

RISK AND INTERMEDIATION IN A DUAL FINANCIAL MARKET ECONOMY

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ABSTRACT. We study the competitive equilibria of a simple economy with moral hazard and intermediation costs. Entrepreneurs can simultaneously get credit from two types of competing institutions: ‘financial intermediaries’ and ‘local lenders’. The former are competitive firms issuing deposits and having a comparative advantage in diversifying credit risks. The latter are individuals with a comparative advantage in credit arrangements with a ‘nearby’ entrepreneur. Because of intermediation costs, local lenders are willing to diversify their portfolio by offering some direct lending to nearby entrepreneurs. 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. In these cases, taxing intermediaries may be welfare-improving. **JEL CLASSIFICATION NUMBERS.** A10, D80, G10, O17. **KEYWORDS.** Financial intermediation, moral hazard.

1. INTRODUCTION

Overview. It is often observed that firms or individuals borrow simultaneously from different sources. In some cases, agents may be able to sign loan contracts with more than one bank or hold multiple credit cards. In other cases, they may sign a loan contract with a bank and, then, issue bonds or raise additional funds from informal credit institutions (such as moneylenders, extended families *et cetera*). Evidence of these phenomena for small business in the United States is provided by Petersen and Rajan [25, 26] and, for less developed countries and informal credit markets, by Hoff and Stiglitz [16, 17].

The issue of simultaneous lending raises important questions concerning the nature and the efficiency of competitive allocations in financial markets. When loan contracts have some effects on the borrowers’ incentives (to exert effort or to default) and lenders

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cannot observe the borrowers' asset position, competition between lenders may generate non-internalized externalities (*e.g.*, Pauly [24], Helpman and Laffont [15], Bizer and DeMarzo [10], Arnott and Stiglitz [5], Kahn and Mookherjee [18]). These externalities may be responsible for a wide range of observed phenomena, from the LDC debt crises and the 'over-borrowing syndrome' (Kletzer [19], McKinnon and Pill [21]) to the high interest rates/excessive borrowing prevailing in some markets (Bizer and DeMarzo [10], Kahn and Mookherjee [18] and Parlour and Rajan [23]). The ability of lenders to monitor borrowers' trades and liabilities or to enforce contract exclusivity requires sophisticated institutions, the efficiency of the judicial system and centralized information (such as credit bureaus). These characteristics are typically missing in less developed countries and, as noted by Kahn and Mookherjee [18] and other authors, they may be missing in developed countries as well.

Most of the literature on this subject has analyzed environments where lenders are identical. In these cases, externalities can be eliminated by preventing the borrower to sign multiple contracts. However, lending institutions have different characteristics and they compete by specializing in different activities. In particular, a small local bank (or credit cooperative) may be better than a large intermediary at monitoring a borrower's behavior, whereas a large intermediary may be better at diversifying loans and raise deposits. Under these conditions, allowing agents to borrow simultaneously from different lending institutions could be an efficient outcome and characterizing the contractual arrangements by which externalities can be eliminated is harder than in more standard environment.

In this paper, we provide a model of a financial market with competing credit institutions which may either concentrate their activity in some local environment ('local lenders') or operate in the global market ('financial intermediaries'). The differentiation between these institutions is based on the idea that, while local lenders, by specializing with a subset of borrowers, can save on intermediation costs (which may arise from bookkeeping, enforcement, monitoring or transportation), financial intermediaries take advantage from credit diversification. More specifically, our economy consists of a large set of 'villages' (or 'countries'), each of them populated by an entrepreneur (local borrower), who operates an investment project with stochastic returns, and a risk averse agent (local lender) endowed with some amount of a unique consumption good. Allocations are subject to two types of imperfections. First, there is a moral hazard problem, *i.e.*, entrepreneurs can affect the probability distribution of investment returns by making a non-observable effort. Second, trading arrangements between lenders and borrowers are costly to establish outside local environments. These intermediation costs are assumed to be insignificant only when trading involves 'nearby' local borrowers and lenders (*i.e.*, a local borrower and a local lender in the same village). Hence, local lenders

avoid intermediation costs by specializing in a single contractual arrangement, but they are subject to a risk of default. By operating on large numbers, financial intermediaries are able to completely diversify their credit risks and they offer their liabilities as a safe asset (deposits) to local lenders as a way of insurance.

The model is liable to at least two different, though related, interpretations. Namely, local lenders (financial intermediaries) may be viewed as informal (formal) lending institutions. Alternatively, our model may describe a very simple multi-country economy with large international financial intermediaries interacting with national lending institutions.

The coexistence of formal and informal financial arrangements is a key issue in development economics and a well documented phenomenon in developing countries, where the informal sector includes credit cooperatives and associations, moneylenders and extended families (see Arnott and Stiglitz [4], Stiglitz [29], Besley and Coate [8], Banerjee, Besley and Guinnane [7]). However, local lenders can also be interpreted as small local banks and credit cooperatives, which play an important role in many industrialized economies. If interpreted as a multi-country economy, our model can be related to the growing literature on international financial integration and economic development (see Kletzer [19], McKinnon and Pill [21], Dooley [11], Hellmann, Murdock and Stiglitz [14], Aizenman [1]).

The way we model the behavior of local lenders and intermediaries is admittedly too simple to capture the reality of financial markets under the above interpretations. For instance, as far as the formal/informal market interpretation is concerned, we sidestep some of the interesting features characterizing non-market finance, such as long-term interaction and peer monitoring.¹ However, the simplicity of the model is motivated by the attempt to analyze the general equilibrium implications of having competing heterogeneous financial institutions. This is an important step if we want to study a variety of issues related to the impact of financial development on growth and the effects of taxation policies on production and welfare.

Results. In our economy, financial intermediaries are price takers, supply loans to local borrowers imposing no quantity constraints and collect demand deposits from local lenders. Local lenders act as principals with respect to the nearby entrepreneur by providing exclusive loan contracts. A competitive equilibrium 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.*,

¹Informal financial exchanges are mostly viewed as arising from a comparative advantage, within small and fragmented local environments characterized by repeated interactions, in monitoring borrowers, enforcing contracts and collecting information (see Banerjee, Besley and Guinnane [7] for a clear definition of these terms).

equilibria where local lenders and intermediaries are both active) are shown to exist, by exploiting large numbers because of the usual lack of convexity due to moral hazard.

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 entrepreneurs' effort (the probability of success of the project). It follows that entrepreneurs' effort is increasing in the share of total credit offered by local lenders. Hence, a higher amount of direct finance from a local lender may reduce the moral hazard problem. Depending on the different interpretations of the model, this result shows that *non-market finance* or *local financial markets* should play a larger role than they play in a competitive environment. By the same token, entrepreneurs may end up borrowing too much from *formal* or *international* financial intermediaries.

This can be viewed as a version of a standard trade-off between the degrees of insurance and moral hazard, although this trade-off arises from agents' interactions in a general equilibrium, instead of arising from the individual decision problem. 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, by reducing the equilibrium deposit rate, 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.

Inefficiency of competitive equilibria arises since, when local lenders evaluate the benefit of a higher effort, they ignore the favorable consequences of this action on the revenue of intermediaries, which could produce a higher safe rate. In the final section of the paper, we discuss the policy implications of the model. Taxing financial intermediaries may induce a higher entrepreneur's effort for the same reasons why effort may increase with a rise in intermediation costs. Since the borrowers' incentive compatible utility is increasing in effort, this tax policy is Pareto improving whenever it has a non-negative effect on local lenders' utility. By collecting taxes where projects have been successful and redistributing the total revenue back to local lenders irrespective of projects outcome, the policy maker can compensate local lenders and produce a welfare improvement.

2. FUNDAMENTALS

We consider a simple two-period, one-commodity economy with production. There is a continuum of (uniformly distributed) identical villages, $I = [0, 1]$, and every village is populated by one (local) lender and one (local) entrepreneur (or borrower). Production takes place in every village subject to an idiosyncratic technological shock: a village can be in a good (successful) state, g , or in a bad (unsuccessful) state, b . Consumption only occurs after uncertainty is revealed.

Entrepreneurs (or borrowers) are risk neutral and have no endowment. They have, however, access to a standard production technology with risky returns: if $k \geq 0$ is investment, the outcome is $f(k)$ in the successful state and zero in the unsuccessful state. The probability of occurrence of the good state, p , depends upon an *unobservable* effort, $e \geq 0$, supplied by the entrepreneur, that is, $p = p(e)$. The effort is costly for entrepreneurs and is measured by a disutility function, v .²

Assumption 1 (Local Borrowers). *The disutility function of effort, $v : \mathbb{R}_+ \rightarrow \mathbb{R}_+$, is unbounded, smooth, smoothly strictly increasing and smoothly strictly convex, with $v(0) = 0$ and $\lim_{e \rightarrow 0} v'(e) = 0$. The probability function, $p : \mathbb{R}_+ \rightarrow [0, 1]$, is smooth, smoothly strictly increasing and smoothly strictly concave, with $p(0) = 0$. The production function, $f : \mathbb{R}_+ \rightarrow \mathbb{R}_+$, is bounded, smooth, smoothly strictly increasing and smoothly strictly concave, with $f(0) = 0$ and $\lim_{k \rightarrow 0} f'(k) = \infty$.*

Given a borrower's consumption in the successful state, $y \geq 0$, and provision of effort, e , his expected utility is

$$p(e)y - v(e),$$

since there is no consumption in the unsuccessful state.

Local lenders have a strictly positive initial wealth, w , and are risk averse. Their consumption, $(c_g, c_b) \geq 0$, which is contingent on idiosyncratic states, is evaluated through a standard expected utility,

$$p(e)u(c_g) + (1 - p(e))u(c_b).$$

where the indexes g and b refer, respectively, to the successful and to the unsuccessful state.

Assumption 2 (Local Lenders). *The Bernoulli utility, $u : \mathbb{R}_+ \rightarrow \mathbb{R}$, is bounded, smooth, smoothly strictly increasing and smoothly strictly concave, with $\lim_{c \rightarrow 0} u'(c) = \infty$.*

²Here, and in the following, the qualification 'smoothly' indicates that the property can be characterized by derivatives. For instance, for a smooth map $f : \mathbb{R} \rightarrow \mathbb{R}$, 'smoothly strictly increasing' ('smoothly strictly concave') means $f' > 0$ ($f'' < 0$).

The economy is also subject to transaction costs, of which we give a simple representation. Suppose that, in every village, some amount of resources, $x \geq 0$, are collected when production is successful (there are no available resources when production is unsuccessful) in order to be redistributed uniformly across all villages. With no transaction costs, the quantity $p(e)x$ is the aggregate amount of collected resources that can be redistributed, where e is the effort supplied in every village and the Law of Large Numbers is used to eliminate risk. Transaction costs are represented by a single parameter, $1 > \gamma > 0$, such that the amount of collected resources available for redistribution is only

$$(1 - \gamma)p(e)x.$$

Remaining resources are somehow wasted in the collection process. However, direct trades occurring in every village between the local borrower and the corresponding local lender are not subject to transaction costs.

Assumption 3 (Transaction Costs). *Trades across villages are subject to the transaction cost γ and trades within villages are free of transaction costs.*

The literal interpretation of transaction costs is technological, that is, they imply a material destruction of resources. An alternative interpretation could be in terms of information. Indeed, one could suppose that, with probability γ , an external observer receive the signal of an unsuccessful state from villages that are instead in the successful state. To make this interpretation consistent with our description, however, one should also take into account the fact that each local borrower would anticipate this misperception. A change in the model to accomodate for the consistency of this alternative interpretation of γ would not substantially alter the results of the paper. For simplicity, we stick to the technological interpretation.

3. THE SUPPLY OF EFFORT

To facilitate presentation, it is useful to characterize the supply of effort by a local borrower first. Since effort cannot be observed, its supply is subject to a standard incentive compatibility constraint. Namely, for given consumption, y , local borrowers supply effort so as to maximize their expected utility. Therefore, the supply of effort is

$$e(y) = \arg \max \{p(e)y - v(e) : e \geq 0\}.$$

This supply is shown to be a well-behaved single-valued map.

Proposition 3.1 (Supply of Effort). *The supply of effort, $e : \mathbb{R}_+ \rightarrow \mathbb{R}_+$, is a single-valued continuous map. Moreover, it is continuously differentiable at all strictly positive consumptions, $y > 0$. Finally, the indirect expected utility and the supply of effort are both strictly increasing in consumption. In particular, $e'(y) > 0$.*

Proof. For given consumption, $y \geq 0$, the supply of effort is given by

$$e(y) = \arg \max \{p(e)y - v(e) : 0 \leq e \leq \bar{e}\},$$

where $\bar{e} > 0$ is such that $p(e)y - v(e) < 0$ for all $e \geq \bar{e}$. By the Maximum Theorem, the maximum is achieved and, by strict concavity of V in e , it is unique. The Maximum Theorem also implies that the supply of effort is continuous in consumption.

Suppose that $y > 0$. It is easy to show that $e(y) > 0$. The optimal supply of effort, thus, satisfies the following first-order condition,

$$p'(e(y))y - v'(e(y)) = 0.$$

The differentiability of the optimal supply of effort, then, follows from the Implicit Function Theorem, which also shows that $e'(y) > 0$.

The last claim follows from the fact that expected utility is strictly increasing in consumption. \square

One of the simplest consequences of the above proposition is that consumption of a local borrower, y , unambiguously determines the supply of effort, $e(y)$, under the incentive compatibility constraint. In addition, if a local borrower can guarantee himself some consumption, $y_0 \geq 0$, the participation constraint takes the simple form $y \geq y_0$, which is equivalent to

$$p(e(y))y - v(e(y)) \geq p(e(y_0))y_0 - v(e(y_0)).$$

Finally, as consumption increases, the borrower's supply of effort and, hence, the probability of success increases.

4. CONSTRAINED EFFICIENCY

We now describe the set of (symmetric) feasible allocations. Feasibility characterizes all the constraints that the planner's allocations must satisfy, including incentive constraints and transaction costs.

An allocation consists of a consumption for local borrowers in the successful state, $y \geq 0$, a direct transfer from every local borrower in the successful state to the corresponding local lender, $z \geq 0$, and an indirect transfer from local borrowers to local lenders, $x \geq 0$. The latter is interpreted as the amount of resources which are collected from all successful villages and pooled together in order to be transferred to local lenders uniformly across villages. Every allocation determines the supply of effort, $e(y)$, subject to incentive compatibility constraint, as explained in the previous section. In particular, the planner cannot directly observe effort when choosing an allocation.

An allocation is feasible if it satisfies the material constraints on resources,

$$y + x + z \leq f(w),$$

that is, the total amount of resources transferred (directly or indirectly) to every agent is less than or equal to the total amount of available resources.

Clearly, given an allocation, the consumption of local lenders, contingent on uncertainty,

$$c_g = (1 - \gamma)p(e(y))x + z, \quad c_b = (1 - \gamma)p(e(y))x,$$

is the amount of resources that is transferred to them directly, z , and indirectly subject to transaction costs, $(1 - \gamma)p(e)x$. Therefore, given a feasible allocation, one obtains the expected utilities of each local lender and each local borrower.

A feasible allocation is said to be (constrained) efficient, or a social optimum, if it is not Pareto-dominated by an alternative feasible allocation. The definition is a simple adaptation of a standard notion in the literature. In particular, we remark that efficiency here already takes into account asymmetric information as well as transaction costs. One could, in principle, allow for contingent indirect transfers to local lenders. However, we rule out this possibility to make (constrained) efficient allocations more comparable with market allocations (as it will be clear in the next section where market allocations are defined).

We now characterize efficient allocations through first-order conditions. Clearly, because of the non-convexity due to moral hazard, such conditions might not be sufficient for a social optimum.

Proposition 4.1 (Constrained Efficiency). *An efficient allocation satisfies $y + x + z = f(w)$, $x > 0$ and the following first-order conditions:*

$$(1) \quad \frac{(1-p)u'_b}{pu'_g} = \frac{1 - (1-\gamma)p}{(1-\gamma)p},$$

$$(2) \quad pu'_g \geq p'e'(u_g - u_b + u'_g x).$$

In particular, the direct transfer is strictly positive, that is, $z > 0$.

Proof. The exhaustion of product, $y + x + z = f(w)$, follows from the monotonicity of agents' preferences. Condition (1) follows from a slight change in the efficient allocation of the form $(y, x, z) \mapsto (y, x - \delta, z + \delta)$, with $\delta \geq 0$, which implies a marginal variation of local lenders' expected utility,

$$pu'_g - pu'_g(1-\gamma)p - (1-p)u'_b(1-\gamma)p \leq 0.$$

The inequality follows from the optimality of the initial allocation. If $z = 0$, then the above inequality reduces to $\gamma \leq 0$, a contradiction. Hence, one is allowed to consider $\delta \leq 0$ and the conclusion follows. Condition (2), instead, evaluates the derivative of the

expected utility of local lenders along the marginal change $(y, x, z) \mapsto (y + \delta, x, z - \delta)$, with $\delta \geq 0$, which makes each local borrower strictly better off. The variation of local lenders' expected utility is

$$p'e'u_g - p'e'u_b + pu'_g(1 - \gamma)p'e'x + (1 - p)u'_b(1 - \gamma)p'e'x - pu'_g \leq 0.$$

Again, the inequality follows from the optimality of the initial allocation. Using the previous first-order condition, one obtains the conclusion. \square

These conditions are easily interpretable. Equation (1) states that the marginal rate of substitution between bad and good state consumption must be equal to the 'distorted' marginal rate of transformation between the two goods, where the distortion arises from transaction costs. Since $\gamma > 0$, one immediately derives the implication that the planner is willing to insure local lenders partially (*i.e.*, $c_g > c_b$) since, because of transaction costs, the implicit price of insurance is not fair.³ Condition (2) establishes that the marginal benefit to the local lender of a rise in the direct transfer (the left hand side of the inequality) must exceed the marginal cost (the right hand side). The former is given by the expected marginal utility of good state consumption, the latter is given by the effect on expected utility due to a loss of effort. Notice that this marginal cost can be decomposed into two parts. The first part, $p'e'(u_g - u_b)$, is the difference between the utilities of good and bad state consumption (*direct effect of a rising effort*). The second part, $p'e'u'_g x$, is the effect on expected utility of a rise in indirect transfers, $(1 - \gamma)px$, through a rise in the supply of effort (*indirect effect of a rising effort*). We will see later on, when the concept of a competitive equilibrium will be defined, that the inefficiency of competitive allocations and the desirability of a tax-transfers policy arises from the agents' failure to internalize the indirect effect of a rising effort through the market mechanism.

An efficient allocation is always characterized by the coexistence of direct and indirect transfers, z and x , respectively. Direct transfers are positive because, with $\gamma > 0$, local lenders are only partially insured. Indirect transfers are positive because local lenders must be guaranteed some consumption in the bad state. Hence, in contrast with some other contributions to the literature on incentives with competing lenders (such as Bizer and DeMarzo [10] or Kahn and Mookherjee [18]), efficient allocations require that borrowers' transfers to investors take two different forms: direct and indirect transfers.

³Notice that, even if we allowed for contingent indirect transfers, partial insurance of local lenders would still obtain at efficient allocations.

5. MARKETS AND CONTRACTS

Competitive markets operate as follows. Local borrowers can trade in loans: they can obtain any amount of credit, $a \geq 0$, at a (gross) rate of interest, $r > 0$, to be repayed only if production is successful. Local lenders can trade in deposits: they can invest any amount of wealth, $d \geq 0$, in a safe asset, which pays off an uncontingent (gross) rate of interest, $\rho \geq 0$. We refer to r and ρ as the rate of interest on loans and on deposits, respectively. Both rates of interest are prices to be determined at a competitive equilibrium.

There is a large finite set of intermediaries. These are competitive firms which take positions in loans and deposits at given prices. If an intermediary provides a loan, a , to every village, the expected revenue is

$$(1 - \gamma)p(e)ra,$$

where e is the supply of effort which is taken as given by the intermediary. In order to provide such a loan, the intermediary must raise an amount of deposits equal to the amount of provided loans, a . Hence, the cost of this provision of loans is ρa . It follows that the profit of the intermediary is

$$(1 - \gamma)p(e)ra - \rho a.$$

This description implies that the terms of each contract (interest rate and loan size), traded in the financial intermediaries' market, are common across borrowers and independent of the transactions made by borrowers with other lenders. By following this approach (recently adopted by Dubey, Geanakoplos and Shubik [13], Dubey and Geanakoplos [12] and Bisin and Gottardi [9], among others) we make the model consistent with the idea that financial intermediaries operate in a large competitive market with limited information about the identity of borrowers, where assets are thought of as 'pools' (a definition taken from Dubey and Geanakoplos [12]).

In every village, there is a bilateral trade between the local lender and the corresponding local borrower. This determines local contracts, given the rates of interest prevailing in the market, which have been described above. Every local lender, acting as a principal with respect to the corresponding local borrower, proposes an *exclusive* contract to the corresponding local borrower. Such a contract specifies a the loan from intermediaries, $a \geq 0$, an additional loan directly provided by the local lender, $b \geq 0$, and a repayment to be made directly to the local lender, $z \geq 0$, in the case of successful production only.

At the given rate of interest charged by intermediaries on loans, r , a contract, (a, b, z) , allows local borrowers to consume

$$y = f(a + b) - ra - z,$$

if production is successful. The outside option for local borrowers is not to accept the contract proposed by the local lender and to demand credit only to intermediaries. The reservation consumption is, therefore,

$$y_0 = \max_k f(k) - rk.$$

Indeed, if a local borrower refuses the proposal of the corresponding local lender, a loan can be still demanded to intermediaries.

Every local lender chooses an investment in deposits, $d \geq 0$, and a contract, $(a, b, z) \geq 0$, so as to maximize expected utility,

$$p(e) u(d\rho + z) + (1 - p(e)) u(d\rho),$$

subject to a budget constraint,

$$(3) \quad b + d \leq w,$$

an incentive compatibility constraint,

$$(4) \quad e = e(y)$$

and a participation constraint,

$$(5) \quad y = f(a + b) - ra - z \geq \max_k f(k) - rk = y_0.$$

Contracts solving this problem, for given rates of interest, are referred to as optimal local contracts.

A *competitive equilibrium* (or, simply, an *equilibrium*) consists of a rate of interest on deposits, $\rho > 0$, a rate of interest on loans, $r > 0$, and a local contract, (a, b, z) , such that the following three properties are satisfied:

- (a) the local contract, (a, b, z) , is optimal;
- (b) intermediaries make no profit, *i.e.*,

$$(1 - \gamma) p(e) ra - \rho a = 0,$$

where e is the supply of effort induced by the optimal local contract;

- (c) markets clear, *i.e.*,

$$a + b = w.$$

The requirement of strict positivity of the rate of interest on deposits is material, for, otherwise, trivial equilibria with inactive intermediaries would always obtain at $\rho = 0$. This feature is common to other economies in which contracts are traded on competitive markets.

Because of the non-convexity due to moral hazard, the uniqueness of local contracts, as well as convex values of the related correspondence, might fail. This is a common feature of economies with moral hazard. It follows that a competitive equilibrium (as defined

in the previous section) might not exist. Nevertheless, using a standard approach, one could exploit the assumption of a continuum of local lenders to restore convexity and define an extended equilibrium in which local contracts are heterogenous across villages at equilibrium. It suffices to suppose that the entire population can be partitioned into sub-populations with local contracts possibly differing across such sub-populations and intermediaries making no profit on average on the entire population. In the appendix we define and prove existence of an *extended equilibrium*, that is, an extension of a competitive equilibrium to the case in which the set of villages can be partitioned into subsets characterized by different contracts.

6. LOCAL CONTRACTS

In this section, we carry out a partial equilibrium analysis. That is, we study optimal local contracts between local lenders and local borrowers at given rates of interest. We first notice that optimal local contracts exist.

Proposition 6.1 (Existence). *For every rate of interest on deposits, $\rho \geq 0$, and every rate of interest on loans, $r > 0$, optimal local contracts exist. As rates of interest vary, the correspondence is upper hemi-continuous with compact values.*

Proof. For given $\rho \geq 0$ and $r > 0$, let $G(\rho, r)$ be the set of all contracts, (a, b, z) , which satisfy the participation constraint,

$$y = f(a + b) - ra - z \geq \sup_{k \geq 0} f(k) - rk = y_0.$$

This correspondence, $G : \mathbb{R}_+ \times \mathbb{R}_{++} \mapsto \mathbb{R}_+ \times \mathbb{R}_+ \times \mathbb{R}_+$, has non-empty compact values and is continuous: non-empty values are obvious; compact values easily follow from the boundedness of production and the strict positivity of r ; continuity can also be established using continuity of production. The Maximum Theorem then implies non-emptiness and upper hemi-continuity of optimal choices. \square

Having ascertained the optimal local contract exists, we now characterize them through a first-order condition approach. We remark again that first-order conditions are only necessary for the optimality of such local contracts.

Proposition 6.2 (Characterization). *For a given rate of interest on deposits, $\rho > 0$, and a given rate of interest on loans, $r > 0$, every local contract, (a, b, z) , fulfills the following conditions. (a) If $pr > \rho$, then local lenders provide a direct funding to corresponding local borrowers, that is, $w > b > 0$. (b) If $a > 0$, then the marginal product of capital is equal to the rate of interest on loans, that is, $f' = r$. (c) The participation constraint implies $rb \geq z$ and it is not binding only if $rb > z$. (d) If $w > b > 0$, $a > 0$ and $z > 0$, then*

$$(6) \quad \frac{(1-p)u'_b}{pu'_g} = \frac{r-\rho}{\rho},$$

$$(7) \quad pu'_g \geq p'e'(u_g - u_b),$$

where the latter holds with the equality if the participation constraint is non-binding, i.e., $rb > z$.

Proof. **(a)** By Inada conditions, $w > b \geq 0$, for, otherwise, local lenders would not consume in the unsuccessful state. Suppose that $b = 0$ and, for small enough $\delta \geq 0$, consider the reallocation $(a, b, z) \mapsto (a - \delta, b + \delta, z + r\delta)$, leaving the local borrowers' effort unaltered. Since such reallocation cannot increase local lenders' utility,

$$-pu'_g\rho - (1-p)u'_b\rho + pu'_gr \leq 0,$$

which amounts to satisfy $\rho \geq pr$ since $u'_g = u'_b$, a contradiction. **(b)** Since a does not directly enter local lenders' expected utility, its only effect goes through the local borrowers' supply of effort. If $b = 0$, then $z = 0$: the condition must be satisfied, for, otherwise, the participation constraint would be violated. If $b > 0$, then $z > 0$: the derivative of the local lenders' expected utility with respect to a is

$$p'e'(f' - r)(u_g - u_b).$$

Since $p'e'(u_g - u_b) > 0$, the result follows. **(c)** Obvious. **(d)** Condition (6) is obtained by considering any small reallocation $(a, b, z) \mapsto (a - \delta, b + \delta, z + r\delta)$, that leaves the local borrowers' effort unaltered. Condition (7) corresponds to any small reallocation $(a, b, z) \mapsto (a, b, z + \delta)$. Such reallocation cannot increase local lenders' utility, but if the participation constraint is binding, it is subject to $\delta \leq 0$, motivating the inequality in the first-order condition. \square

The amount of direct funding, a , is determined so as to maximize the net output, $f(a + b) - ra$, in the successful state. This serves the direct interest of both local borrowers and local lenders and it obviously implies that the marginal product of capital is equalized to the rate of interest of loans. In addition, since intermediaries supply loans without quantity constraints, the rate of interest on loans determines the reservation value for local borrowers. It follows that the implicit rate of interest that is charged by local lenders on their direct loans to local borrowers cannot exceed the rate of interest that is charged by intermediaries on indirect loans, that is, $rb \geq z$.

Optimal local contracts are of two types, 'binding' and 'non-binding', according to whether, respectively, the participation constraint is satisfied with equality and strict inequality. Equivalently, binding and non-binding optimal local contracts arises whenever $rb = z$ and $rb > z$, respectively. These contracts are designed to obey two purposes,

portfolio diversification and incentive creation, as reflected by two distinct first-order conditions, (6) and (7).

Wealth is allocated according to condition (6), which states that marginal rate of substitution between bad and good state consumption equals a measure of the spread between the marginal product of capital, r , and the deposit rate, ρ (a risk premium). The local lender chooses a risky portfolio, $0 < b \leq w$, as long as the risk premium is positive, that is, $pr > \rho$. In turn, this inequality always hold in equilibria with $a > 0$, where $\rho = (1 - \gamma)pr < pr$.

The incentive to borrowers and, hence, the probability of success of the project are determined by the evaluation of the marginal benefit and cost associated with an increase of the repayment, z , as shown by condition (7). This is equivalent to condition (2), except for the last term on the right hand side of the equation (which we labeled *indirect effect of a rising effort*), completely missing in condition (7). For the interpretation of these conditions we refer to the discussion in section 4.

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 perfect substitute for a borrower. The case which we shall focus on, however, is that of a competitive equilibrium 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.

7. COMPARATIVE STATICS

We now explore the effect of a varying value of the intermediation costs on the equilibrium probability of a successful investment project. Our aim is to point out that an increase in transaction costs may raise the average probability of successful projects. For this purpose, we carry out a competitive statics exercise around a competitive equilibrium such that optimal contracts supplied by local lenders are (locally) smooth in all relevant parameters.

Locally, around a smooth equilibrium, the equilibrium effect of a change in transaction costs can be examined in the (p, ρ) -plane studying the intersection of the zero-profit condition,

$$(1 - \gamma)p(e)r - \rho = 0,$$

and the map $p = p(e(\rho))$ which locally gives the success probability implicitly chosen by local lenders through contracts for a varying deposit rate, ρ . Then, comparative statics reduces to the following observation (also exemplified by figure 1).⁴

⁴Here and in the following, the derivatives with respect to endogenous parameters (such as the deposit rate and, later on, the subsidy) capture the (parametric) behavior of local lenders, whereas the derivatives

Proposition 7.1 (Effect of Rising Transaction Costs). *Locally, at a smooth equilibrium with non-binding local contracts, if effort smoothly decreases in the deposit rate (that is, $\partial e/\partial \rho < 0$), then equilibrium effort is smoothly increasing in transaction costs (that is, $\partial e/\partial \gamma > 0$).*

Proof. The zero-profit condition implies

$$\frac{\partial \rho}{\partial \gamma} = \frac{\partial p}{\partial e} \frac{\partial e}{\partial \gamma} (1 - \gamma) r - pr.$$

Therefore, since $\partial e/\partial \gamma = \partial e/\partial \rho \cdot \partial \rho/\partial \gamma$,

$$\frac{\partial e}{\partial \gamma} = -pr \left(1 - \frac{\partial p}{\partial e} \frac{\partial e}{\partial \rho} (1 - \gamma) r \right)^{-1} \frac{\partial e}{\partial \rho},$$

which is positive if $\partial e/\partial \rho < 0$. □

The result is a consequence of the trade-off faced by local lenders between insurance and borrowers' incentives. If local lenders reduce borrowers' incentives when they face a higher return on the safe asset, then higher transaction costs require a lower deposit rate for the zero-profit condition to be satisfied.

To be more specific about the conditions implying a drop in the equilibrium effort as transaction costs are reduced, we decompose the optimization problem of local lenders into two parts and use some Monotone Comparative Statics methods (Milgrom and Shannon [22]).

Monotone Comparative Statics Theorem. *Let $f : X \times Y \rightarrow \mathbb{R}$, where X and Y are intervals of \mathbb{R} . Then $\arg \max \{f(x, y) : x \in X\}$ is (weakly) increasing in y if and only if f satisfies the single crossing conditions in (x, y) . In addition, if f is twice continuously differentiable, the single crossing condition is satisfied whenever $\partial^2 f/\partial x \partial y \geq 0$.*

At equilibrium rate of interest on loans, $r = f'(w) > 0$, $t = rb - z \geq 0$ is a local borrower's 'opportunity gain' from getting a local contract relative to the 'market' equilibrium interest payments if optimal local contracts are non-binding. The supply of effort depends on the contract only through the value of t , that is, $e = e(y_0 + t) = e(t)$. Of course, the premium to borrowers is restricted by $0 \leq t \leq rw$, for, otherwise, local lenders would obtain negative consumptions. The decomposition operates as follows. The first part consists of choosing the investment on the risky asset, $b(t, \rho)$, at given supply of effort, $e = e(t)$, so as to maximize the expected utility of local lenders, that is,

$$b(t, \rho) = \arg \max \left\{ U(b, t, \rho) : \frac{t}{r} \leq b \leq w \right\},$$

with respect to exogenous parameters (such as transaction costs and, later on, the tax rate) represent equilibrium adjustments.

where

$$U(b, t, \rho) = p(e(t)) u(\rho(w - b) + rb - t) + (1 - p(e(t))) u(\rho(w - b))$$

The above is a standard portfolio choice problem with a tax, $t \geq 0$, in the successful state. The second part consists of choosing local borrowers' opportunity gain, $t \geq 0$, and, hence, the supply of effort, $e = e(t)$, so as to maximize the indirect expected utility, $W(t, \rho) = U(b(t, \rho), t, \rho)$. The solutions to this sequence of problems are equivalent to the solutions of the original problem.

By the Monotone Comparative Statics Theorem, verifying that the supply of effort, e , is locally decreasing in the deposit rate, ρ , amounts to verifying that the indirect expected utility function, W , satisfies the single crossing condition in $(-t, \rho)$. By direct computations,

$$\frac{\partial^2 W}{\partial t \partial \rho} = p' e' u'_g \left(\frac{p}{p' e'} M_g - \frac{\gamma}{(1 - \gamma)(1 - p)} \right) a + p' e' u'_g \left(\frac{p}{p' e'} M_g + \frac{1}{1 - p} \right) (r - \rho) \frac{\partial b(t, \cdot)}{\partial \rho},$$

where $M_j = -u''_j/u'_j$ is the absolute measure of risk aversion and all derivatives are evaluated at the equilibrium with non-binding local contracts. If intermediation costs are high enough and the absolute risk aversion is, say, bounded, the first term of the above expression is negative. Therefore, a sufficient condition for the equilibrium success probability to be locally increasing in intermediation costs is that the local lender's risky investment, at given probability, is locally decreasing in the safe return, that is, $\partial b(t, \cdot)/\partial \rho < 0$. This seems a rather plausible assumption.

In figure 2, we present a simulation where a rise of γ has a negative effect on the local lender's expected utility and a positive effect on effort. Restrictions are the following:

$$p(e) = e, \quad u(x) = 2x^{1/2}, \quad f(w) = 8.5, \quad f'(w) = 1.5, \quad w = 5.$$

We plot the local lender's indirect expected utility function, W , for the first part of the decomposed optimization problem, so that, for a given value of ρ , the maximum of $W(\cdot, \rho)$ gives the optimal local lenders' effort. The figure shows that $W(\cdot, \rho)$ shifts downward and to the right when ρ goes from 0.4 to 0.6. By computation, one can show that there is a smooth equilibrium with $e = 0.7$, when $\gamma = 0.63$.

8. WELFARE AND TAXATION

Inefficiency. Competitive equilibria might be (constrained) inefficient. We first point out that inefficiency is not due to a misallocation of indirect, $x = ra$, and direct, z , repayments. That is, no Pareto improvement can be obtained by a balanced reallocation of x and z .

Proposition 8.1 (Under-Provision of Effort). *An equilibrium allocation cannot be Pareto dominated by a feasible allocation involving the same supply of effort.*

Proof. Suppose that (y, x, z) is an equilibrium allocation, where $x = ra$, and is strictly Pareto dominated by a feasible allocation (y', x', z') involving the same supply of effort, that is, $y = y'$. It follows that $x' + z' = x + z$. Let a' be such that $ra' = x'$ and set $b' = w - a'$. If $z' \leq rb'$, then the alternative contract, (a', b', z') , satisfies the participation constraint and, by hypothesis, makes local lenders strictly better off, leaving the welfare of local borrowers unaltered. Observe that

$$z' = x + z - x' = ra + z - ra' \leq ra + rb - ra' = r(w - a'),$$

which suffices to show a contradiction. \square

Thus, an inefficient competitive equilibrium involves under-provision of effort. Inefficiency arises since, when local lenders evaluate the benefit of a higher effort, they ignore the favorable consequences on the revenue of intermediaries, which could be exhausted by a higher deposit rate.

Proposition 8.2 (Inefficiency at Equilibrium). *An equilibrium with non-binding local contracts is inefficient.*

Proof. It follows from a comparison of first-order conditions at equilibrium and at an efficient allocation. \square

Moving from the latter conclusion, we show below that a taxation policy might indeed be beneficial when competitive equilibrium local contracts are non-binding.

Taxation Policy. A potential role for taxation emerges when there are transaction costs, since the competitive equilibrium allocation is not constrained efficient when local contracts are non-binding at equilibrium. We consider the case of a taxation on the revenue of intermediaries.

Let τ be a small proportional tax on the revenue of intermediaries and s an unconditioned transfer to local lenders. The determination of local contracts is only modified by the presence of this additional small subsidy. Because of taxation, the profit of an intermediary becomes

$$(1 - \tau)(1 - \gamma)p(e)ra - \rho a.$$

An equilibrium requires, in addition, a balanced public budget,

$$(1 - \tau)s = \tau\rho a.$$

To evaluate the consequences of taxation, we carry out a comparative statics exercise moving from a smooth equilibrium with non-binding local contracts and no taxation.

A taxation policy is welfare improving if and only if it increases equilibrium effort. Indeed, the tax induces an adverse effect on the expected utility of local lenders, through a fall of the deposit rate, and a benefit, through an increase in the subsidy. At constant

plans, the overall effect on the expected utility of local lenders is neutral, since, being public policy balanced, the cost is completely compensated by the benefit. If effort increases at equilibrium, however, the policy generates a surplus by increasing the subsidy comparatively more than the associated drop in the return on deposits.

Proposition 8.3 (Welfare and Effort). *At a smooth equilibrium with non-binding local contracts and no taxation, an increase in the tax rate is smoothly welfare improving if and only if it induces a smooth increase in equilibrium effort (that is, $\partial e/\partial\tau > 0$).*

Proof. By the Envelope Theorem, the marginal impact of an increase in the tax rate on the expected utility of local lenders is, at equilibrium,

$$(pu'_g + (1-p)u'_b) \left(\frac{\partial\rho}{\partial\tau}a + \frac{\partial s}{\partial\tau} \right),$$

where we make use of the fact that the participation constraint is non-binding. Since equilibrium imposes

$$\begin{aligned} (1-\gamma)p(e)r - \left(\frac{1}{1-\tau} \right) \rho &= 0, \\ s - \left(\frac{\tau}{1-\tau} \right) \rho a &= 0, \end{aligned}$$

differentiating, one obtains

$$\frac{\partial\rho}{\partial\tau}a + \frac{\partial s}{\partial\tau} = \frac{\partial p}{\partial e} \frac{\partial e}{\partial\tau} (1-\gamma)ra,$$

which proves the proposition. \square

A taxation policy, in turn, increases equilibrium effort whenever the supply of effort is downward sloped in the deposit rate. The latter conditions, however, is not necessary for a welfare improving taxation policy.

Proposition 8.4 (Welfare Improving Policy). *Locally, at a smooth equilibrium with non-binding local contracts and no taxation, if effort smoothly decreases in the deposit rate (that is, $\partial e/\partial\rho < 0$), then equilibrium effort smoothly (weakly) increases in the tax rate (that is, $\partial e/\partial\tau \geq 0$).*

Proof. Locally, equilibria are smooth functions of the policy parameter, τ , which satisfy the following system of equations

$$\begin{aligned} (1-\gamma)p(e)r - \left(\frac{1}{1-\tau} \right) \rho &= 0, \\ s - \left(\frac{\tau}{1-\tau} \right) \rho a &= 0, \end{aligned}$$

where e and a are optimally chosen by local lenders given relevant parameters. Differentiating, we obtain

$$\frac{\partial \rho}{\partial \tau} = \frac{\partial p}{\partial e} \frac{\partial e}{\partial \tau} (1 - \gamma)r - \rho.$$

Since $\partial e / \partial \tau = \partial e / \partial \rho \cdot \partial \rho / \partial \tau + \partial e / \partial s \cdot \partial s / \partial \tau$ and $\partial s / \partial \tau = \rho a$,

$$\frac{\partial e}{\partial \tau} = \rho \left(1 - \frac{\partial e}{\partial \rho} (1 - \gamma)r \right)^{-1} \left(\frac{\partial e}{\partial s} a - \frac{\partial e}{\partial \rho} \right),$$

where all the derivatives are evaluated at the smooth equilibrium with non-binding local contracts and without taxation. It then suffices to show that $(\partial e / \partial s) a - \partial e / \partial \rho \geq 0$.

Notice that the derivative $(\partial e / \partial s) a - \partial e / \partial \rho$ evaluates the adjustment of plans as the parameters (ρ, s) vary along changes of the form $(\rho', s') = (\rho - \phi, \phi a)$. Using the already discussed decomposition of the optimization problem of local lenders, one obtains the indirect expected utility, $W(t, \phi) = U(b(t, \phi), t, \phi)$, where

$$b(t, \phi) = \arg \max \left\{ U(b, t, \phi) : \frac{t}{r} \leq b \leq w \right\}$$

and

$$U(b, t, \phi) = p(e(t)) u((\rho - \phi)(w - b) + \phi a + t) + (p(e(t))) u((\rho - \phi)(w - b) + \phi a).$$

(As ϕ and t are close to their equilibrium values, we neglect further boundary conditions.) Therefore, by the Monotone Comparative Statics Theorem, $(\partial e / \partial s) a - \partial e / \partial \rho \geq 0$ whenever, around an equilibrium, $\partial^2 W / \partial t \partial \phi \geq 0$. By direct computation,

$$\frac{\partial^2 W}{\partial t \partial \phi} = -p u'_g a (p r - \rho) \frac{\partial b(t, \cdot)}{\partial \phi}.$$

Applying again the Monotone Comparative Statics Theorem, one shows that $\partial^2 U / \partial b \partial \phi \geq 0$, so proving that $\partial b(t, \cdot) / \partial \phi \geq 0$. This concludes our argument. \square

Taxation can be welfare improving since, by lowering the deposit rate, it induces a reallocation of the portfolios of local lenders in favor of direct funding to local borrowers. The increase in the riskiness of portfolios, in turn, obliges lenders to reduce the repayments of direct credit. Lenders avoid the adverse consequences of a more risky portfolio since they are compensated by uncontingent lump-sum transfers.

9. CONCLUDING REMARKS AND RELATED LITERATURE

We have considered an economy where entrepreneurs can simultaneously get loan contracts from two sources, financial intermediaries and local lenders. The former have a comparative advantage in the diversification of risks and the latter have a cost advantage when lending to a local entrepreneur. Because of moral hazard, an increase in the cost of intermediation may induce entrepreneurs to choose safer projects. This effect comes

about because a higher cost of intermediation implies a fall of financial intermediaries' finance and an increase in the amount of direct finance from local lenders, who offer credit at cheaper conditions. We have also proved that market allocations fail to internalize an externality between lenders and, by taxing intermediaries, a policymaker can generate a Pareto improvement.

The constrained inefficiency of competitive allocations in the presence of moral hazard is a well known possibility. Constrained efficiency can be recovered only if agents are able to observe individuals' trades in goods, assets or insurance. In particular, when loan contracts have some effects on the borrowers' incentives (to exert effort or to default) and lenders cannot observe the borrowers' asset position or enforce contract exclusivity, competition between lenders may generate non-internalized multilateral externalities (*e.g.*, Pauly [24], Helpman and Laffont hellaf, Bizer and DeMarzo [10], Arnott and Stiglitz [5], Kahn and Mookherjee [18]). This explains why the full observability of individuals' trades is crucial for the efficiency results obtained by Prescott and Townsend [27] or Kocherlakota [20] in competitive equilibrium models with moral hazard.⁵

Many authors claim that the amount of information required to generate constrained efficiency may be very high and difficult to implement in reality (see the informal discussion in Stiglitz [30]). In particular, implementing contract exclusivity requires sophisticated financial institutions and efficient monitoring agencies. The problem may be particularly severe with respect to financial transactions taking place in less developed countries (frequently characterized by the coexistence of formal and informal credit), sovereign debt and, in some cases (*e.g.*, for small business or credit card markets), economies characterized by well developed financial systems.

More specifically, the possibility that non-market financial institutions may have a positive role in developing economies has been explored in Arnott and Stiglitz [4] in a model with market and non-market insurance provision ('peer monitoring view'). In this model there is a market for insurance 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 can get additional unobservable insurance from some informal institutions with superior monitoring ability. The efficiency gain arising from this monitoring activity may more than compensate for the efficiency loss caused by the assumed market failure (contract non-exclusivity). More general models of insurance and moral hazard with non exclusive contracts are in Pauly [24], Helpman and Laffont [15] and Arnott and Stiglitz [5]. The mechanism explaining inefficiency in our model, however,

⁵Kocherlakota [20] explains that the full information of agents' asset holdings and the way this information is used to generate efficient allocations is compatible with perfect competition under the assumption that full information and contract enforcement is delegated to a 'monitoring agency'.

cannot be fully understood as a case of over-insurance as in these contributions. In the models by Pauly [24], Helpman and Laffont [15] and Arnott and Stiglitz [5], constrained inefficiency would persist even with risk neutral agents. In our model, on the other hand, all competitive equilibria would be constrained efficient if local lenders were risk neutral. In this case, intermediaries would not be active at equilibrium and every local lender would act as a principal with respect to the corresponding local borrower. The latter would provide a socially optimal contract. Even when local lenders are risk averse, local borrowers supply positive effort in our model, since they have no access to insurance markets.

Bizer and DeMarzo [10] and Kahn and Mookerjee [18] analyze an environment with moral hazard in which agents may borrow sequentially from multiple lenders and they establish that, because of moral hazard and the inability of the borrowers to commit to obtaining only one loan, equilibria may be characterized by excessive borrowing and too high interest rates with respect to the second best allocation. Our model mostly builds on these contributions by assuming the existence of an economic environment in which borrowing from multiple lenders simultaneously is possible and it may generate inefficient competitive allocations. However, contrary to Bizer and DeMarzo [10] and Kahn and Mookerjee [18], we assume that lenders can fully enforce contract exclusivity with respect to any alternative loan contract offered by a competing lender. In our model, inefficiency does not arise from the lender's inability to monitor the borrower's individual transactions, but from his inability to monitor the transactions of lenders who are simultaneously lending to the same borrower. This problem can never arise in models where lenders are all identical, since, in this case, contract exclusivity eliminates the possibility that an individual can simultaneously borrow from different sources. In our model, on the contrary, lenders are assumed to be heterogeneous and the presence of a transaction cost affecting lenders asymmetrically implies that allowing an individual to borrow simultaneously from different sources may be an efficient outcome. In some sense, our model describes a situation in which efficient financial contracting could be implemented by letting a principal (a financial intermediary) offering a contract to two agents simultaneously (a local borrower and a local lender).

In other words, whereas most agency models of financial relationships are either assuming that a lender is unable to enforce exclusive lending privileges or that he is unable to monitor the borrower's transactions in other markets, our model focuses on the difficulties of devising efficient contractual arrangements when financial relationships require the joint action of different type of lenders.

The inefficiency arising in our model could be related to the fact that local lenders and financial intermediaries are price takers and make anonymous trades in the market for safe assets (deposits and diversified loans). More specifically, we rule out the possibility that

financial intermediaries act strategically by making a take-it-or-leave-it contract offer to borrowers and local lenders to be accepted or refused simultaneously by borrowers and local lenders in each village. However, it is unlikely that this type of contractual arrangement can be realized in practice. The problem is that, in our model, there exists a direct externality between agents (local lenders and borrowers in the same village).

From a macroeconomic viewpoint, we think that the model can be improved to address some of the issues related to financial opening in international environments. A large literature on this topic has focused on the role of moral hazard and financial market imperfections to understand why opening up developing countries to short-term capital inflows may increase the chances of financial crises (see Kletzer [19], McKinnon and Pill [21], Dooley [11], Hellmann, Murdock and Stiglitz [14], Aizenman [1]). This literature is mainly concerned with the possibility of over-borrowing as a consequence of moral hazard when investors believe that they will be bailed out of bad investments by taxpayers. According to some authors (Rodrick [28], Arteta, Eichengreen and Wyplosz [6] and Aizenman [2]), there is some evidence that financial opening does not have positive effects on growth and that it may increase the chances of financial crises. Our model captures an over-borrowing syndrome (from financial intermediaries) arising from a non internalized externalities between ‘local’ and ‘global’ lenders.

APPENDIX

An *extended equilibrium* consists of a rate of interest on deposits, $\rho > 0$, a rate of interest on loans, $r > 0$, and a pair of local contracts, (a_1, b_1, z_1) and (a_2, b_2, z_2) , such that, for some $(\mu_1, \mu_2) \geq 0$ with $\sum_i \mu_i = 1$, the following three properties are satisfied:

- (a) every local contract, (a_i, b_i, z_i) , is optimal;
- (b) intermediaries make no profit on average, *i.e.*,

$$\sum_i ((1 - \gamma)p(e_i)ra_i - \rho a_i)\mu_i = 0,$$

where e_i is the supply of effort induced by the corresponding optimal local contract;

- (c) markets clear, *i.e.*,

$$\sum_i (a_i + b_i)\mu_i = w.$$

The proof of existence of an extended equilibrium is simple since the loan rate equalizes the marginal product on social investment, which implies market clearing. The only binding restrictions are, consistently, the optimality of local contracts and the zero-profit conditions for intermediaries.

Proposition 9.1 (Existence). *An extended equilibrium exists.*

Proof. Set $r = f'(w) > 0$, which ensures market clearing, and consider the correspondence

$$\Lambda(\rho) = \{(1 - \gamma)p(e(f(a + b) - ra - z))r - \rho : (a, b, z) \text{ is optimal at } (r, \rho)\},$$

which is well defined on $S = \mathbb{R}_+$. This is an upper hemi-continuous correspondence with non-empty compact values. In addition, $\max \Lambda(0) > 0$ and $\min \Lambda(\rho) < 0$ for some large enough $\rho > 0$. Let

$$S_+ = \{\rho \in S : \max \Lambda(\rho) \geq 0\},$$

$$S_- = \{\rho \in S : \min \Lambda(\rho) \leq 0\}.$$

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 hemi-continuity of Λ), 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 (μ_1, μ_2) over at most two optimal contracts, if needed, one implying non-negative profit and the other non-positive profit for intermediaries. \square

REFERENCES

- [1] Aizenman, J. (2001), "Capital Mobility in a Second Best World - Moral Hazard with Costly Financial Intermediation", NBER W.P. 6703.
- [2] Aizenman, J. (2002), "Financial Opening: Evidence and Policy Options", mimeo.
- [3] Arnott, R. and J. Stiglitz (1991), "Equilibrium in Competitive Insurance Markets with Moral Hazard", NBER W.P. 3588.
- [4] Arnott, R. and J. Stiglitz (1991), "Moral Hazard and Nonmarket Institutions: Dysfunctional Crowding Out or Peer Monitoring", *American Economic Review*, 81, 179-90.
- [5] Arnott, R. and J. Stiglitz (1994), "Price Equilibrium, Efficiency, and Decentralizability in Insurance Markets with Moral Hazard", mimeo.
- [6] Arteta, C., B. Eichengreen and C. Wyplosz (2001), "When Does Capital Account Liberalization Help More Than It Hurts?", NBER W.P. 8414.
- [7] Banerjee, A.V., T. Besley and T.W. Guinnane (1994), "Thy Neighbor's Keeper: The Design of a Credit Cooperative with Theory and a Test", *Quarterly Journal of Economics*, 109, 490-515.
- [8] Besley, T. and S. Coate (1995), "Group Lending, Repayment Incentives and Social Collateral", *Journal of Development Economics*, 46, 1-18.
- [9] Bisin, A. and P. Gottardi (1999), "General Competitive Analysis with Asymmetric Information", *Journal of Economic Theory*, 87(1), 1-48.
- [10] Bizer, D.S. and P.M. DeMarzo (1992), "Sequential Banking", *Journal of Political Economy*, 100, 41-61.
- [11] Dooley, M. (2000), "A Model of Crises in Emerging Markets", *The Economic Journal*, 110, 256-272.
- [12] Dubey, P. and J. Geanakoplos (2002), "Competitive Pooling: Rothschild-Stiglitz Reconsidered", Cowles Foundation Discussion Paper 1346RR.
- [13] Dubey, P. and J. Geanakoplos and M. Shubik (2000), "Default in a General Equilibrium Model with Incomplete Markets", Cowles Foundation Discussion Paper 1247.
- [14] Hellmann, T., K. Murdock and J. Stiglitz (2000), "Liberalization, Moral Hazard in Banking and Prudential Regulation: Are capital Requirements Enough?", *American Economic Review*, 90, 147-165.
- [15] Helpman, E. and J-J. Laffont (1975), "On Moral Hazard in General Equilibrium", *Journal of Economic Theory*, 10, 8-23.
- [16] Hoff, K. and J.E. Stiglitz (1990), "Imperfect Information and Rural Credit Markets—Puzzles and policy Perspectives", *World Bank Economic Review*, 4, 235-250.
- [17] Hoff, K. and J.E. Stiglitz (1997), "Moneylenders and Bankers: Price-Increasing Subsidies in a Monopolistically Competitive Market", *Journal of Development Economics*, 52, 429-462.
- [18] Kahn C. M. and D. Mookerjee (1998), "Competition and Incentives with Nonexclusive Contracts", *RAND Journal of Economics*, 29, 443- 65.
- [19] Kletzer, K. M. (1984), "Asymmetries of Information and LDC Borrowing with Sovereign Risk", *Economic Journal*, 94, 287-307.
- [20] Kocherlakota, N.R. (1998), "The Effects of Moral Hazard on Asset Prices when Financial Markets are Complete", *Journal of Monetary Economics*, 41, 39-56.
- [21] McKinnon, R.I. and H. Pill (1996), "Credible Liberalizations and International Capital Flows: The Overborrowing Syndrome", in Ito, T. and A.O. Krueger (eds.), *Financial Deregulation and Integration in East-Asia*, NBER-East Asia Seminar on Economics, 5, Chicago U.P., 7-42.
- [22] Milgrom, P. and C. Shannon (1994): "Monotone Comparative Statics", *Econometrica*, 62, 157-180.

- [23] Parlour, C. A. and U. Rajan (2003), "Competition in Loan Contracts", *American Economic Review*, 91, 1311-1329.
- [24] Pauly, M. (1974), "Overprovision and Public Provision of Insurance: The Roles of Adverse Selection and Moral Hazard", *Quarterly Journal of Economics*, 88, 44-62.
- [25] Petersen, M.A. and R.G. Rajan (1994), "The Benefits of Lending Relationships: Evidence from Small Business Data", *Journal of Finance*, 49, 3-37.
- [26] Petersen, M.A. and R.G. Rajan (1995), "The Effect of Credit Market Competition on Lending Relationships", *Quarterly Journal of Economics*, 110, 407-444.
- [27] Prescott, E. and R. Townsend (1984), "Pareto Optima and Competitive Equilibria with Adverse Selection and Moral Hazard", *Econometrica*, 52, 21-45.
- [28] Rodrick, D. (1998), "Who Needs Capital-Account Convertibility?" in Kennen, P. (ed.) *Should the IMF Pursue Capital Account Convertibility?*, Essays in International Finance, N. 207, Princeton U.P.
- [29] Stiglitz, J.E. (1990), "Peer Monitoring and Credit Markets", *World Bank Economic Review*, 4, 351-66.
- [30] Stiglitz, J.E. (1991), "The Invisible Hand and Modern Welfare Economics", NBER W.P. No. 3641.

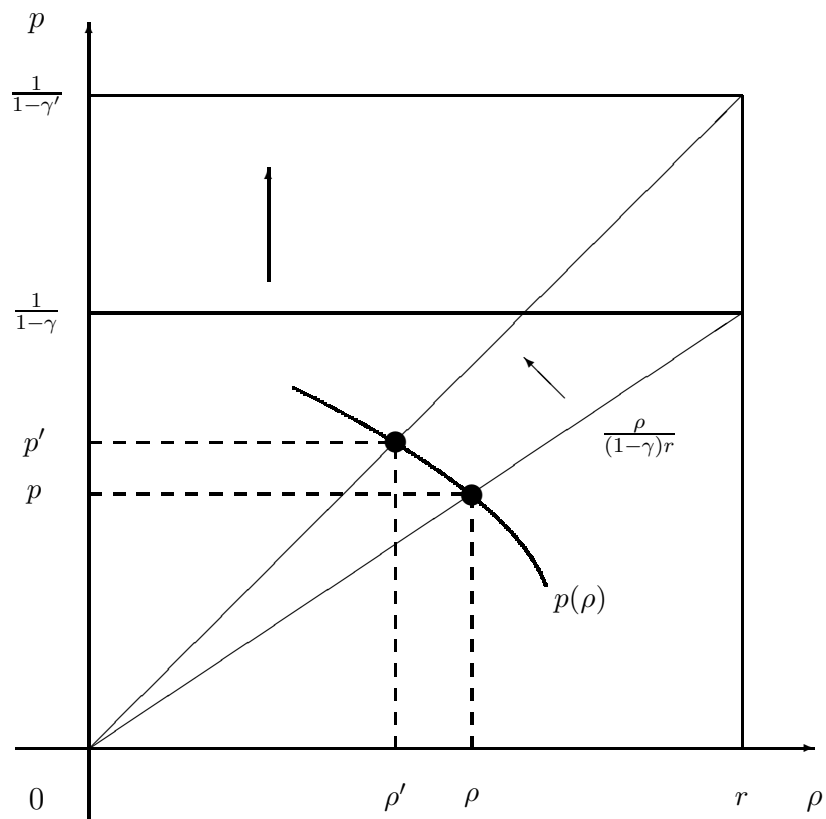


Figure 2

The effect of an increase in intermedation costs
on equilibrium values of ρ and p .

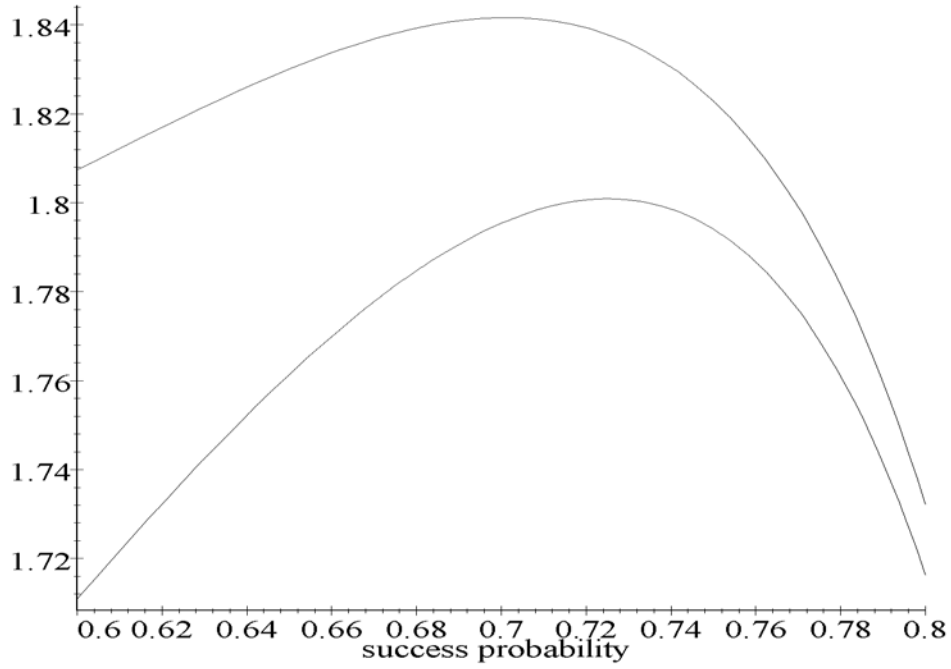


Figure 2

Indirect expected utility $U^*(e, \rho)$.Curve above: $\rho = .6, \gamma = .42$. Curve below: $\rho = .4, \gamma = .63$.