that $\tilde{\theta}$ equals 1 is denoted by p.*

We assume that the maximum loss that an entrepreneur can be forced to bear when he is unable to fulfill his contractual obligations cannot exceed the value of his assets. Since he has no assets when the project fails, all financial contracts are limited liability contracts such that the lender gets nothing when $\tilde{\theta} = 0$. In this case we say that the entrepreneur is bankrupt.

Intermediaries are a large, finite set. These are competitive firms collecting deposits from local lenders, on which a given, gross rate of interest $\rho \geq 0$ accrues, and offering non rationed credit to entrepreneurs at a given, gross rate of interest $r > 0$. Each intermediary can be active in many villages, a (Borel-measurable, possibly empty) subset of all villages. Since we assume that borrowers are all equal and the realizations of $\tilde{\theta}$ are i.i.d. across borrowers, the law of large numbers implies that the effective revenue to an intermediary *per* unit of loan is deterministic.

Information, monitoring and loan contracts. Entrepreneurs can simultaneously contract with many intermediaries and local lenders. The reason why these two sources of credit may coexist depend on how information is distributed in the economy.

We assume that the probability distribution of $\tilde{\theta}$ is common knowledge. However, the *ex post* realizations of this random variable for a project managed by entrepreneur i are private information of entrepreneur i and the associated local lender i.

If an agent (other than local lender i) has granted a loan contract to entrepreneur i, he is entitled to monitor the project at some cost (entirely paid by the lender). Monitoring allows this agent to perfectly observe the *ex-post* realizations of the entrepreneur's project.

For simplicity and without loss of generality, we assume that, if finance with monitoring is profitable, only intermediaries engage in this activity. In other words, we assume that local lenders delegate monitoring to intermediaries when they find it profitable to invest their funds outside their own village.

We do not allow for random monitoring strategies. Hence, intermediaries need to monitor all entrepreneurs who declare bankruptcy, for, otherwise, successful borrowers will have an incentive to lie. The monitoring cost is defined by the following assumption.

Assumption 3 (Monitoring costs) *Intermediaries can observe the* ex-post *realization of a project by paying $\gamma > 0$ units of the unique final commodity for every unit of loan.*

Since local lenders are assumed not to engage in monitoring, they will never invest directly in a project activated by an entrepreneur living in a different village and they are unable to diversify funds among projects unless they go through an intermediary, *i.e.*, unless they make a deposit (indirect investment).

To fix the ideas, we imagine that a contract offered by an intermediary is part of market, or formal, finance and all contracts offered by local lenders is part of non-market, or informal, finance.

The reason why local lenders may be induced to offer direct finance to an entrepreneur is that, because of intermediation costs, the rate on deposits may be too low. In other words, even if intermediaries are making zero profit in equilibrium, the price of the insurance that they are offering to local lenders by issuing deposits is not a fair price and local lenders are induced to insure themselves incompletely against the risk of investment activity.

Moral hazard and incentive compatibility. Let $a \geq 0$ be the size of the loan that a borrower takes from intermediaries at the gross rate of interest $r > 0$. A loan from a local lender is a pair $(b, z) \geq 0$, where b is the size of the loan and z is the size of the repayment, *i.e.*, the amount that the local lender receives from the borrower in the next period for this loan if the borrower is successful. Given $c = (a, b, z)$ and r, the revenue of a successful borrower is

$$f(a+b) - ra - z.$$

The relation between borrowers and lenders is affected by a moral hazard problem: the probability distribution of investment projects depends on a costly unobservable effort, $0 \leq e < 1$, provided by the entrepreneur.

Assumption 4 (Effort) *The probability p of a successful project equals the entrepreneur's effort, $0 \leq e < 1$, and this has a disutility measured by $v(e) = v(p)$. The disutility function $v : [0, 1) \to \mathbb{R}$ is smooth, strictly increasing and strictly convex, with boundary conditions*

$$v(0) = 0, \qquad \lim_{e \to 0} v'(e) = 0, \qquad \lim_{e \to 1} v'(e) > M,$$

where $M = \sup_{k \geq 0} f(k)$.

The expected payoff of a borrower getting credit at conditions (c, r) is

$$p(f(a+b) - ra - z) - v(p).$$

Once credit is accepted by the borrower, the optimal effort (probability) is given by a continuous function, $p(c, r)$, and is fully characterized by the first-order condition

$$v'(p(c, r)) \leq f(a+b) - ra - z, \tag{1}$$

with equality if $f(a+b) - ra - z > 0$.

We also define

$$\bar{p}(b, z, r) = \max_{a \geq 0} p(c, r),$$

which represents the optimal effort/probability at the market rate r when the borrower can adjust the demand of funds from intermediaries.

It is clear that the borrower's preferences on credit arrangements, (c, r), are represented by his supply of effort, $p(c, r)$. Therefore, incentive compatibility reduces to $p = p(c, r)$.

Local lenders' contracts. Local lenders act as principal with respect to borrowers and can enforce exclusive contracts. Their consumption across the two idiosyncratic states is denoted by $x = (x_g, x_b) \geq 0$. We assume that local lenders are risk-averse and their preferences are represented by a Bernoulli utility satisfying some standard hypotheses.

Assumption 5 (Local lenders' preferences) *The utility* $u : \mathbb{R}_+ \to \mathbb{R}$ *is smooth, smoothly increasing and smoothly strictly concave, with boundary (Inada's) condition* $\lim_{x\to 0} u(x) = \infty$*.*

A local lender i is not competing with any other local lender when offering a loan to entrepreneur i. He is assumed to choose this loan (b, z) so as to maximize his own expected utility for a given rate of interest $r > 0$ charged by intermediaries and a given safe rate on deposits $\rho \geq 0$. Since the local lender can observe the entrepreneur's balance sheet position, he can make loans contingent on the loan size a that the entrepreneur may get from intermediaries. Then, a local lender is effectively choosing the borrower's entire liability position and repayment (except for the market rate r). This choice is represented by the vector $c = (a, b, z)$ (henceforth called a "contract"), where a is an enforceable recommendation on the amount of funds obtained from intermediaries and (b, z) is the local lender's loan contract.

The local lender's problem reduces to

$$\max_{c\geq 0} pu(\rho(w-b)+z) + (1-p)\,u(\rho(w-b))$$

$$\text{subject to } p = p(c,r) \geq \bar{p}(0,r),$$

where the explicit (participation) constraint ensures that contract c is not refused by the entrepreneur, whereas incentive compatibility is embodied in our map $p(c,r)$. Given $r > 0$ and $\rho \geq 0$, the set of optimal contracts is denoted $C(r,\rho)$.

Since the local lenders' problem is non-convex, optimal contracts $C(r,\rho)$ need not form a convex set and the existence of an equilibrium in pure actions may fail. We, therefore, introduce probability measures π on contracts c, provided by local lenders. These can be interpreted either as a random choice of each local lender or as the distribution of determinist choices across villages. Without loss of generality, we restrict ourself to finitely supported probability measures.

Equilibrium contracts. The intermediary's expected profit on a single project is

$$Q(c,r,\rho) = (p(c,r)\,r - \rho - \gamma(1-p(c,r)))\,a,$$

with associated excess demand of deposits

$$Z(c) = a + b - w.$$

Averaging across villages, intermediary's profit is

$$Q(\pi, r, \rho) = \int Q(c, r, \rho)\, d\pi(c) = \sum_j Q(c_j, r, \rho)\, \pi_j,$$

with associated excess demand of deposits

$$Z(\pi) = \int Z(c)\, d\pi(c) = \sum_j Z(c_j)\, \pi_j.$$

This definition derives form the assumption that all borrowers must be monitored, for, otherwise, they will have an incentive to declare bankruptcy. Intermediaries pool infinitely risky projects and eliminate risk completely.

A *competitive equilibrium* consists of a safe rate of interest on deposits, $\rho^* \geq 0$, a rate of interest on loans, $r^* > 0$, and a (finitely supported) probability measure on local lenders' contracts, π^*, such that the following three properties are satisfied:

- local lenders' contracts are optimal, *i.e.*,

$$\text{support}(\pi^*) \subset C(r^*, \rho^*);$$

- intermediaries make zero profits, *i.e.*,

$$Q(\pi^*, r^*, \rho^*) = 0;$$

- markets clear, *i.e.*,

$$Z(\pi^*) = 0.$$

Intermediaries can be regarded as short-term firms endowed with a constant return-to-scale technology which transforms deposits $d \geq 0$ in a given period into $prd - (1-p)\gamma d$ units of commodity in the following period. Two technological parameters, however, embodies the external effect of local lenders and borrowers and are endogenously determined.

3 Optimal Contracts

Given $r > 0$ and $\rho > 0$, optimal local lenders' contracts exist. However, since moral hazard induces a non-linear dependence of local lenders' expected utility on probability, we cannot exclude multiple optimal choices.

Proposition 1 (Optimal contracts) *For every $r > 0$ and $\rho \geq 0$, optimal contracts exist. Moreover, (a) two distinct optimal contracts involve distinct supplies of effort and, so, associated probabilities; (b) if $c \in C(r, \rho)$, then $p(c, r) = \bar{p}(b, z, r)$; (c) if $\bar{p}(0, r)\, r > \rho$ and $c \in C(r, \rho)$, then $w > b > 0$. Finally, the optimal contracts correspondence C is upper hemicontinuous with compact values.*

Proof. Since production is bounded and $r > 0$, we can truncate the space of choices for a local lender without affecting the optimality of his choice. Namely, let

$$T = \{c \geq 0 : 0 \leq b \leq w, 0 \leq z \leq M\},$$

where $M = \sup_{a \geq 0} f(a)$. The participation constraint defines a continuous correspondence $g : R \times S \mapsto T$ with non-empty, compact and convex values, where $R = \{r \in \mathbb{R} : r > 0\}$ and $S = \{\rho \in \mathbb{R} : \rho \geq 0\}$. Berge's Maximum Theorem then implies non-emptiness and upper hemicontinuity of optimal choices jointly in (r, ρ).

(a) If two distinct solutions are optimal given $r > 0$ and $\rho \geq 0$ and involve the same probability, then its proper convex combination satisfies the participation constraint and makes the local lender strictly better off since the probability does not decrease.

(b) If $z > 0$ and $p(c, r) < \bar{p}(b, z, r)$, then the local lender would be able to increase the probability without altering his consumption across the two idiosyncratic states, which makes him strictly better off. If $z = 0$, it is clear that $b = 0$ and the result follows.

(c) If not, then $(b, z) = 0$ and a is uniquely determined by the condition $p(0, a, r) = \bar{p}(0, r)$. Then just evaluate the derivative of expected utility along the direction $\lambda(1, r, -1)$. **Q.E.D.**

Remark 1 (Non-exclusivity) Suppose that we remove the assumption that the local lender is able to make his loans contingent on a, because the borrower's balance sheet position is not entirely observable (non-exclusive contracts). In this case, the local lenders' problem is

$$\max_{(b,z)\geq 0} pu\left(\rho\left(w-b\right)+z\right)+\left(1-p\right)u\left(\rho\left(w-b\right)\right)$$

$$\text{subject to } p=\bar{p}\left(b,z,r\right)\geq\bar{p}\left(0,r\right),$$

This amounts to letting a borrower negotiate the loan with an intermediary and with a local lender independently. It is, however, clear that this modification of the problem would not alter our analysis in any meaningful way. Notice that, when a borrower is indifferent between contracting with a local lender or with an intermediary, we implicitly assume that the indeterminacy is solved in favor of the local lender.

Optimal contracts can be characterized using first-order conditions. It is clear that a is optimal only if $p=p\left(c,r\right)=\bar{p}\left(b,z,r\right)$, which amounts to require

$$f'\left(a+b\right)-r\leq 0, \tag{2}$$

with the equality if $a>0$. Thus, borrowers are never rationed by intermediaries. When $\bar{p}\left(0,r\right)r>\rho>0$, the contract c is designed by a local lender so as to satisfy two purposes, the optimal allocation of wealth between a risky and a safe activity and the creation of the incentive to the borrower.

Wealth is allocated according to

$$pu'\left(x_g\right)\left(r-\rho\right)=\left(1-p\right)u'\left(x_b\right)\rho, \tag{3}$$

where $x_g=\rho\left(w-b\right)+z$ and $x_b=\rho\left(w-b\right)$. Such a condition states that the marginal rate of substitution between bad and good state consumption equals the "fair" price of insurance, $\left(1-p\right)/p$, plus a measure of the spread between the marginal product of capital and the deposit rate, a risk premium. The local lender chooses a risky portfolio as long as the risk premium is positive (that is, $pr>\rho$).

A second first-order condition is

$$u\left(x_g\right)-u\left(x_b\right)\leq pu'\left(x_g\right)v''\left(p\right), \tag{4}$$

where equality holds if $p>\bar{p}\left(0,r\right)$. If the participation constraint is strict at an optimal contract, condition (4) states that the marginal benefit to the lender of an increase in the cost of borrowing, z, cannot fall short of its marginal cost, *i.e.*, the drop in the lender's expected utility due to a fall in the probability, p. This is called the "pecuniary externality" in the literature on moral hazard and it shows a possible trade-off between the degree of insurance and the extent of moral hazard in the lender's choice problem (more insurance implies a smaller gap between x_g and x_b and a smaller value of p by equation (4)).

Local lenders' optimal contracts are of two types, which we define as binding and non-binding. The first type satisfies the participation constraint $p \geq \bar{p}(0, r)$ with equality and condition (4) with inequality, the second type satisfies condition (4) with equality.

We can give the following characterization of a binding contract $c \gg 0$. Let $\hat{a}(r) = \arg\max_{a \geq 0} (f(a) - ra)$. Since, by Proposition 1, $p(c, r) = \bar{p}(b, z, r)$, a binding contract c satisfies:

$$f(a+b) - ra - z = f(\hat{a}(r)) - r\hat{a}(r), \qquad f'(a+b) = r = f'(\hat{a}(r)).$$

From the above we get $z = rb$. Then, an optimal binding contract $c \gg 0$ is a vector $(\hat{a}(r) - b, b, rb) \in C(r, \rho)$.

For analytical tractability, we find it useful to decompose local lenders' problem into two parts. Define $P(r)$ as the set of probabilities p such that, for some choice of c, participation and non-negativity constraints on consumption are satisfied. Given some $p \in P(r)$, let $C_p(r, \rho)$ denote the optimal choices of b, z and a. It follows that

$$c \in C(r, \rho) \Rightarrow c = C_{p(c,r)}(r, \rho).$$

Interestingly, $C_p(r, \rho)$ is a single-valued map and we can use $b_p(r, \rho)$ and $z_p(r, \rho)$ to denote such unique optimal choices. Letting

$$s(p, r) = v'(p) - \max_{a \geq 0} (f(a) - ra),$$

the repayment $z_p(r, \rho)$ is uniquely determined by the loan size $b_p(r, \rho)$ through the condition

$$z_p(r, \rho) = rb - s(p, r).$$

A contract $c_p \in C_p(r, \rho)$ satisfies the first order conditions (2) and (3) and the above equality. By strict convexity of the expected utility for given p, $b_p(r, \rho)$ is increasing in p.

Since $s(p, r) = 0$ when $p = \bar{p}(0, r)$, a binding contract $c \in C(r, \rho)$ is such that

$$z = rb_{\bar{p}(0,r)}(r, \rho)$$

and, since $b_p(r, \rho)$ is increasing in p, any non-binding contract $c \in C(r, \rho)$ has

$$b \geq b_{\bar{p}(0,r)}(r, \rho).$$

In words, the local lender would have a clear benefit from the expansion of his credit if this inequality were not satisfied.

Finally, if inequality (4) is not satisfied at $b_{\bar{p}(0,r)}(r,\rho)$, all optimal contracts must be non-binding. It is clear that robust examples of non-binding contracts can be provided.

4 Existence of a Competitive Equilibrium

A simple consequence of our definition of an equilibrium is that the rate on loans, $r^* > 0$, charged by intermediaries coincides with the marginal product of the aggregate investment, $w > 0$, in the risky project, unless intermediaries remain inactive.

Proposition 2 (Characterization) *Suppose that* (r^*, ρ^*, π^*) *is a competitive equilibrium. Then* $r^* \geq f'(w)$ *and* $\rho^*(r^* - f'(w)) = 0$.

Proof. Assume that $\rho^* > 0$. It follows that, for all $c^* \in C(r^*, \rho^*)$, $w - b^* > 0$. If $r^* < f'(w)$ $(r^* > f'(w))$, then $Z(c^*) > 0$ $(Z(c^*) < 0)$ for all $c^* \in C(r^*, \rho^*)$, violating market clearing. Therefore, $r^* = f'(w)$.

Assume that $\rho^* = 0$. It follows that, for all $c^* \in C(r^*, \rho^*)$, $w - b^* = 0$. If $r^* < f'(w)$, then $Z(c^*) > 0$ for all $c^* \in C(r^*, \rho^*)$, violating market clearing. Therefore, $r^* \geq f'(w)$. **Q.E.D.**

Competitive equilibria trivially exist when $\rho^* = 0$, since we allow for inactive intermediaries. However, since random choices and the continuum of local lenders restore convexity, competitive equilibria exist even with intermediation ($\rho^* > 0$) when monitoring costs are not extremely high.

Proposition 3 (Existence) *A competitive equilibrium exists. Moreover, if monitoring costs* $\gamma > 0$ *are low enough, then there is a competitive equilibrium with intermediation (that is, with* $\rho^* > 0$*).*

Proof. The first statement is straightforward. Set $\rho^* = 0$. Suppose that there are no intermediaries and local lenders are the only source of credit for borrowers. Take any optimal contract c^* for local lenders in this modified problem and choose r^* high enough so as to make non profitable for borrowers to demand loans at the rate r^* when c^* is available (this amounts to choose r^* so as to satisfy $f'(b^*) \leq r^*$ and $z^* \leq r^* b^*$).

Concerning the second statement, set $r^* = f'(w)$, which ensures market clearing, and consider the correspondence

$$g(\rho) = p(C(r^*, \rho), r^*)(r^* + \gamma) - \rho - \gamma,$$

which is well defined on S. This is an upper hemicontinuous correspondence with non-empty, compact values. In addition, $\min g(0) > 0$ (if monitoring cost are low enough) and $\min g(\rho) < 0$ for some large enough $\rho > 0$. Let

$$S_+ = \{\rho \in S : \max g(\rho) \geq 0\},$$
$$S_- = \{\rho \in S : \min g(\rho) \leq 0\}.$$

If $S_+ \cap S_- = \emptyset$, then we have a non-trivial partition of S into two non-empty, closed sets (these sets are closed by the upper hemicontinuity of g), which is a contradiction since S is connected. It is then easy to show that profits can be made zero in correspondence of any $\rho^* \in S_+ \cap S_-$ by choosing a probability measure π^* over two contracts, c_1^* and c_2^*, selected from $C(r^*, \rho^*)$ so as to give $Q(c_1^*, r^*, \rho^*) \geq 0$ and $Q(c_1^*, r^*, \rho^*) \leq 0$, respectively. **Q.E.D.**

Notice that a competitive equilibrium with intermediation may well involve only binding contracts for local lenders. In such a case, indeed, credit from local lenders and intermediaries are prefect substitute for a borrower. The interesting case is, however, that of a competitive equilibrium with intermediation in which local lenders provide funds to borrowers which, though rationed in size, bear a more favorable implicit rate of interest, that is, local lenders' equilibrium contracts are non-binding.

5 Comparative Statics

We now explore the effect of a varying value of the intermediation cost, $\gamma > 0$, on the equilibrium probability of a successful investment project. In particular, we aim at pointing out that a decrease in monitoring costs may raise the average probability of successful projects.

As the rate of interest on loans, r, equals the marginal product on investment, $f'(w)$, at every equilibrium with intermediation, we omit it from notation whenever this does not create any ambiguity. A simple equilibrium with intermediation is an equilibrium with intermediation achieved at a unique local lenders' optimal contract. This equilibrium is said to be smooth if there is a smooth selection of local lenders' optimal contracts correspondence around the given equilibrium point (that is, there is a smooth map $c(\rho) \in C(\rho)$ on a neighborhood of ρ^*).

Around a simple, smooth equilibrium with intermediation, (c^*, ρ^*, p^*) of an economy with $\gamma = \gamma^*$, the equilibrium effect of a change in γ can be carried out simply considering the zero-profit equation,

$$\phi(\rho)(r^* + \gamma) - \rho - \gamma = 0,$$

where $\phi(\rho) = p\,(c(\rho))$. Indeed, under the regularity condition

$$(r^* + \gamma^*)\phi'(\rho^*) \neq 1, \tag{5}$$

the implicit function theorem implies that equilibria with intermediation are locally given as a smooth function of γ near γ^*. Comparative statics then reduces to the following observation (also exemplified in Figure 1).

Proposition 4 (Comparative statics) *If, at a simple, smooth equilibrium with intermediation* $\phi'(\rho^*) < 0$ *(that is, the success probability associated to (selected) optimal contracts is locally decreasing in* ρ*), then this probability is locally increasing in monitoring costs in equilibrium.*

The result is a consequence of the trade-off faced by local lenders between insurance and incentive to borrowers. If local lenders reduce the incentive to borrowers when facing higher returns on the safe asset, then higher monitoring costs require a lower rate of interest on deposits in order to restore equilibrium.

One can be more specific about the circumstances in which a rise in γ may imply a rise in the equilibrium success probability. Namely, recall the definition of $b_p\,(r, \rho)$ as the local lender's optimal portfolio allocation when probability p is fixed and repayment z is incentive compatible (cf. section 3) and let $M_j = -u''(x_j)/u'(x_j)$ be the Arrow-Pratt degree of risk aversion at j-state consumption. In Appendix 1 we show that the condition stated in Proposition 4 can be written as

$$(r^* - \rho^*)\left[\frac{1}{1-p^*} + p^* v'' M_g\right]\frac{\partial b_p}{\partial \rho} - (w - b^*)\frac{p^* r^* - \rho^*}{(1-p^*)\rho^*} < 0.$$

It follows that a sufficient condition for the equilibrium success probability to be locally decreasing in intermediation costs is that the local lender's risky investment for given probability p, $b_p(r, \rho)$, is decreasing in the safe return ρ. Notice that

$$\frac{\partial b_p}{\partial \rho} = \frac{(M_b - M_g)(r-\rho)(w-b) - pr/\rho}{(r-\rho)((r-\rho)M_g + \rho M_b)}.$$

Hence, the condition is always satisfied when the absolute degree of risk aversion is constant.

In Figure 2 we show a computation of the local lender's expected utility as a function of p for an incentive compatible contract satisfying the optimal portfolio condition (3). Utility is assumed to be CRRA with $\alpha = 1/2$ and

ρ is fixed at the equilibrium level $p(\gamma)r^* - (1 - p(\gamma))\gamma$. In the computation we evaluate the maximum expected utility levels for two different values of γ. One can see that this maximum is a unique $p(\gamma) > p(w)$ for both values of γ and that $p(\gamma)$ is increasing in γ.

The computation shows that, for this particular case, a rise in γ cannot be a Pareto improvement. In fact, whereas the entrepreneur's payoff must be increasing with γ (recall that this payoff is increasing in p), the local lender's expected utility level falls when γ goes up.

Remark 2 (Strategic intermediaries) One may argue that the comparative statics result shown above could be an artifact of the price taking assumption, *i.e.*, the assumption that intermediaries are unable to set the loan rate strategically. We argue that, if we assume that intermediaries are Bertrand competitors in the market for loans (and price takers with respect to the deposit rate ρ) then the comparative statics of the model in equilibrium does not change. However, proving the existence of an equilibrium in the new setting could be problematic.

To be more precise, assume that a intermediaries set the rate r so as to maximize the entrepreneur's expected payoff subject to the participation and incentive compatibility constraint for given contract c offered by a local lender. This way of setting r is a consequence of assuming that intermediaries are Bertrand competing with each other. Since intermediaries are uniformed about the borrowing relations that an entrepreneur may have with other parties, they cannot make their are unable to ration credit.

Then, a simple equilibrium for this model satisfies all the equilibrium conditions characterizing a simple equilibrium of the previous model plus some additional constraints (a set of conditions preventing intermediaries to have profitable deviations). In other words, if there is a deterministic equilibrium for the model with strategic intermediaries, this is also an equilibrium for the model where intermediaries are price taking and the comparative statics result of the two models are equivalent.

Remark 3 (CRRA Utility Functions) Assume that the local lender's utility u has a constant relative risk aversion α, *i.e.*,

$$u(x) = \begin{cases} x^{1-\alpha}/(1-\alpha) & \text{if} \quad \alpha \neq 1 \\ \log x & \text{if} \quad \alpha = 1. \end{cases}$$

In Appendix 2, we show that there exists a value $p^M > 0$ and $\gamma(w) > 0$ such that, when the following two conditions are verified

$$\bar{p}\left(0, f'(w)\right) < p^M, \qquad \gamma > \gamma(w),$$

any simple equilibrium of a CRRA economy with $\alpha \leq 1$ and $\gamma > \gamma(w)$ must be such that the success probability $p(\gamma)$ is increasing in γ.

6 Welfare Effects and Taxation

Since the equilibrium success probability is increasing in the entrepreneurs' expected payoff (expected profit minus disutility of effort), a rise in intermediation costs is always beneficial for entrepreneurs' welfare whenever this cost has a positive effect on p. This may not be a Pareto improvement, since a rise in γ may produce a fall in the equilibrium deposit rate ρ and this fall always has a negative effect on local lenders' expected utility.[1]

In order to have a Pareto improvement from a rise in γ, it is sufficient to show examples in which p is increasing and ρ is non decreasing in γ at equilibrium. In general, we cannot rule out this possibility, since a rise in γ has two opposite effect on ρ, a direct and an indirect effect. Let $p(\gamma)$ be the equilibrium probability of success in a simple, smooth equilibrium with intermediation and recall the zero profit equation

$$\rho = p\,(r + \gamma) - \gamma.$$

The direct effect of a rise of γ on ρ is negative and measured by $(p\,(\gamma) - 1)$ (the effect for given equilibrium probability), the indirect effect is positive and measured by $(r + \gamma)\,\partial p/\partial \gamma$. Hence, a Pareto improving rise of γ can only arise if the effect of γ on p is strong enough, *i.e.*, $\partial p/\partial \gamma\,(r + \gamma) > (1 - p)$.

A potential role for taxation emerges when monitoring costs are positive. Assume that the government has no superior information with respect to financial intermediaries. Hence, it does not observe the *ex-post* realizations of investment returns (with no monitoring), the entrepreneurs' effort and their contractual relations with local lenders.

Let $0 \leq \tau < 1$ be a proportional tax on the real rate on deposits earned by the local lenders and $T \geq 0$ a lump sum subsidy. Denoting ρ the net rate of interest on deposits, the local lender's problem becomes

$$\max_{c \geq 0} pu\,(\rho\,(w - b) + z + T) + (1 - p)\,u\,(\rho\,(w - b) + T)$$

$$\text{subject to } p = p\,(c, r) \geq \bar{p}\,(0, r)\,.$$

The set of optimal contracts is (locally) denoted $c\,(\rho, T)$. A competitive simple, smooth equilibrium requires the additional restriction of a balanced

[1] This is obvious since a lower ρ reduces local lenders' expected utility, while it does not modify the set of contracts satisfying the participation constraint.

tax policy, that is,

$$T-\left(\frac{\tau}{1-\tau}\right)\rho a=0.$$

We carry out a comparative statics exercise moving from a smooth equilibrium with non-binding contracts (and, obviously, $\gamma>0$).

The equilibrium effect of an increase in the tax rate τ on local lenders' expected utility at $\tau=0$ can be written as

$$\left(pu_g'+(1-p)\,u_b'\right)\frac{\partial p}{\partial\tau}\,(r+\gamma)\,a,$$

where all variables are evaluated at equilibrium values. Hence, the imposition of a small tax rate on the safe rate of return along with a balanced budget transfer to local lenders implies a Pareto improvement whenever this implies a rise in the equilibrium probability of success.

Locally, equilibria are a smooth function of the policy parameter τ which satisfies the following system of equations

$$\begin{aligned}\phi(\rho,T)\,(r+\gamma)-\frac{\rho}{(1-\tau)}-\gamma &= 0,\\ T-\left(\frac{\tau}{1-\tau}\right)\rho a(\rho,T) &= 0,\end{aligned}$$

where $\phi(\rho,T)=p(c(\rho,T))$. Differentiating, we obtain

$$\frac{\partial\rho}{\partial\tau}=\left(1-\phi_\rho\,(r+\gamma)\right)^{-1}\left[(r+\gamma)\,\phi_T\rho a-\rho\right].$$

Since

$$\frac{\partial p}{\partial\tau}=\phi_\rho\frac{\partial\rho}{\partial\tau}+\phi_T\rho a,$$

we have

$$\frac{\partial p}{\partial\tau}=-\phi_\rho\left(1-\phi_\rho\,(r+\gamma)\right)^{-1}\rho+\left(1+\frac{\phi_\rho\,(r+\gamma)}{1-\phi_\rho\,(r+\gamma)}\right)\phi_T\rho a.$$

It follows that $\partial p/\partial\rho<0$ and $\phi_T\geq 0$ jointly imply $\partial p/\partial\tau>0$.

One can be more explicit about conditions implying a welfare improving policy. This amounts to verifying whether the optimal probability chosen by local lenders is locally non-decreasing in the subsidy.

Define:

$$A=(r-\rho)\left[\frac{1}{1-p}+pv''M_g\right],\qquad H=(r-\rho)M_g+\rho M_b.$$

Then, $\phi_\rho < 0$ and $\phi_T \geq 0$ are respectively implied by the conditions:

$$A\frac{\partial b_p}{\partial \rho} < \quad (w-b)\left(pr-\rho\right)/(1-p)\rho, \tag{6}$$

$$A\frac{\partial b_p}{\partial T} + pv''M_g \geq \quad \left(pr-\rho\right)/(1-p)\rho, \tag{7}$$

where:

$$\frac{\partial b_p}{\partial \rho} = \frac{1}{H}\left[(w-b)(M_b-M_g) - \frac{pr}{(r-\rho)\rho}\right], \qquad \frac{\partial b_p}{\partial \rho} = \frac{1}{H}\left(M_b-M_g\right).$$

It follows that the effect of a rise in τ is always Pareto improving with constant and sufficiently high absolute risk aversion, i.e.:

$$pv''M \geq \frac{pr-\rho}{(1-p)\rho}.$$

7 Conclusion

We have considered an economy where entrepreneurs can simultaneously get loan contracts from two type of lenders, financial intermediaries and local lenders. The former have a comparative advantage in the diversification of risks and the latter have superior information on a local entrepreneur. This superior information allows local lenders to save on intermediation costs and act as monopolists with respect to the local entrepreneur. However, local lenders' inability to diversify, make them exposed to excessive risk taking. Within this environment we have shown that an increase in the costs of intermediation may induce entrepreneurs to choose safer projects, through a moral hazard mechanism in the relation between borrowers and lenders. This effect comes about because a higher cost of intermediation implies a fall of intermediaries' finance and an increase in the amount of direct lending from local lenders who are able to offer credit at cheaper conditions.

A remarkable feature of the model is that our result holds despite the fact that intermediaries are choosing contracts so as to maximize entrepreneurs' profits, i.e., so as to maximize the probability of success of investment projects (the increasing relation between this probability and the entrepreneurs' profits is a consequence of moral hazard), whereas local lenders are choosing contracts so as to maximize their own expected utility. In addition, our result is of a general equilibrium type and any increase in the costs of intermediation translates into a fall in the rate of return on the safe asset of local lenders' portfolio, i,e., a rise in the spread between risky and safe asset returns. In fact, one could interpret our result as a consequence of a standard trade-off between moral hazard and insurance

Our assumptions about the characteristics of local lenders and intermediaries try to mimic the basic features of an economy where financial market imperfections and an underdeveloped legal system allow for the co-existence of market and non-market finance. The former is represented by a set of competitive intermediaries engaged in risk diversification and operating economy-wide. The latter is represented by a very large set of local moneylenders. An immediate prediction of our model is that there may be specific environments where taxing the rates of return offered in the market by intermediaries may be beneficial.

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Appendix 1

Assume that (c^*, ρ^*) is a simple, smooth equilibrium such that $\bar{p}(b^*, z^*, r^*) > \bar{p}(0, r^*)$ for some $\gamma = \gamma^o$ (the optimal contract is interior). Then, c^* satisfies the first order conditions defined by equations (3) and (4).

In section 3 we defined $b_p(r, \rho)$ as the optimal portfolio allocation that the local lender would choose for given p and (r, ρ). Now let:

$$x_g(p, \rho) = (r - \rho)b_p(r, \rho) + \rho w - s(p, r), \qquad x_b(p, \rho) = \rho(w - b_p(r, \rho)).$$

The loan $(b_p(r, \rho), rb_p(r, \rho) - s(p, r))$ is optimal and interior if it satisfies the remaining first order condition (4) with equality, i.e.:

$$u(x_g(p, \rho)) - u(x_b(p, \rho)) - v''(p)pu'(x_g(p, \rho)) \equiv \Phi(p, \rho) = 0,$$

The above equation is satisfied in the equilibrium (c^*, ρ^*) by assumption. By the assumption that this equilibrium is simple and smooth and by the second order conditions for optimality, we can also claim that $\Phi_p < 0$ evaluated at equilibrium values. Finally, by the implicit function theorem, the success probability defined by equation (5), $p(c(\rho))$, is a differentiable function of ρ, $\phi(\rho)$, near ρ^*. This function is such that:

$$g'(\rho) = -\Phi_\rho / \Phi_p$$

for all ρ in a neighborhood of ρ^*. Now consider the zero profit condition:

$$\phi(\rho)(r^* + \gamma) - (\rho + \gamma) = 0.$$

We know that this equation has a solution (ρ^*, γ^o). Then, the regularity condition (5) evaluated at γ^o can be written as:

$$(r^* + \gamma^o)\Phi_\rho(\phi(\rho^*), \rho^*) + \Phi_p(\phi(\rho^*), \rho^*) \neq 0.$$

By the implicit function theorem there exists a neighborhood U of γ^o where a differentiable function $\rho(\gamma)$ is defined such that:

$$\rho^* = \rho(\gamma^o), \qquad (c(\gamma), \rho(\gamma)),$$

is a simple equilibrium and:

$$\rho'(\gamma) = -\frac{(1-p)\Phi_p}{(r+\gamma)\Phi_\rho + \Phi_p}, \qquad \frac{\partial \phi(\rho)}{\partial \gamma} = -\frac{(1-p)\Phi_\rho}{(r+\gamma)\Phi_\rho + \Phi_p},$$

for all $\gamma \in U$.

Hence, the equilibrium probability of success is locally decreasing in monitoring costs if $\Phi_\rho(p(\rho), \rho) < 0$ for $\gamma \in U$.

An evaluation of these derivatives show that:

$$\Phi_\rho = (r-\rho)\left[\frac{1}{1-p} + pv''(p)M_g\right]\frac{\partial b_p}{\partial \rho} - (w-b)\frac{pr-\rho}{(1-p)\rho},$$

$$\frac{\partial b_p}{\partial \rho} = \frac{(M_b - M_g)(r-\rho)(w-b) - pr/\rho}{(r-\rho)((r-\rho)M_g + \rho M_b)}.$$

Appendix 2

To simplify the notation, set $\bar{p}(0, r^*) = p(w)$ and assume $p(w)r^* > \rho$, where, we recall, $r^* = f'(w)$. This assumption is always satisfied in any equilibrium with intermediation.

Finally, define $p^M > 0$ as the (unique) solution to the following equation:

$$f'(w) = v'(p^M) + (1-\alpha)pv''(p^M),$$

and, for $p < p^M$, let:

$$\rho(p) = \frac{pr^*}{p + (1-p)h(p)},$$

where:

$$h(p) = \begin{cases} \left(1 + \frac{(1-\alpha)v''(p)}{f(w) - v'(p) - (1-\alpha)pv''(p)}\right)^{\alpha/1-\alpha} & \text{if} \quad \alpha \neq 1 \\ \exp\{v''(p)/\left(f(w) - v'(p)\right)\} & \text{if} \quad \alpha = 1 \end{cases}$$

Then, we can make the following claims.

Claim 1 *When $p(w)r^* > \rho$, an optimal contract $c \in C(\rho)$ is such that:*

- *$\bar{p}(b, z, r^*) = p(w)$ implies $\rho \geq \rho(p(w))$ and $p(w) \geq p^M$ or $p(w) < p^M$;*
- *$p(c) > p(w)$ implies $\rho = \rho(p(\rho))$.*

Claim 2 *Consider a simple equilibrium associated to some intermediation cost* $\gamma > 0$ *where* p^*_γ *is the equilibrium probability of success. Then* $p^*_\gamma = p(w)$ *implies that either* $p(w) \geq p^M$ *or* $p(w) < p^M$ *and:*

$$\gamma \leq \gamma(w) \equiv (h(p(w)) - 1)\rho(p(w)).$$

On the other hand, $p^*_\gamma > p(w)$ *implies* $p(w) < p^M$ *and* $\gamma > \gamma(w)$*. In addition, if there is a simple equilibrium where* $p^*_\gamma > p(w)$ *and* $\alpha \leq 1$*, we have:*

$$\partial p^*_\gamma / \partial \gamma > 0.$$

Proof. The proposition simply follows by using the intermediaries zero profit condition to set $\rho = pr^* - (1-p)\gamma$ in Claim 1. In particular, when the simple equilibrium admits $p^*_\gamma > p(w)$, Claim 1 implies:

$$\gamma = (h(p^*_\gamma) - 1)\rho(p^*_\gamma).$$

One can easily check that $\gamma'(p) > 0$ for all $p \in (0, p^M)$ and $\alpha \leq 1$. Then, $\gamma(p)$ has an inverse γ^{-1} in $(0, p^M)$. Now assume that there is a simple equilibrium with $p = p^*_{\gamma'}$ for some $\gamma' > \gamma(w)$. Then, there is a neighborhood of γ' such that $p^*_\gamma = \gamma^{-1}(\gamma)$ for all γ in this neighborhood and the proposition follows. **Q.E.D.**

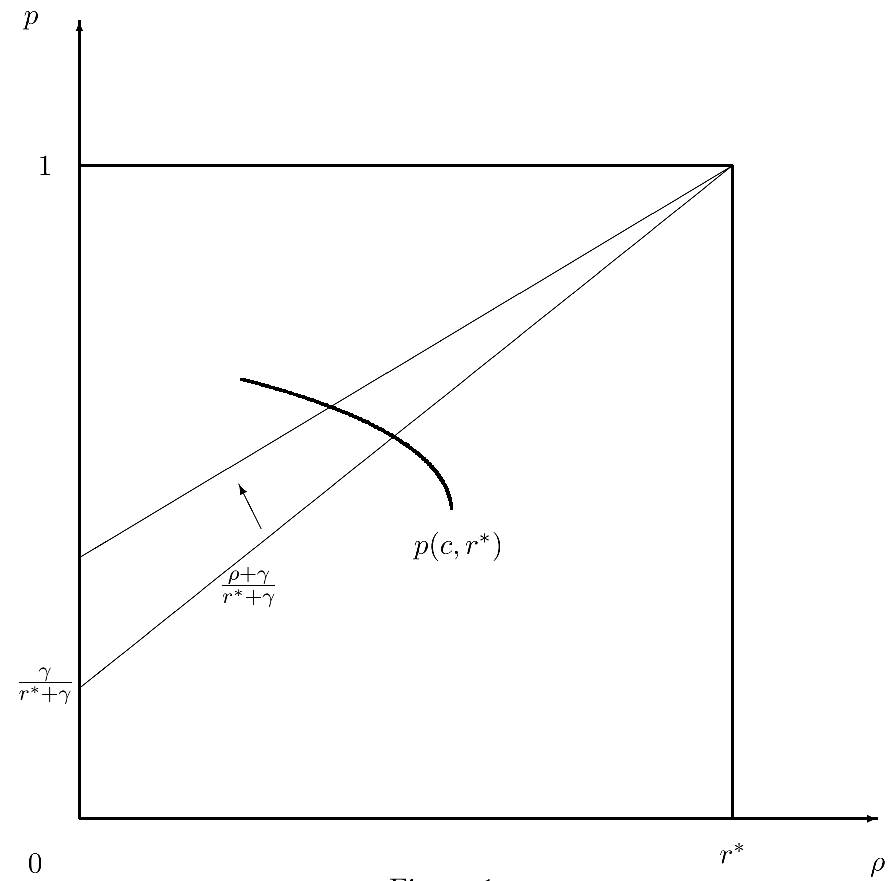
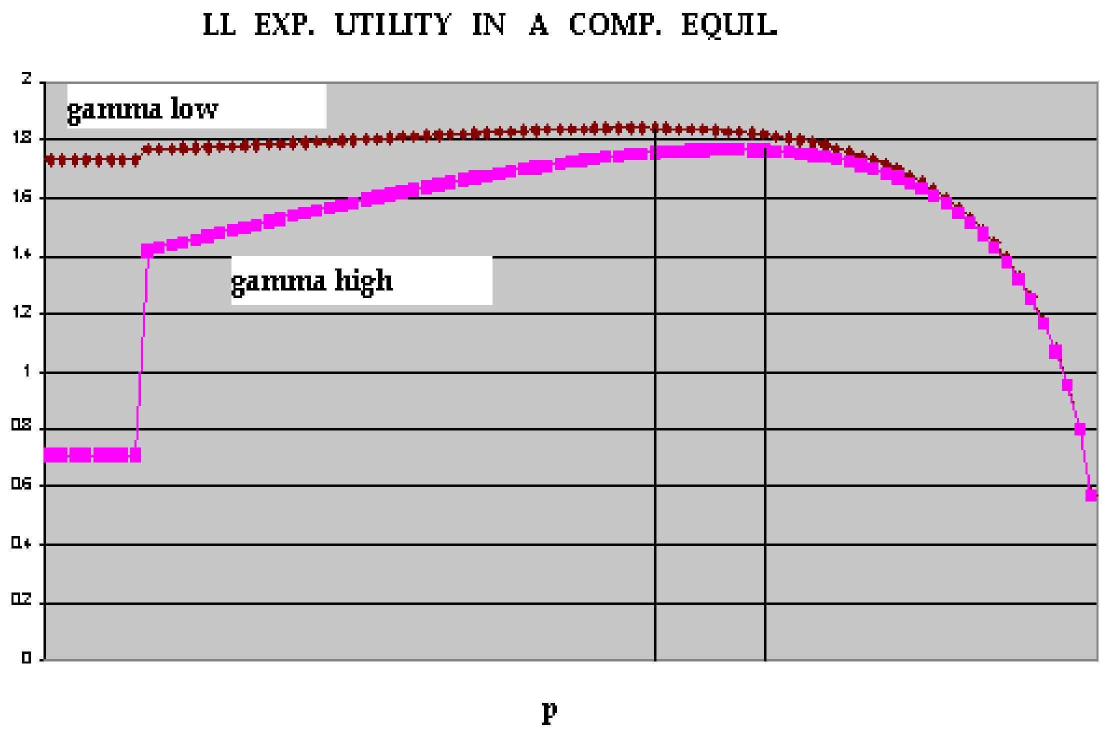


Figure 1



LL EXP. UTILITY IN A COMP. EQUIL.
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
gamma low
gamma high
p

Figure 2