Welfare Implications of Formal Credit

Rajlakshmi Mallik*

Loreto College, Calcutta
and
Economic Research Unit, Indian Statistical Institute, Calcutta

First draft : do not quote

Abstract

This paper deals with the welfare issue in the context of a model in which financial dualism is defined in terms of the differences in ex-post monitoring cost of the FL and IL. It reaches the conclusion that informal loans induce low effort and result in lower expected output and is therefore not desirable. It also follows from the analysis that informal interest-rate is higher than the formal interest-rate, which is a commonly observed feature of the credit markets of LDCs.

Key Words: Informal Credit**,** Competition, Effort, Welfare

JEL Classification: D62, C72

Address for correspondence
Rajlakshmi Mallik
Economic Research Unit
Indian Statistical Institute
203, B.T. Road, Calcutta – 700 035
e-mail: m_rajlakshmi@hotmail.com

* The author wishes to thank Professor Abhirup Sarkar for valuable comments and suggestions.
I am grateful to Prof. Sugata Marjit (CSSS), Prof. Bhaswar Maitra (JU) and Dr. Diganta Mukherjee (ISI), for their helpful suggestions. I thank the seminar participants at the 11th Annual Conference on Contemporary Issues in Development Economics organised by JU for their comments. The usual disclaimer applies.

1. Introduction:

The structural heterogeneity of the credit markets in LDCs is very often reflected in the co-existence of lenders with differences in transaction costs. Specifically, informal lenders (ILs) having low transaction cost co-exists with formal lenders (FLs) having high transaction cost. FLs refer to the large institutional lenders, like commercial banks and other government owned banks that are subject to various central bank regulations. The ILs on the other hand are a heterogeneous lot and consist of non-institutional lenders like indigenous bankers, moneylenders, traders, landlords etc., who are outside the gambit of the central bank

A significant component of the transaction cost is the cost of monitoring loans, for bad debts. Since borrowers in informal markets are generally known parties under continuous surveillance, it makes the state verification cost low and also makes recovery possible without having to go to the courts. To quote Hoff and Stiglitz (1990),

> " In developing countries potential lenders vary greatly in their costs of … monitoring. For some lenders, such costs are low; information is a by-product of living near the borrower or being part of the same kinship group… Thus, village lenders often do considerable monitoring, while banks may find it virtually impossible to do so….".

Ramachandran and Swaminathan (2000), in their survey of rural credit in Gokulapuram village in Tamilnadu observe that the money-lenders enjoy great power and wield a lot of influence. The fear of public disgrace brought upon by the money-lenders and lack of alternative employment opportunities is a great deterrent against default on loans, by the borrowers, who are socially and economically in much weaker position. Unlike in the informal sector, the relationship between the FL and its clients is not personalised. The high operating cost and the elaborate procedural complexities that the FL has to go through in case of default makes the loan recovery cost very high.

A question that is inevitably raised in the context of the credit markets in most LDCs, is whether the financial dualism that characterises it, is efficient. In other words if the informal credit market shrinks, will it increase welfare. The literature on informal credit discusses the welfare issue mainly in terms of the high rates of interest charged by ILs. Hoff and Stiglitz (1990) provide an overview of some of the empirical surveys of the informal credit markets in Pakistan, India, Nigeria and Thailand. These studies provide empirical support to the hypothesis that ILs charge exploitatively high rates of interest much to the misery of the borrowers. The study conducted by Ramachandran and Swaminathan (2000) of rural credit in Tamilnadu, India reports similar findings. There is also a large theoretical literature that has analysed the adverse welfare implications of informal credit from the same point of view. Bottomley (1964), Basu (1984a) are two well-cited papers in the literature in this area. They offer alternative explanations[1] for the high rates of interest charged by the ILs. Basu views the high informal interest rates as a veil for transferring collateral, rather than the outcome of the higher risk faced by the ILs on agricultural loans, as argued by Bottomley. Bose (1998) has addressed the issue from a different angle. He attributes the inefficiency of the IL to the low volume of credit generated by the IL because of clientalisation.

[1] For more discussion on this area refer to Chapter 1.

A totally different approach is to look at informal credit as filling the gap between demand and supply of formal credit, especially with regard to the small-scale sector. The informal credit is then viewed as playing a positive role in promoting growth in the small-scale sector (which is an important potential growth sector in developing or newly industrialising countries as the experience of the Eastern European and Asian counties suggest) and overall growth in national income. Kan (2000) provides empirical support for this hypothesis from Taiwan[2]. Thus, in this approach the IL is not the usurious moneylender as envisaged in the literature cited above.

This chapter/paper addresses the issue of adverse effect of informal lending on welfare, in terms of a model in which financial dualism is reflected in the differences in ex-post loan monitoring cost. It reaches the conclusion that informal loans induce low effort and result in lower expected output and is therefore not desirable. It also follows from the analysis that informal interest-rate is higher than the formal interest-rate, which is a commonly observed feature of the credit markets of LDCs. However given that the IL is the low cost type while the FL is the high cost type the result is not intuitively obvious.

Ex-post information asymmetry that shows up as positive monitoring cost has been used in the literature to explain the phenomenon of equilibrium credit rationing. Gale and Hellwig (1985), used a costly state verification set up with variable loan size for highlighting credit market equilibrium where credit is rationed by restricting the size of loans. Williamson (1987), in his paper used ex-post monitoring cost for modeling credit market equilibrium characterised by number rationing.[3]The focus of this chapter/paper is however different from that in the literature cited above. This chapter/paper is primarily concerned with addressing the issue of the inefficiency of financial dualism. The costly state verification set up with differences in state verification cost across lenders is crucial in revealing the relative inefficiency of the ILs.

Structurally the model shares several important features with Williamson's (1987) model. In Williamson's model as in this model, ex-ante information asymmetry between borrowers and lenders is ruled out by assumption. Borrowers are identical and lenders have perfect knowledge about the probability distribution of the returns from the borrowers' projects. Ex-post information asymmetry is incorporated in terms of a positive monitoring cost for observing output. Loan size is fixed at unity. However unlike in Williamson, this model assumes away differences in opportunity returns to the lenders. On the other hand it introduces lender differentiation in terms of monitoring cost.

The plan of this chapter/paper is as follows. Section 2A develops the conceptual framework. Section 2B describes the payoff functions. Section 2C briefly discusses the nature of credit market equilibrium when output is independent of effort. Section 3 considers the welfare effects of formal lending in terms of a model of production uncertainty in which expected output increases with effort. Section 3A discusses the nature of the profit functions of the agents. The optimal contracts and the welfare implications are discussed in section 3B. Finally section 4 presents conclusions.

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[2] See also Dessus et al. (1995), Ho (1980).

[3] This stands in contrast to the credit market situation modeled by Stiglitz and Weiss (1981), and Keeton (1979), where ex-ante information asymmetry plays a key role in inducing number rationing.

2.Analysis of the model in the absence of effort

2A. Conceptual framework

There are two types of agents: entrepreneurs and lenders. Each lender is endowed with one unit of an investment good. The entrepreneurs do not have any endowments of their own. They only have access to a risky project of unit size, which yields a random output $q \in [0, \overline{q}]$. Let $f(q)$ and $F(q)$ be the p.d.f. and c.d.f. respectively, corresponding to q.

The entrepreneurs must borrow the investment good from the lenders in order to undertake the project. Loan demand per entrepreneur is fixed at unity. We assume that the aggregate demand for loans is large in relation to the supply of formal loans. The loan market is however characterised by information asymmetry. The realised output *q* is observable only to the entrepreneurs. The lenders must incur a monitoring cost in order to observe the output. Now suppose that lenders are differentiated in terms of their monitoring cost. Let γ_F and γ_I be the monitoring cost of the formal lenders (FL) and informal lenders (IL) respectively, with $\gamma_F > \gamma_I$. Given the information asymmetry the optimal contract in either case must satisfy the incentive compatibility or truth telling constraint of the entrepreneur. This is in addition to the entrepreneur's participation and the feasibility constraints.

The contracting problem that is involved here is a standard one. In the existing literature however, the usual practice is to regard the entrepreneur's expected profit as the objective to be maximised subject to the lender's participation. In the developing countries the lenders enjoy a dominant position vis-à-vis the entrepreneurs. The number of entrepreneurs is large in relation to the number of lenders. Therefore the appropriate formulation of the optimal contracting problem would be to regard the lender as the principal whose profit is the objective to be maximised subject to the entrepreneurs (agents) receiving their reservation utility. The switch in roles of the entrepreneur and lender, as principal and agent however does not affect the optimality of the debt contract. Thus either the entrepreneurs pay $r_j, j = F, I$ which is the gross interest on formal or informal loans as the case may be. In case of default [4], that is in case .the entrepreneurs fail to pay r_j, the lenders monitor and take away the entire realised output *q*.

Note that here the FL is also a profit maximiser with a free interest rate. This is unlike the situation where the FL has to implement a regulated interest rate. We take this assumption here, since our objective is to compare the relative efficiency of the two types of lenders

2B. Payoff Functions

[4] Since it is not incentive compatible to lie when $q \geq r_j$, therefore the entrepreneurs will default only when $q < r_j$.

We consider a model of a localised credit market with just one FL and one IL. As mentioned above both the FL and the IL maximise their profit by choosing the rate of interest optimally. Note that here the lenders need not compete, as the market is supply constrained. In other words, we need not consider the possibility of Bertrand competition between the FL and the IL, which would have left the lenders with zero profits.

Assuming that q is uniformly distributed over the interval $[0,\overline{q}]$, the lender's optimisation problem may now be stated as:

$$\underset{r_j}{Max} \quad \Pi_l^j(r_j,\gamma_j) = r_j - \frac{r_j^{\;2}}{2\overline{q}} - \frac{\gamma_j\, r_j}{\overline{q}} \qquad \text{for } j = F, I. \qquad (1)$$

$$\text{subject to} \qquad \Pi_e^j(r_j) = \frac{\overline{q}}{2} + \frac{r_j^{\;2}}{2\overline{q}} - r_j \geq \overline{w} \qquad \text{for } j = F, I. \qquad (2)$$

The sum of the first two terms in the lenders profit function stated in (1), is the expected loan repayment. Given r_j, the probability of default and hence the probability that the lender will have to monitor is $r_j/\overline{q}$. Thus the third term in (1) is the lenders' expected monitoring cost. Inequality (2) represents the entrepreneur's participation constraint. The left hand side of inequality (2) is the entrepreneur's profit function, which is the difference between expected output equal to $\overline{q}/2$ and expected loan repayment.

Using standard calculus it is easily demonstrated that the Π_l function is concave in r_j and reaches its maximum at $r_j{*} = \overline{q} - \gamma_j < \overline{q}$. The Π_e function is decreasing in r_j. As r_j increases, the lenders receive more when the entrepreneurs are successful. This increases the lender's expected return. But as r_j increases, it increases the probability of default as well, leading to an increase in the expected monitoring cost. This tends to reduce the lender's expected return. The net effect is positive at low r_j and becomes negative at high r_j, making the Π_l^j curve inverted-U shaped. The negative slope of the Π_e^j curve follows, because with an increase in r_j, expected loan repayment increases while expected output remains the same.

Figure 1 below shows Π_l as a function of r, for the FL and the IL, given γ_F and γ_I. Now $\partial\Pi_l^j/\partial\gamma_j = -F(r_j) < 0$. For the FL , whose monitoring cost is γ_F, the expected monitoring cost corresponding to any r_F is higher. Thus the $\Pi_l^F(r_F,\gamma_F)$ curve lies below the $\Pi_l^I(r_I,\gamma_I)$ curve. This makes the expected loan repayment net of expected monitoring cost, Π_l lower. Moreover with higher monitoring cost, an increase in r_F causes the expected monitoring cost to increase at a faster rate. This causes the negative effect of r_F increase to dominate at a lower r_F. Thus the maxima of the Π_l^F curve will lie to the left of the maxima of the Π_l^I curve. Hence $r_F{*} < r_I{*}$.

2C.Equilibrium

The loan market equilibrium is discussed in terms of figure 1 where the relative position of the payoff curves has already been discussed in the in the previous sub-section. We first consider the case where the entrepreneurs' reservation utility is $\overline{w}_2$. This makes the entrepreneur's participation constraint non-binding at r_F* and r_I*. Thus in equilibrium, the FL will always choose r_F*, yielding an amount of payoff represented by the line segment r_F*F to the entrepreneurs.

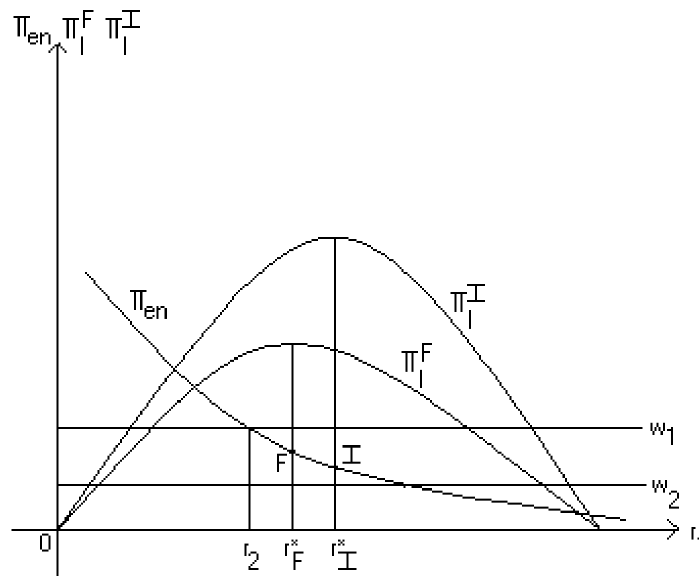

FIG.1

With credit rationing[5] in the formal sector, given that the maxima of the Π_l^I curve lies more to the right, the equilibrium rate of interest for the IL would be $r_I*>r_F*$. In other words the FL whose monitoring cost is high will choose a lower rate of interest to make monitoring less likely. The entrepreneurs borrowing from the IL will earn an expected return $r_I*I<r_F*F$. In the absence of credit rationing in the formal sector the equilibrium rate of interest chosen by the IL would be r_F*.

Let us now consider the case where the entrepreneur's reservation utility is sufficiently high, say at $\overline{w}_1$. This makes both r_F* and r_I* infeasible. Thus in equilibrium both the FL and the IL would choose $\overline{r}_2$, leaving the entrepreneur's just at their reservation payoff. Note that in this model productivity is not affected by the rate of interest. From the above discussion we have the following proposition:

[5] There exists credit rationing in the sense that the FL would not increase r_F beyond r_F* even if there is an excess demand for loans.

Proposition 1: Suppose (i) there exist high monitoring cost and low monitoring cost lenders and identical entrepreneurs
(ii) output is entirely random and observable only to the entrepreneur, and
(iii)lenders are profit maximisers subject to yielding a reservation utility to entrepreneurs. Then it would follow that:
(a) Standard Debt Contract with bankruptcy (SDC) is the optimal contract form
(b) $r_F^E \le r_I^E$ where r_j^E is the equilibrium rate of interest charged by lender of type *j*, $j = F, I$ .Thus in equilibrium the interest rate charged by the IL (who is low cost) would be at least as high as that charged by the FL (who is high cost).

3. Welfare effects of formal lending

3A. Payoff functions

We will now study a more realistic model of production uncertainty to study the welfare effects of formal lending.

Let us assume that the distribution function of q is not exogenously given. It is also affected by the entrepreneur's effort [6] e, which is observable to the lender and is contractible. The lender does not have to incur any monitoring cost for observing effort. Let the expected output be an increasing function of e with diminishing marginal returns. We further assume that effort causes disutility $c(e)$ to the entrepreneur with, $c'(e) > 0, c''(e) > 0$. Thus any change in effort affects the entrepreneur's expected residual output after loan repayment and his disutility from effort as well.

As in the previous section we assume that the realised output q, is not observable to the lender. The lender has to incur a monitoring cost γ_j, $j = F, H$ in case he wants to observe output, with $\gamma_F > \gamma_I$. Since effort is contractible, the incentive problem and hence the optimality of the debt contract remains unchanged. Considering an uniform distribution for q conditional on effort, $f(q,e) = \frac{1}{\overline{q}}$, $\overline{q} = h(e)$, $h'(e) > 0, h''(e) < 0$, the optimal choice problem reduces to:

$$\max_{e_j, r_j} \Pi_l^j = r_j - \frac{r_j^2}{2h(e_j)} - \frac{\gamma_j r_j}{h(e_j)} \tag{3}$$

$$\text{subject to} \quad \Pi_e^j = \frac{h(e_j)}{2} + \frac{r_j^2}{2h(e_j)} - r_j - c(e_j) \ge \overline{w} \quad \text{for } j = F, I \tag{4}$$

The lender's profit function in (3) expresses the difference between expected loan repayment and expected monitoring cost as before. However the expected loan repayment and expected monitoring cost are now affected by e as well. The expected

[6] Note that e may be interpreted in general as any complementary input.

output is given by $h(e_j)/2$. The inequality in (4) represents the entrepreneur's participation constraint. Since effort causes disutility to the entrepreneur, therefore the entrepreneur's profit function on the left hand side of inequality (4) now includes an additional term, $c(e_j)$ representing disutility from effort. This has to be deducted from expected output from the project along with expected loan repayment to arrive at the entrpreneur's payoff.

Below we make a remark, which will be used subsequently to characterise the equilibrium discussed in proposition 2.

Remark 1: The slope of the Π_e^j contours drawn in (e_j, r_j) space is:

$$\frac{dr_j}{de_j} = -\frac{\partial \Pi_e^j / \partial e_j}{\partial \Pi_e^j / \partial r_j} = -\frac{\frac{1}{2}h'(e_j)\{1 - F(r_j)^2\} - c'(e_j)}{F(r_j) - 1} \; \underset{>}{\overset{<}{-}} \; 0 \text{ according as,}$$

$$c'(e_j) \; \underset{<}{\overset{>}{-}} \; \tfrac{1}{2}h'(e_j)\{1 - F(r_j)^2\}.$$

Thus if an increase in *e* leads to a large increase in disutility from effort that more than offsets the increase in the entrepreneur's residual output after loan repayment, then an increase in *e* will reduce the entrepreneurs expected return.

Since $c''(e_j) > 0$, it means the disutility effect of an increase in effort gets stronger the higher the level of effort. This implies that at higher levels of effort the increased disutility from increased effort might more than offset the increase in the entrepreneur's residual output after loan repayment. Thus the expected return to the entrepreneur might fall with an increase in effort. Further given that the entrepreneur's profit is decreasing in r_j, the Π_e^j contours are likely to have a positive slope at low levels of effort and become negatively sloped at high levels of effort. It would also follow that the Π_e^j contours corresponding to higher values of Π_e^j will lie lower.

3B. Optimal Contract

In order to find out the optimal contracts (C_F^E, r_F^E) and (C_I^E, r_I^E) of the FL and the IL respectively, we solve the lender's optimisation problem stated in (3) and (4). We solve this problem for a general γ. The FL's (IL's) optimal contract is obtained if we substitute γ by γ_F (γ_I). The Lagrangean objective function for the lenders' optimisation problem is,

$$Z(e,r,\lambda) = r - \frac{r^2}{2h(e)} - \frac{\gamma r}{h(e)} - \lambda\left[w - \frac{h(e)}{2} - \frac{r^2}{2h(e)} + r + c(e)\right] \tag{5a}$$

The Kuhn-Tucker conditions are given by:

$$\frac{\partial Z}{\partial e} = \frac{h'(e)r}{h^2(e)}\left(\frac{r}{2} + \gamma\right) - \lambda\left(-\frac{h'(e)}{2} + \frac{r^2 h'(e)}{2h^2(e)} + c'(e)\right) \leq 0 \qquad e \geq 0, \quad e\frac{\partial Z}{\partial e} = 0 \tag{5b}$$

$$\frac{\partial Z}{\partial r} = 1 - \frac{r+\gamma}{h(e)} - \lambda\left(-\frac{r}{h(e)} + 1\right) \leq 0 \qquad r \geq 0, \quad r\frac{\partial Z}{\partial r} = 0 \tag{5c}$$

$$\frac{\partial Z}{\partial \lambda} = w - \frac{h(e)}{2} - \frac{r^2}{2h(e)} + r + c(e) \leq 0 \qquad \lambda \geq 0, \quad \lambda\frac{\partial Z}{\partial \lambda} = 0 \tag{5d}$$

Now we consider certain lemmas.

Lemma 1: $\lambda^E > 0$ for $e^E, r^E > 0$ i.e. for non-trivial solution the participation constraint is always binding in equilibrium.

Proof: Suppose not. Then $\lambda^E = 0$ and $e^E, r^E > 0$.

Now for $e^E > 0$ and $\lambda^E = 0$, from the Kuhn-Tucker conditions we have, $\frac{\partial Z}{\partial e} = \frac{h'(e)r}{h^2(e)}\left(\frac{r}{2} + \gamma\right) = 0 \Rightarrow h'(e) = 0$. This contradicts the assumption that $h'(e) > 0$.

This proves lemma 1.

Lemma 2: $\left.\frac{dr}{de}\right|_{\Pi_e} = \left.\frac{dr}{de}\right|_{\Pi_l} < 0$ at (e^E, r^E). The entrepreneur's iso-profit contour corresponding to his reservation utility, i.e. the entrpreneur's participation constraint must be negatively sloped at the equilibrium point. Hence the lender's iso-profit contour must be negatively sloped at the equilibrium point.

Proof: Π_e initially increases and then decreases with e. This follows from $c''(e) > 0, h''(e) < 0$. As the level of effort increases, the marginal disutility from effort eventually offsets the increase in the entrepreneur's residual output after loan repayment (vide Remark 1). Thus for any choice of r, there exists two values of e, say e_1 and e_2, $e_1 < e_2$, such that $\Pi_e(r,e_1)=\Pi_e(r,e_2)$ and $c'(e_k) \le$ or $>$ $\frac{1}{2}h'(e_k)\{1-F(r)^2\}$ at $k=1,2$ respectively. Note that Π_l is increasing in e. Thus for any choice of r the lender would always choose $e_2 > e_1$. However at e_2, $\left.\frac{dr}{de}\right|_{\Pi_e} < 0$.

This follows from,

$$-\frac{\partial\Pi_e/\partial e}{\partial\Pi_e/\partial r} = -\frac{\frac{1}{2}h'(e)\{1-F(r)^2\}-c'(e)}{F(r)-1} \begin{smallmatrix} < \\ - \\ > \end{smallmatrix} 0\text{, according as, } c'(e) \begin{smallmatrix} > \\ - \\ < \end{smallmatrix} \frac{1}{2}h'(e)\{1-F(r)^2\}.$$

Now in equilibrium, $\left.\frac{dr}{de}\right|_{\Pi_e} = \left.\frac{dr}{de}\right|_{\Pi_l}$.

This proves lemma 2.

We now focus on the profit function of the lender, Π_l.

The slope of the iso-profit contours of the lenders, in the (e,r) space is given by $\left.\frac{dr}{de}\right|_{\Pi_l} = -\frac{\partial\Pi_l/\partial e}{\partial\Pi_l/\partial r}$. Now $\frac{\partial\Pi_l}{\partial e} = \frac{r^2}{h^2(e)}\frac{h'(e)}{2} + \frac{r\gamma\, h'(e)}{h^2(e)} > 0$ at all (e,r). Further $\frac{\partial\Pi_l}{\partial r} = \left(1-\frac{r+\gamma}{h(e)}\right) \begin{smallmatrix} > \\ - \\ < \end{smallmatrix} 0$ according as $r \begin{smallmatrix} < \\ - \\ > \end{smallmatrix} h(e)-\gamma = r^*(e)$, given e. Thus $\left.\frac{dr}{de}\right|_{\Pi_l} <$ or $>$ 0 according as $r <$ or $> r^*(e)$, given e. Thus for any given e, the iso-profit contours are negatively sloped below $r^*(e)$ and positively sloped above $r^*(e)$. Note that the tangents to the iso-profit contours of the lenders become vertical at $(e, r^*(e))$. The equilibrium contract will however lie on the negatively sloped portion of the Π_l contours. This follows from lemma 2.

Remark 2: The lender's iso-profit contours are C-shaped.

Remark 3: $r^*(e)$ maximises $\Pi_l(e,r)$ for a given e. (The second order condition for a maximum is satisfied at r^* since the derivative $\frac{\partial^2\Pi_l}{\partial r^2} = -\frac{1}{h(e)} < 0$). Further note that e is the minimum effort required to achieve $\Pi_l^* = \Pi_l((e,r^*(e)))$. Hence the iso-profit contours of the lenders corresponding to Π_l^*, will lie at or to the right of this minimum e, as illustrated in figure 3.

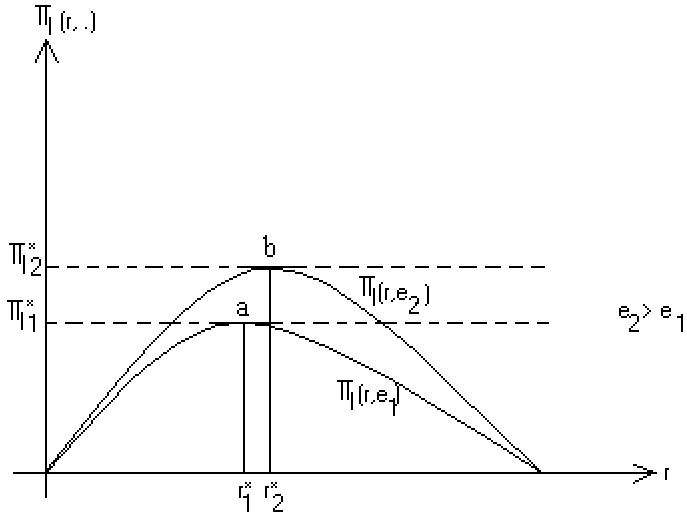

FIG. 2

Each curve in figure 2 shows Π_l as a function of r, for a given e. The maxima of Π_l curves corresponding to higher effort will lie more to the right. At a higher level of effort the probability of success is higher. Thus the increase in expected loan repayment corresponding to any increase in r will be higher. Hence the increase in expected monitoring cost would dominate the rise in expected loan repayment at a higher r. Note that the points 'a' and 'b' in figure 2, correspond to the points in (e,r) space at which the iso-profit contours of the lenders corresponding to Π^*_{l1} and Π^*_{l2} will become vertical.

Now the equation of the locus of points in (e,r) space at which the tangents to the lender's iso-profit contours become vertical is given by

$$r^*(e) = h(e) - \gamma \tag{6}$$

We now use equation (6) to compare the iso-profit contours for the FL and the IL in the following lemma.

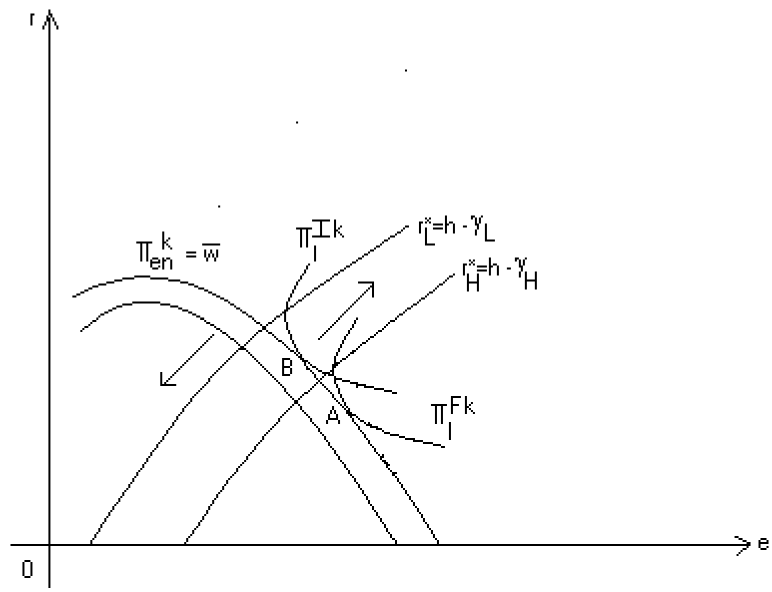

FIG.3

Lemma 3: For each profit level, the iso-profit contour of the FL will lie below that of the IL.

Proof: Since $\gamma_F > \gamma_I$ therefore, substituting γ_F and γ_I for γ in equation (6), yields $r_I{*} = h(e_I) - \gamma_I > r_F{*} = h(e_F) - \gamma_F$, if $e_F = e_I$. In other words the locus of points at which the tangents to the FL's iso-profit contours are vertical will lie below the locus corresponding to the IL.
Hence lemma 3 follows.

Now consider the contract (e_0, r_0) satisfying $r_0 = h(e_0) - \gamma_I$. Let $\Pi_l^I(e_0, r_0) = \Pi_l^0$. Again consider the contract (e_0, r_1) where $r_1 = h(e_0) - \gamma_F$. From equation (3) we have the lender's profit decreasing in γ_j. Hence $\Pi_l^F < \Pi_l^I$ at all $r_F = r_I$, if $e_F = e_I$. Moreover from equation (6) we know that $r_F{*}(e) < r_I{*}(e)$. This means that $\underset{r_F}{Max}\,\Pi_l^F < \underset{r_I}{Max}\,\Pi_l^I$. In other words from equation (6) and equation (3) we find that for any given level of effort the profit maximising interest rate and the maximum profit of the high cost lender would be lower than that of the low cost lender. Hence $\Pi_l^F(e_0, h(e_0) - \gamma_F) < \Pi_l^0$. It follows that the iso-profit contour of the high-cost lender that lies vertically below that of the low cost lender will correspond to a lower level of profit. Hence we have the following remark.

Remark 4: For each profit level the iso-profit contour of the high cost lender will lie to the right of that of the low cost lender.

Lemma 4: The lenders iso-profit contours are convex in the region where they are negatively sloped.
Proof: See Appendix.

Proposition 2: In equilibrium, $e_F^E > e_I^E$ and $r_F^E < r_I^E$. In other words the equilibrium contract offered by the FL (who is high cost) will specify a higher level of effort and a lower rate of interest, compared to the contract offered by the IL (who is low cost). The entrepreneurs will receive just their reservation utility, irrespective of the source of loan.

Proof: From lemmas 1 and 2 it follows that the equilibrium contracts must lie on the negatively sloped portion of the iso-profit contour representing the entrepreneur's participation constraint. From lemmas 3 and 4 it would follow that the point of tangency of the FLs iso-profit contour with the entrepreneur's participation constraint must correspond to a higher level of effort and a lower interest rate.

Since expected output is an increasing function of effort we have the following remark based on proposition 2.

Remark 5: Formal loans induce larger expected output.

The inverse relationship between equilibrium rate of interest and effort level may be explained in terms of figure 4.

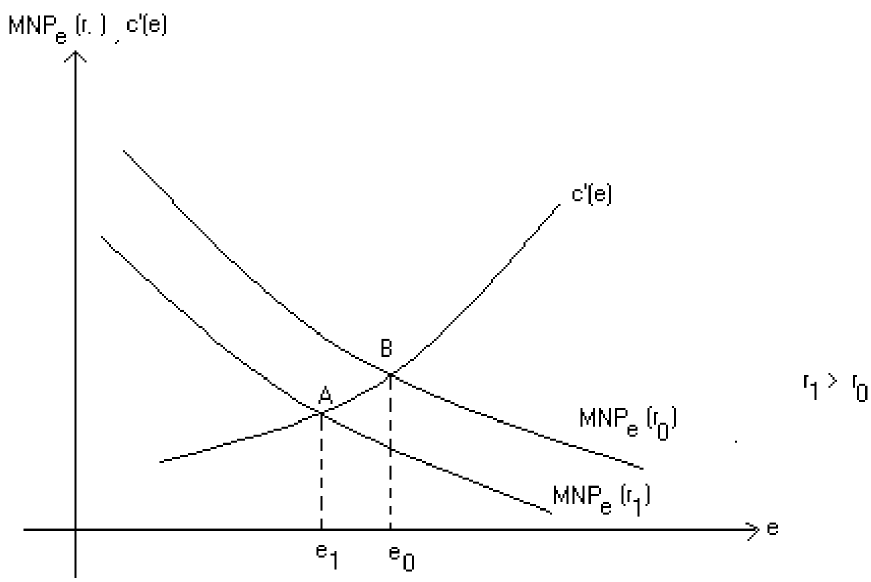

FIG. 4

For a given rate of interest r, an increase in effort causes expected output to increase faster than the expected loan repayment. This leaves the entrepreneur with a larger surplus output at higher effort. In other words the marginal net product from effort, MNP_e is positive. However

$$\frac{\partial}{\partial r}[\frac{\partial}{\partial e}(E(q)) - \frac{\partial}{\partial e}(E(LR))] = \frac{\partial}{\partial e}(E(LR)) = -h'(e)F(r)f(r) < 0$$

Thus a higher the rate of interest , reduces the marginal net product from effort. This is because the rate of increase in expected output is independent of r. However, a higher r would imply a larger increase in expected loan repayment as e increases. This is due to both the effect on probability of success and repayment effect. Not only will the entrepreneurs have to pay more if they are successful, but the probability of success also increases.

Now given r, the entrepreneur's effort choice must be such that, it would equate the $\mathrm{MNP_e}$ and the marginal disutility from effort. This requires that $\frac{\partial}{\partial e}(E(q)) - \frac{\partial}{\partial e}(E(LR)) = c'(e)$, where $E(q)$ and $E(LR)$ represent expected output and expected loan repayment respectively.

As stated above a higher r reduces the entrepreneur's marginal net product from effort. Hence given $c''(e) > 0$, a higher r would induce entrepreneurs to choose a lower e in equilibrium. Here the implicit assumption is that $c''(e) > \partial \mathrm{MNP_e} / \partial e$. The $\mathrm{MNP_e}$ may be increasing or decreasing in e. Violation of the inequality would imply that the entrepreneur's payoff is convex in effort which is unrealistic.

In the subsequent discussion we will consider a continuum of γ values for ease of exposition.

Proposition 3: Formal lending is more conducive to welfare , if $\gamma_F < \gamma^*$.

Proof: Denoting the total surplus by S, we have

$$S = \Pi_e + \Pi_l. \tag{7a}$$

Substituting for Π_l and Π_e using (3) and (4) respectively and simplifying we have,

$$S = \frac{h(e)}{2} - c(e) - \frac{\gamma\, r}{h(e)} \tag{7b}$$

Now differentiating (7a) with respect to γ yields,

$$\frac{\partial S}{\partial \gamma} = \frac{\partial \Pi_e}{\partial \gamma} + \frac{\partial \Pi_l}{\partial \gamma} \tag{8}$$

Since the entrepreneur's participation constraint in (4) is always binding i.e. $\Pi_e = \overline{w}$ in equilibrium, therefore the derivative $\frac{\partial \Pi_e}{\partial \gamma} = 0$ at $\left(e^E, r^E\right)$. Hence using equation (8), we may express the rate of change in total surplus for equilibrium values of r and e as,

$$\frac{\partial S}{\partial \gamma} = \frac{\partial \Pi_l}{\partial \gamma} = \frac{\partial}{\partial \gamma}\left(r - \frac{r^2}{2h(e)}\right) - \frac{\partial}{\partial \gamma}\left(\frac{\gamma r}{h(e)}\right) \tag{9}$$

That is as γ increases, the change in value of total surplus is equal to the change in the lender's profit in equilibrium. In other words, the change in total surplus is the difference between the change in expected loan repayment and change in the expected monitoring cost of the lender.

Since $\frac{\partial \Pi_e}{\partial \gamma} = 0$ in equilibrium, it also follows that the change in expected loan repayment may be expressed as the difference between the change in expected output from the project and the change in disutility from effort (as γ changes).

$$\frac{\partial}{\partial \gamma}\left(r - \frac{r^2}{2h(e)}\right) = \frac{\partial}{\partial \gamma}\left(\frac{h(e)}{2}\right) - \frac{\partial}{\partial \gamma}c(e) = \left(\frac{h'(e)}{2} - c'(e)\right)\frac{de}{d\gamma} \tag{10}$$

Note that here we are concerned with the equilibrium values of e and r which are functions of γ. Now $h''(e) < 0$ and $c''(e) > 0$ by assumption and $de/d\gamma > 0$ (from proposition 2). Hence the expression on the right hand side in (10) is likely to be negative for very high levels of effort and positive for low levels of effort, irrespective of the value of r. Therefore the expected loan repayment is likely to increase and then decrease with effort and hence with γ, as effort varies directly with γ.

The rate of change in the expected monitoring cost following a change in γ is given by,

$$\frac{\partial}{\partial \gamma}\left(\frac{\gamma r}{h(e)}\right) = \frac{r}{h(e)}\left(1 - \frac{\gamma\, h'(e)}{h(e)}\frac{de}{d\gamma}\right) + \frac{\gamma}{h(e)}\frac{dr}{d\gamma} \tag{11}$$

The second term on the right hand side of (11) is negative, since $dr/d\gamma < 0$ (proposition 2). Thus a sufficient condition for the change in expected monitoring cost of the lender to be negative is that $\frac{\gamma}{h(e)}\frac{h'(e)}{}\frac{de}{d\gamma} > 1 \Leftrightarrow \left(\frac{dh(e)}{de}\frac{e}{h(e)}\right)\left(\frac{de}{d\gamma}\frac{\gamma}{e}\right) > 1$. The first term of the product on the left-hand side of the inequality is output elasticity with respect to effort. The second term is the elasticity of the equilibrium value of effort with respect to γ . For small values of γ the output elasticity is likely to be greater than one since the value of equilibrium is small. Again for small γ , $\frac{de}{d\gamma}\frac{\gamma}{e}$ is likely to be large, given that the iso-profit contours of the entrepreneurs are concave in e. Thus for small γ , the condition is likely to be satisfied. Then the expected monitoring cost of the lender will decrease as γ increases, for small γ .

Alternatively, suppose $d^2e/d\gamma^2 < 0$. This implies that $d^2r/d\gamma^2 \geq 0$, given proposition 2 and given that the iso-profit contours of the entrepreneur are concave. Now suppose $d^2r/d\gamma^2 > 0$. Then if γ is very small, from proposition 2 it follows that the equilibrium value of e is small and that of r is large. Further $de/d\gamma$ and $h'(e)/h(e)$ are large. This follows because $h''(e) < 0$ and $d^2r/d\gamma^2 > 0$ by assumption. Hence $\frac{r}{h(e)}\left(1-\frac{\gamma\ h'(e)}{h(e)}\frac{de}{d\gamma}\right)$ is likely to be a negative or small positive number, inspite of the fact that $\frac{r}{h(e)}$ will be larger compared to the case when γ is large. The effect of a large $\frac{r}{h(e)}$ will not be dominant, as it is a (positive) fraction. Further $\frac{\gamma}{h(e)}\frac{dr}{d\gamma}$ is likely to be a large negative number as γ and $h(e)$ both are small and $dr/d\gamma$ is large. Thus for small γ , the expected monitoring cost is likely to decrease as γ increases.

For large γ , the derivative in (11) may be either positive or negative as the first term will be positive and the second term will be negative. However the absolute value of the sum will be small as the first term will be the product of two small fractions and the second term will be the product of a fraction and $dr/d\gamma$, which is likely to be small for large γ .

Again, alternatively, the lender's optimisation problem is valid only for those values of γ for which $\Pi_l(e^E, r^E) > 0$. Since the left-hand side of the inequality is decreasing in γ , therefore the admissible values of γ must be less than $\bar{\gamma}$, where $\bar{\gamma}$ is the solution to the equation $\Pi_l(e^E, r^E) = 0 \Leftrightarrow \gamma = h(e^E) - r^E/2$, (the equilibrium values of e and r both being functions γ).

Now suppose $\gamma \to \bar{\gamma}$. Then the derivative $\frac{\partial}{\partial\gamma}\left(\frac{\gamma r}{h(e)}\right)$ will tend to,

$$\frac{r}{h(e)}\left(1-\frac{(h(e)-r/2)h'(e)}{h(e)}\frac{de}{d\gamma}\right)+\frac{h(e)-r/2}{h(e)}\frac{dr}{d\gamma}$$

From proposition 2, we know that the equilibrium value of e is large and r is small if γ is large. A small value of r implies that $\frac{(h(e)-r/2)}{h(e)}$ will be close to 1. Since $h''(e)<0$ and $d^2e/d\gamma^2<0$ and $d^2r/d\gamma^2>0$ by assumption, it will also follow that the absolute values of $de/d\gamma$, $dr/d\gamma$, $r/h(e)$ and $h'(e)$ are small. Thus the first term in the above expression will be a negative or a small positive number and the second term will be a small negative number. However the magnitude of the second term is likely to be larger than that of the first. Hence the sign of the entire expression is likely to be negative. But the absolute value of the sum and hence the derivative will be small.

Thus we find that the expected loan monitoring cost of the lender will decrease as γ increases. However for very large γ the effect of an increase in γ on expected monitoring cost is likely to be negligible. On the other hand for large γ, the expected loan repayment will fall significantly with further increase in γ. This means for large γ the lender's equilibrium profit and hence the total surplus is likely to fall.

On the other hand for small value of γ a further increase in γ will cause the expected loan repayment to increase and the expected monitoring cost to fall. This means for small γ the lender's equilibrium profit and hence the total surplus is likely to rise.

Hence there will exist a critical value of $\gamma=\gamma^*$, which will maximise the total surplus. Therefore for $\gamma_I<\gamma_F\leq\gamma^*$, formal lending is more conducive to welfare compared to informal lending. For $\gamma_I<\gamma^*<\gamma_F$ may or may not be conducive to welfare compared to informal lending.

4. Conclusion

In this chapter/paper we develop a model of production uncertainty and costly state verification, in which lenders are differentiated in terms of their ex-post monitoring cost. Differences in the cost of monitoring loans especially for bad debts is a commonly observed feature of the credit markets in the LDCs. The differences in loan monitoring cost reflect the more fundamental structural differences, namely, the difference in the degree of information asymmetry and bargaining power between the FLs and the ILs with respect to the entrepreneurs. The ILs, because of their strategic position and their personalised relationship with their clientele exert a stronger influence (enjoy greater bargaining power) and are in a much better position to recover loans than the FLs. The FLs, unlike the IL, have to go through the legal procedure for recovering loans.

The optimal contracts are derived for the FL and the IL for a credit market that is supply constrained. It is shown that the higher monitoring costs of the FL will actually induce the FL to charge a lower rate of interest in order to avoid the possibility of default and monitoring. This may cause the FL's expected loan monitoring costs to fall if γ is not too high. Since the lower rate of interest will induce greater effort by the entrepreneurs, this also causes the expected loan repayment to increase, as the probability of success is higher. The higher effort increases expected output. The total surplus will increase if the FL's monitoring costs are below a certain threshold level γ^*. Thus formal lending will be welfare enhancing compared to informal lending for a certain range of γ (as discussed in section 3).

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Appendix.

Lemma 4: The lenders iso-profit contours are convex in the region where they are negatively sloped.

Proof. $$\frac{d}{de}\left(\left.\frac{dr}{de}\right|_{\Pi_l}\right)=\frac{d}{de}\left[-\frac{\partial\Pi_l/\partial e}{\partial\Pi_l/\partial r}\right]$$

$$=-\frac{1}{\left(\partial\Pi_l/\partial r\right)^2}\left(\frac{\partial\Pi_l}{\partial r}\frac{d}{de}\left(\frac{\partial\Pi_l}{\partial e}\right)-\frac{\partial\Pi_l}{\partial e}\frac{d}{de}\left(\frac{\partial\Pi_l}{\partial r}\right)\right)>0$$

$$\frac{d}{de}\left(\frac{\partial\Pi_l}{\partial e}\right)=\left\{\frac{\partial}{\partial r}\left(\frac{\partial\Pi_l}{\partial e}\right)\frac{dr}{de}+\frac{\partial}{\partial e}\left(\frac{\partial\Pi_l}{\partial e}\right)\right\}<0\,.$$

When $\frac{dr}{de} < 0 \Rightarrow \frac{\partial \Pi_l}{\partial r} > 0$,

$$\frac{\partial}{\partial r}\left(\frac{\partial \Pi_l}{\partial e}\right) = \frac{\partial}{\partial r}\left[\frac{h'(e)}{h^2(e)}\left\{\gamma r + \frac{r^2}{2}\right\}\right] = \frac{h'(e)}{h^2(e)}\{\gamma + r\} > 0$$

$$\frac{\partial}{\partial e}\left(\frac{\partial \Pi_l}{\partial e}\right) = \frac{\partial}{\partial e}\left[\frac{h'(e)}{h^2(e)}\left\{\gamma r + \frac{r^2}{2}\right\}\right]$$

$$= \left\{\gamma r + \frac{r^2}{2}\right\}\frac{h^2(e)h''(e) - h'(e)2h(e)h'(e)}{h^4(e)} < 0$$

$$\frac{d}{de}\left(\frac{\partial \Pi_l}{\partial r}\right) = \left[\frac{\partial}{\partial r}\left(\frac{\partial \Pi_l}{\partial r}\right)\frac{dr}{de} + \frac{\partial}{\partial e}\left(\frac{\partial \Pi_l}{\partial r}\right)\right] > 0 \quad \text{since}$$

$$\frac{\partial^2 \Pi_l}{\partial r^2} < 0 \quad \text{and} \quad \frac{\partial}{\partial e}\left(\frac{\partial \Pi_l}{\partial r}\right) > 0.$$

This proves lemma 4.