Informal Credit Markets, Interlinkage and Migration

by

Yasmeen Khwaja *

July 2002

* *Department of Economics and Finance, Brunel University, Uxbridge, Middlesex UB8 3PH*. E-mail: yasmeen.khwaja@brunel.ac.uk

JEL classification: D82, J61, O12
Key words: Migration, credit markets, moral hazard, interlinkage.

Abstract

This paper develops a model of interlinkage in the credit market and labor market. A credit-cum-labor contract provides the necessary funds to undertake an investment in migration, given the absence of sufficient collateral. The optimal interlinked contract eliminates the scope for strategic default. The result shows that the very presence of inequality is a necessary condition for migration to take place. This could explain the apparent paradox of why poor households in villages where asset distribution is very skewed are more likely to migrate than households in poorer villages with less unequal asset distribution.

Acknowledgments

I am grateful to Laurence Harris, Giancarlo Marini, Pasquale Scaramozzino and seminar participants at Brunel for very helpful suggestions.

1. Introduction

A puzzling aspect of migration in some developing countries is that the poorest households in villages where the distribution of assets is very skewed have a greater propensity to migrate than households in poor villages with a more equal asset distribution (Stark and Taylor, 1989). This paper shows that the unequal distribution of assets is a necessary condition for migration for those households that do not have access to formal credit markets.

The main feature of credit markets in rural areas in developing countries is the prevalence of informal credit relationships (see Mansuri, 1997; quoted in Ray, 1998; Bell and Srinivasan, 1985; and Bardhan and Rudra, 1978, 1980, 1981). Informational asymmetries, moral hazard and credit rationing are widespread. Given the absence of sufficient collateral, loans are seldom taken up with formal lending institutions. Borrowers who are unable to gain credit in the formal market may decide to turn to the informal credit market. However, interlinking credit market transactions with those in related markets allows the lender one method of avoiding strategic default. By exerting some form of control over the borrower, the landlord may be more certain of repayment.

Many opinions have been offered for the reason for interlinkage and its effects. Bardhan (1984) cites the absence of perfect and complete market structures for the presence of interlinked contracts, while Bell (1988) considers interlinked contracts as a way of reducing the lenders' transaction costs. Evidence suggests that interest rates in rural areas are on average high and do vary significantly across households and individuals (see Reserve Bank of India, 1977). Again, the reasons for such variability differ. Bhaduri (1973, 1977), Rudra (1984), and Basu (1997) see the moneylender as a monopolist who exploits the production relations to his advantage. Indeed, one type of interlinked contract occurs when a landlord only grants a tenancy if the would-be tenant also borrows exclusively from him, thereby bundling all the transactions of the tenant in the credit and labor market for his own benefit (see Braverman and Srinivasan (1981), Braverman and Stiglitz (1982) and Mitra (1983)).

Von Pishke, Adams and Donald (1983) alternatively see the moneylender as providing a valuable service to borrowers even if it is subject to abuse. Ray (1998) also sees the prevailing credit arrangements in developing countries as the result of the interlocking of market. Moneylenders do not necessarily set usurious rates of interest on their loans: quite the opposite, since interest rates are not set at an excessive level in order not to attract too many high-risk customers, in the presence of informational asymmetries regarding the borrowers' risk characteristics. Bardhan and Udry (1999) argue that interlinking can act as a device by which the landlord is able to enforce a non-linear pricing mechanism, and thereby to extract the entire surplus from the credit relationship. Bardhan and Udry acknowledge that interlinking can serve efficiency purposes, but also maintain that it can lead to monopolistic exploitation.

Banerji (1995) finds that interlinked contracts under adverse selection on the type of borrowers are second best to non-interlinked contracts, and reduce investment. By contrast, Basu, Bell and Bose (2000) show that interlinkage can be superior under moral hazard, when the tenant has limited liability. Chakrabarty and Chaudhury (2001) consider the interactions between the formal and the informal sector credit market and the impact these could have on the terms of interlinked contracts.

This paper considers an interlinked contract where the borrower may be required to supply labor at a discounted rate as part of the repayment. For the borrower, the purpose of entering a *credit-cum-labor* contract is to acquire the necessary funds needed to invest in migration, where the migrant household has insufficient assets to provide collateral. This raises a number of specific issues. Firstly, there is asymmetric information between the migrant household and the lender regarding the outcome of migration. The lender is unable to observe or to verify the wage realized by the migrant in the destination area. There is therefore potentially a scope for strategic default, whereby the borrower falsely claims to be insolvent. Secondly, there is the problem of the enforceability of the credit agreement. Once migration takes place, a household can sever its links with the area of origin and so it is almost impossible for the lender to recoup the loan.

The interlinkage of credit and labor markets not only provides a feasible solution to these problems, but also ensures that lending can actually take place in the rural economy, despite insufficient collateral and the unverifiability of the destination wage. The optimal contract designed by the landlord/moneylender can require that some members of the migrating household remain in the village of origin, and that they supply labor at a discounted rate if the returns from migration are reported to be insufficient to cover fully the debt repayment. In this way, the lender ensures that the borrower does not sever links with the village of origin. Additionally, by requiring that discounted labor be supplied, there is no incentive to misreport the realized destination wage. By the revelation principle (Mas Colell, Whinston and Green, 1995), the optimal contract will be such that the borrower will always truthfully report the destination wage, thereby eliminating the scope for strategic default. Moreover, interlinkage emerges as the means through which (costly) migration becomes feasible and allows for a more efficient inter-village allocation of labor.

Townsend (1979) and Gale and Hellwig (1985) consider the problem of unverifiability of returns from an investment and prove the optimality of the standard debt contract, which involves the repayment of a fixed sum when there is no verification of the state of nature.

The results of this paper show that interlinkage of the credit and labor market allows for investment in migration, by resolving the issues associated with moral hazard in the destination area. The very underlying inequality of assets in the rural economy allows for borrowing in order to cover the cost of migration. Inequality in the distribution of assets therefore constitutes a necessary condition for migration.

The heterogeneity of borrower types is captured through the customized nature of the optimal contract, that is dependent on the lender's expectation of the household's earning potential. The interlinked contract results in an improved inter-village allocation of labor, since borrowers can migrate to areas with higher labor productivity.

Section 2 of this paper develops the optimal interlinked contract that solves the strategic default problem for a two-period set-up. Section 3 extends the model to consider longer-term loans, and illustrates how the migration decision is affected by the possibility to borrow on a longer horizon. Section 4 summarizes the main results and concludes.

2. The model

This section presents a two-period model of migration, where the periods are indexed by t = 0, 1. The decision-making unit is the laborer household. The migration decision is made at time $t = 0$. If the household chooses to migrate, it will have to incur a cost $I > 0$ at time $t = 0$. For simplicity, and without loss of generality, the migration cost I is normalized to unity: $I = 1$. The household is assumed to have no wealth and no collateral. A potential lender therefore faces the problem of enforceability of the credit contract. For convenience of exposition, the labor endowment of the household is normalized to 2 units. When the household decides to migrate, 1 unit of labor migrates to the area of destination and 1 unit remains in the village of origin. For simplicity, the household is here assumed to be risk-neutral and its subjective rate of discount is set equal to zero.

The laborer household can only borrow from the landlord. Repayment of the loan takes place in period t=1. The wage earned by the migrant in the destination village at time t=1 is a random variable, $\tilde{w}_1^D \in [w^D, W^D]$, which is not verifiable by the lender (technically, the destination wage is unobservable) [1]. At the beginning of period t=1 the migrant reports a destination wage $\hat{w}_1^D$, which in principle could be different from the actual wage $\tilde{w}_1^D$. Since the repayment of the loan must be a function of the reported destination wage, $\hat{w}_1^D$, it is necessary to avoid the scope for strategic default, which can occur when the household declares a wage $\hat{w}_1^D$ that is less than the true wage $\tilde{w}_1^D$. The wage in the village of origin is $\tilde{w}_0^O$ and $\tilde{w}_1^O$ at time t=0 and t=1 respectively. The joint probability distribution function of the wages in the village of origin and in the destination village at time t=1 is given by $G(\tilde{w}_1^O, \tilde{w}_1^D)$, where $(\tilde{w}_1^O, \tilde{w}_1^D) \in [w^O, W^O] \times [w^D, W^D]$, where w^O>0 and w^D>0. If the reported wage $\hat{w}_1^D$ is not large enough to cover the full repayment of the loan, then the credit contract with the lender/landlord may require that, as part of the repayment, the laborer household supplies 1 unit of labor in period t=1 at the wage $\overline{w}_1^O$, which in general is less that the market wage: $\overline{w}_1^O < \tilde{w}_1^O$. The difference $\tilde{w}_1^O - \overline{w}_1^O$ measures the discount at which laborers are required to supply labor in the interlinked contract.

The lender can borrow and lend in the formal credit market at a gross rate r (which includes the principal). This is therefore the opportunity cost of lending to the household. The contract specifies a repayment to the lender at time t=1, as a function of the reported destination wage: $g(\hat{w}_1^D)$. It will be shown that the optimal contract requires that there exists a set S of reported values of the destination wage, $\tilde{w}_1^D \in [w^D, W^D]$, for which the household has to supply labor at a discounted wage rate, $\overline{w}_1^O$. Let w_1^* denote the critical value of the reported destination wage, below which the laborer household has to supply labor at a discounted wage. Then $S = \{\hat{w}_1^D \in [w^D, W^D] \mid w^D \leq \hat{w}_1^D < w_1^*\}$.

The optimal *credit-cum-labor* contract between the landlord and the laborer must satisfy the individual rationality (or participation) constraints for both. Moreover, by the revelation principle (Mas Colell, Whinston and Green, 1995), the optimal contract must be designed in such a way that it is always in the interest of the laborer to report truthfully the destination wage: $\hat{w}_1^D = \tilde{w}_1^D$. This is the *truth-telling constraint*, also known as the *incentive compatibility constraint*. The revelation principle implies that attention can be restricted to the set of contracts that satisfy the incentive compatibility constraint.

The individual rationality constraint for the landlord is:

[1] Alternatively, one could think that there is a very large verification cost.

(1) $$E[g(\hat{w}_1^D)] \geq r$$

that is, the expected repayment to the landlord must be at least as high as the opportunity cost of funds, as measured by the alternative return on the investment r>1.

The individual rationality constraint for the laborer household is:

(2) $$E[\tilde{w}_1^D + \tilde{w}_1^O - g(\hat{w}_1^D)] \geq 2E[\tilde{w}_1^O]$$

or:

(2') $$E[\tilde{w}_1^D - g(\hat{w}_1^D)] \geq E[\tilde{w}_1^O]$$

that is, the expected value from migration at time t=1, net of the repayment cost $g(\hat{w}_1^D)$ (the left-hand side of equation (2)), must be at least as large as the expected value from remaining in the village of origin (the right-hand side of equation (2)).

Equation (2') implies:

(2") $$E[g(\hat{w}_1^D)] \leq E[\tilde{w}_1^D - \tilde{w}_1^O]$$

By combining (1) and (2"), a necessary condition for the existence of a contract is:

(3) $$E[\tilde{w}_1^D - \tilde{w}_1^O] \geq r \ (>1)$$

that is, the expected excess wage in the destination area, relative to the village of origin, must be at least as high as the opportunity cost of funds to the landlord.

Furthermore, since an optimal contract only exists when $E[\tilde{w}_1^D - \tilde{w}_1^O] > 1 = I$, migration financed by interlinkage always improves the allocative efficiency of labor, since labor moves from a low-productivity to a high-productivity area (net of migration costs). There is therefore an efficiency gain in the inter-village allocation of labor.

The incentive-compatibility (or truth-telling) constraint for the laborer is:

(4) $$\tilde{w}_1^D - g(\tilde{w}_1^D) \geq \tilde{w}_1^D - g(\hat{w}_1^D) \qquad \forall \hat{w}_1^D \neq \tilde{w}_1^D$$

or, equivalently:

(4’) $$g(\hat{w}_1^D) \leq g(\tilde{w}_1^D) \qquad \forall \hat{w}_1^D \neq \tilde{w}_1^D$$

The following upper bound must be placed on the expected value of the excess wage in the village of destination:

(5) $$E[\tilde{w}_1^D - \tilde{w}_1^O] \leq w^O + w^D$$

Assumption (5) is required for the feasibility of the contract.

The total surplus to the parties from the contract is given by the difference $E[\tilde{w}_1^D - \tilde{w}_1^O] - r$. The division of the surplus between the landlord and the household will in general depend on their relative bargaining power. It will be assumed that the bargaining power rests entirely with the landlord, who will therefore appropriate the total surplus. The justification for this assumption is that the borrowers have to compete for funds from the landlord, who is the only potential suppliers of funds for migration.

The optimal contract must therefore maximize the expected return to landlord, consistent with the incentive compatibility constraint for laborer (4) and with the individual rationality constraints for both parties, (1) and (2). Proposition 1 describes this optimal contract.

Proposition 1.

The optimal contract consists of the following repayment function:

(6)
$$g(\hat{w}_1^D) = \begin{cases} E[\tilde{w}_1^D - \tilde{w}_1^O] & \text{if} \quad \hat{w}_1^D \geq w_1^* \\ \hat{w}_1^D + (\tilde{w}_1^O - \overline{w}_1^O) & \text{if} \quad \hat{w}_1^D < w_1^* \end{cases}$$

where w_1^* *is the threshold reported destination wage rate below which the household must supply labor at a discounted wage:* $S = \{\hat{w}_1^D \in [w^D, W^D] \mid w^D \leq \hat{w}_1^D < w_1^*\}$, *and where* $\overline{w}_1^O$ *is the discounted wage rate. The threshold reported wage rate* w_1^* *is given by:*

(7)
$$w_1^* = E[\tilde{w}_1^D - \tilde{w}_1^O]$$

and the discounted wage rate $\overline{w}_1^O$ *is given by:*

(8)
$$\overline{w}_1^O = \hat{w}_1^D + \tilde{w}_1^O - E[\tilde{w}_1^D - \tilde{w}_1^O]$$

Note that, when $\hat{w}_1^D < w_1^*$, the total repayment to the landlord according to equation (6) consists of two components. The first component is repayment from the migration unit, $\hat{w}_1^D$. The second component is the discounted labor that has to be supplied by the household unit remained in the village of origin, $(\tilde{w}_1^O - \overline{w}_1^O)$. Note from equation

(8) that, *ceteris paribus*, the lower the reported destination wage $\hat{w}_1^D$, the lower the discounted wage rate $\overline{w}_1^O$. This is the key for understanding the incentive compatibility of the contract. The household has no advantage in falsely reporting a wrong destination wage, since if it declares a lower wage in the destination area it will be required to supply labor at a lower wage in the interlinked contract.

Proposition 1 relies on the following Lemma.

Lemma 1.

For the optimal contract described in Proposition 1,

(9) $$g(\hat{w}_1^D) = E[\tilde{w}_1^D - \tilde{w}_1^O]$$

Proofs of Lemma 1 and of Proposition 1. See Appendix.

These results are consistent with those on debt and costly verification in the finance literature. Gale and Hellwig (1985) derive the standard debt contract as the optimal debt contract when it is costly to verify the revenue of the borrower, but there is no interlinkage of the credit with the labor market. They establish that the optimal contract is the standard debt contract, whereby the borrower returns a fixed amount if it is solvent, and the creditor appropriates the borrower's assets if the latter is insolvent and there is bankruptcy. Diamond (1984) obtains a similar outcome for a debt model without interlinkage. The lender is able to hedge its risk through diversification, in the presence of costs of monitoring the outcome of the risky investment project undertaken by the borrower. The model presented in this section represents a departure from the standard literature on debt. The optimal contract is the outcome of the link between the credit market and the labor market, resulting in improved efficiency in the inter-village allocation of labor.

An important implication of Proposition 1 is that the repayment function itself is household-specific, contingent upon the expected wage differential $E[\tilde{w}_1^D - \tilde{w}_1^O]$. The optimal contract thus captures the cross-sectional heterogeneity across households. Despite the informational asymmetries associated with moral hazard over the destination wage, the landlord is still able to design a customized credit contract that is a function of the specific household's earning potential.

Moreover, it is shown that inequality in the distribution of assets is a necessary condition for the existence of an informal credit market, which is itself a necessary condition for lending and thus for migration. Without the presence of this inequality there would be no opportunity to borrow the funds to undertake the migration investment.

3. Long-term loan contracts and interlinkage

Interlinkage ensures the existence of an optimal contract. In this section the model is generalized to allow for a longer time horizon for the credit contract. The role of long-term contracts and intermediate repayments in the credit relationship can thus be addressed.

Consider a three-period model: t=0, 1, 2. Households face uncertainty over wages both in period 1 and in period 2. Debt must be repaid in full by period t = 2. The optimal debt contract can involve a repayment in the first period and the supply of labor to the lender/landlord at a discounted wage rate in the first period and/or in the second period. If the realized wage outcome of the destination wage in period t=1 is sufficiently large, the household will repay the entire debt in the first period. If the outcome in period t=1 is unsatisfactory, the migrant household might be forced to pay an intermediate repayment and in addition to supply labor at a discounted rate. If the outcome of the destination wage in period t=2 is also unsatisfactory, the household will have to supply discounted labor in the second period as well.

Chang (1990) considers a three-period debt contract, where the optimal contract is an extension of the standard debt contract obtained by Gale and Hellwig (1985), modified to allow for the provision of intermediate repayments.

This section develops a three-period debt contract with Interlinkage, allowing for intermediate repayments. The three periods are indexed by t = 0, 1, 2. At time t = 0, the household decides whether to migrate or not. Migration entails a cost I = 1. In each period, the household has a labor endowment equal to 2: one unit of labor can migrate, the other unit must remain in the village of origin. The household has no wealth and no collateral. Migration can be only financed through a loan from the landlord. The two-period gross opportunity cost of fund to the lender is $R > 1$. There is uncertainty about the destination wage and about the origin wage at both time t = 1 and t = 2. We denote the wage in the destination area by $\tilde{w}_1^D$ and $\tilde{w}_2^D$, and the wage in the area of origin by $\tilde{w}_1^O$ and $\tilde{w}_2^O$ at time t = 1 and t = 2 respectively.

The joint cumulative probability distribution function for $\tilde{w}_1^O$, $\tilde{w}_2^O$, $\tilde{w}_1^D$, and $\tilde{w}_2^D$, is $F(\tilde{w}_1^O, \tilde{w}_2^O, \tilde{w}_1^D, \tilde{w}_2^D) : [w^O, W^O]^2 \times [w^D, W^D]^2 \rightarrow [0,1]$. The wage in the destination area is $\tilde{w}_1^D$ and $\tilde{w}_2^D$, and is unverifiable by the lender. The migrant household reports wages $\hat{w}_1^D$ and $\hat{w}_2^D$. In general, $\hat{w}_1^D \neq \tilde{w}_1^D$ and $\hat{w}_2^D \neq \tilde{w}_2^D$. As in section 3, by the revelation principle, the optimal contract requires that the truth-telling (or incentive-compatibility) constraints be satisfied. If the destination wages are not large enough, the contract might require that the household supplies labor in the village of origin at the wage $\overline{w}_1^O$ in the first period and $\overline{w}_2^O$ in the second period.

A contract consists of a set of repayments $G_1(\hat{w}_1^D)$, $G_2(\hat{w}_1^D, \hat{w}_2^D)$ at times t=1 and t=2 respectively. The individual rationality constraint for the landlord is:

(10) $$E[G_1(\hat{w}_1^D) + G_2(\hat{w}_1^D, \hat{w}_2^D)] \geq R$$

Equation (10) requires that the expected the return from the repayment must be no less than the alternative two-period return to the landlord, R. The individual rationality constraint for the household is:

(11) $$E[\tilde{w}_1^D + \tilde{w}_2^D - G_1(\hat{w}_1^D) - G_2(\hat{w}_1^D, \hat{w}_2^D) + \tilde{w}_1^O + \tilde{w}_2^O] \geq 2 \cdot E[\tilde{w}_1^O + \tilde{w}_2^O]$$

which may be written as:

(11') $$E[\tilde{w}_1^D + \tilde{w}_2^D - R_1(\hat{w}_1^D) - R_2(\hat{w}_1^D, \hat{w}_2^D)] \geq E[\tilde{w}_1^O + \tilde{w}_2^O]$$

or also:

(11") $$E[G_1(\hat{w}_1^D) + G_2(\hat{w}_1^D, \hat{w}_2^D)] \leq E[\tilde{w}_1^D + \tilde{w}_2^D - \tilde{w}_1^O - \tilde{w}_2^O]$$

The individual rationality constraint for the household requires that the expected wage in the destination area, net of the expected repayments, must be at least as large as the expected wage in the area of origin.

Comparison of (10) with (11”) yields the condition:

(12) $$E[\tilde{w}_1^D + \tilde{w}_2^D - \tilde{w}_1^O - \tilde{w}_2^O] \geq R$$

Contrasting equation (11”) with equation (12), the migrant household is constrained in its demand for credit when

(13) $$E[\tilde{w}_1^D + \tilde{w}_2^D - \tilde{w}_1^O - \tilde{w}_2^O] \geq R > E[G_1(\hat{w}_1^D) + G_2(\hat{w}_1^D, \hat{w}_2^D)]$$

In this case, the household would like to borrow (since equation (11”) is satisfied), but the lender is unwilling to supply credit (since equation (10) is not satisfied).

From equation (12), the loan contract will lead to an increased efficiency in the allocation of rural labor, since $R > 0$. Hence, the interlinked credit contract allows labor to migrate from low- to high-productivity areas.

Let

(14) $$M \equiv E[\tilde{w}_1^D + \tilde{w}_2^D - \tilde{w}_1^O - \tilde{w}_2^O]$$

Analogously to (5) for the two-period case, the following upper bound must be placed on the expected value of the excess wage in the village of destination:

(15) $$2(w^O + w^D) \geq E[\tilde{w}_1^D + \tilde{w}_2^D - \tilde{w}_1^O - \tilde{w}_2^O]$$

Assumption (15) is required for the feasibility of the contract.

Proposition 2.

In the three-period model, the optimal contract between the lender and the household takes the following form:

(i) $\hat{w}_1^D \geq M$

There is full repayment at t=1, no discounted labor must be supplied:

$G_1(\hat{w}_1^D) = M$

$G_2(\hat{w}_1^D, \hat{w}_2^D) = 0$

(ii) $M - w^D \leq \hat{w}_1^D < M$

There is a first installment at t=1, and a final repayment at t=2:

$G_1(\hat{w}_1^D) = \hat{w}_1^D$

$G_2(\hat{w}_1^D, \hat{w}_2^D) = M - \hat{w}_1^D$

(iii) $M - w^D - w^O \leq \hat{w}_1^D < M - w^D$

Discounted labor must be supplied at time t=1, and there is a final repayment at t=2:

$G_1(\hat{w}_1^D) = \hat{w}_1^D + (\hat{w}_1^O - \overline{w}_1^O)$ *where* $\overline{w}_1^O = \hat{w}_1^D + \tilde{w}_1^O + w^D - M$

$$G_2(\hat{w}_1^D, \hat{w}_2^D) = M - \hat{w}_1^D - (\tilde{w}_1^O - \overline{w}_1^O)$$

(iv) $M - w^D - 2w^O \leq \hat{w}_1^D < M - w^D - w^O$

Discounted labor must be supplied at time t=1 at the wage rate $\overline{w}_1^O = 0$*, and there is a final repayment at t=2:*

$$G_1(\hat{w}_1^D) = \hat{w}_1^D + \tilde{w}_1^O, \qquad \overline{w}_1^O = 0$$

$$G_2(\hat{w}_1^D, \hat{w}_2^D) = M - \hat{w}_1^D - \tilde{w}_1^O$$

(v) $M - 2w^D - 2w^O \leq \hat{w}_1^D < M - w^D - 2w^O$

Discounted labor is supplied at t=1 and t=2

$$G_1(\hat{w}_1^D) = \hat{w}_1^D + \tilde{w}_1^O, \qquad \overline{w}_1^O = 0$$

$$G_2(\hat{w}_1^D, \hat{w}_2^D) = M - \hat{w}_1^D - \tilde{w}_1^O \qquad \text{if} \qquad \hat{w}_2^D \geq w_2^*$$

$$= \hat{w}_2^D + (\hat{w}_2^O - \overline{w}_2^O) \qquad \text{if} \qquad \hat{w}_2^D < w_2^*$$

where

$$w_2^* = M - \hat{w}_1^D - \tilde{w}_1^O$$

$$\overline{w}_2^O = \hat{w}_2^D + \tilde{w}_2^O - [M - \hat{w}_1^D - \tilde{w}_1^O]$$

Proposition 2 relies on Lemma 2.

Lemma 2.

For the optimal contract,

(16) $$G_1(\hat{w}_1^D) + G_2(\hat{w}_1^D, \hat{w}_2^D) = M \equiv E[\tilde{w}_1^D + \tilde{w}_2^D - \tilde{w}_1^O - \tilde{w}_2^O]$$

Proofs of Lemma 2 and of Proposition 2. See Appendix.

The intuition for the optimal contract can be expressed as follows. When the realization of the destination wage in period 1 is large enough, the landlord will require that the debt must be repaid in full in the first period. No discounted labor has to be supplied, and the migrant household can appropriate the full returns from migration in the second period. By contrast, if the destination wage in the first period is not sufficiently large, the household will have to supply discounted labor to the lender, to ensure full repayment of the loan. If the reported destination wage in the second period is also not sufficiently high, the household will have to supply labor at a discounted rate in the last period as well.

4. Conclusion

Interlinkage between credit and labor can be the efficient contract, when the destination wage is not verifiable by the lender and when the migrant household has insufficient funds to be used as collateral. Interlinkage of credit and labor markets does not necessarily imply exploitation of the migrant household by the landlord: without the interlinked contract, there would be no lending and the household would be unable to migrate. Hence, both the landlord and the migrant would be worse off (or no better off) without the interlinked contract. Inter-village migration, made possible by interlinkage, brings about increased efficiency.

The surplus from migration is assumed to be entirely appropriated by the landlord. The migrant household's utility is therefore at its reservation level, and the household is indifferently off whereas the landlord is better off following migration. This assumption can be justified on the grounds that the landlord is likely to wield a greater bargaining power. However this assumption is not essential for the results, and it would be straightforward to extend the model to the case in which both the landlord and the laborer household have some bargaining power.

The optimal contract is designed to share the expected surplus from the migration decision. Rural households with different observable characteristics will have a different expected surplus from migration. The lender/landlord therefore customizes the *credit-cum-labor* contract for each potential migrant household.

It is precisely because the income distribution in the village of origin is highly uneven that interlinked contracts can be drawn up, and this explains why the propensity to migrate amongst the very poor tends to be greater in such villages (see Stark, 1984). Poor households can borrow from the relatively wealthy landlords in order to finance their migration decision. In villages where everybody is poor there is no possibility of an interlinked contract. Given the unverifiability of the destination wage, only those households with sufficient collateralisable assets can afford to borrow from moneylenders to finance their migration decision. The model explains the apparent paradox of why extremely needy rural households are unable to migrate away from their poverty.

Appendix

Proof of Lemma 1.

Consider first the case $\hat{w}_1^D \geq w_1^*$. From equation (6), $g(\hat{w}_1^D) = E[\tilde{w}_1^D - \tilde{w}_1^O]$.

Consider next $\hat{w}_1^D < w_1^*$. From equations (6) and (8),

$$
\begin{aligned}
g(\hat{w}_1^D) &= \hat{w}_1^D + (\tilde{w}_1^O - \overline{w}_1^O) \\
&= \hat{w}_1^D + \tilde{w}_1^O - \hat{w}_1^D - \tilde{w}_1^O + E[\tilde{w}_1^D - \tilde{w}_1^O] \\
&= E[\tilde{w}_1^D - \tilde{w}_1^O]
\end{aligned}
$$

End of proof.

Proof of Proposition 1.

The proof of optimality involves the following steps:

1. the truth-telling (or incentive-compatible) constraints for the laborer household are satisfied;
2. the contractual repayment is always feasible;
3. the contract satisfies the individual rationality (or participation) constraints for both the laborer household and for the landlord;
4. the expected payoff for the landlord is maximized.

Let: (a) $\hat{w}_1^D \notin S \quad \Leftrightarrow \quad \hat{w}_1^D \geq w_1^* \equiv E[\tilde{w}_1^D - \tilde{w}_1^O]$

(b) $\hat{w}_1^D \in S \quad \Leftrightarrow \quad \hat{w}_1^D < w_1^* \equiv E[\tilde{w}_1^D - \tilde{w}_1^O]$

Step 1. Truth-telling constraints for the household: it must be shown that

$$g(\hat{w}_1^D) \geq g(\tilde{w}_1^D) \qquad \forall \hat{w}_1^D \neq \tilde{w}_1^D$$

From Lemma 1, $g(\hat{w}_1^D) = E[\tilde{w}_1^D - \tilde{w}_1^O]$ independently of $\hat{w}_1^D$. Hence:

(a) $g(\tilde{w}_1^D) = E[\tilde{w}_1^D - \tilde{w}_1^O] = g(\hat{w}_1^D)$ if $\tilde{w}_1^D \geq w_1^*$

(b)
$$g(\tilde{w}_1^D) = \tilde{w}_1^D + (\tilde{w}_1^O - \overline{w}_1^O)$$
$$= \tilde{w}_1^D + \tilde{w}_1^O - \tilde{w}_1^D - \tilde{w}_1^O + E[\tilde{w}_1^D - \tilde{w}_1^O]$$
$$= E[\tilde{w}_1^D - \tilde{w}_1^O]$$
$$= g(\hat{w}_1^D) \qquad \text{if } \tilde{w}_1^D < w_1^*$$

The truth-telling constraint is therefore taken to be satisfied in the remainder of the proof: $\hat{w}_1^D$ can therefore be replaced with $\tilde{w}_1^D$.

Step 2. Feasibility.

It is necessary to prove that:

(i) $\tilde{w}_1^D + \tilde{w}_1^O \geq g(\hat{w}_1^D)$

(ii) $\overline{w}_1^O \geq 0$ if $\tilde{w}_1^D < w_1^*$

(iii) $\overline{w}_1^O \leq \tilde{w}_1^O$ if $\tilde{w}_1^D < w_1^*$

Proof of (i).

$$\tilde{w}_1^D + \tilde{w}_1^O \geq w^D + w^O > w^D$$
$$\geq E[\tilde{w}_1^D - \tilde{w}_1^O] \qquad \text{by assumption (5)}$$
$$= g(\tilde{w}_1^D) \qquad \text{by Lemma 1}$$

Proof of (ii).

$$\overline{w}_1^O = \tilde{w}_1^D + \tilde{w}_1^O - E[\tilde{w}_1^D - \tilde{w}_1^O]$$
$$\geq w^D + w^O - E[\tilde{w}_1^D - \tilde{w}_1^O]$$

$$> w^{D} - E[\tilde{w}_1^{D} - \tilde{w}_1^{O}]$$

$$\geq 0 \qquad \text{by assumption (5)}$$

Proof of (iii).

$$\overline{w}_1^{O} = \tilde{w}_1^{D} + \tilde{w}_1^{O} - E[\tilde{w}_1^{D} - \tilde{w}_1^{O}]$$

$$\leq \tilde{w}_1^{O} \qquad \text{when } \tilde{w}_1^{D} < w_1^{*} = E[\tilde{w}_1^{D} - \tilde{w}_1^{O}]$$

Step 3. Individual Rationality.

Consider first the Individual Rationality constraint for the landlord, equation (1). One obtains:

$$g(\tilde{w}_1^{D}) = E[\tilde{w}_1^{D} - \tilde{w}_1^{O}] \qquad \text{by Lemma 1}$$

$$\geq r \qquad \text{by (3)}$$

Consider now the individual rationality constraint for the household, equation (2”):

$$E[g(\tilde{w}_1^{D})] = E[\tilde{w}_1^{D} - w_1^{O}] \qquad \text{by Lemma 1.}$$

Step 4. The landlord’s expected return from the contract, $E[g(\tilde{w}_1^{D})]$, is maximized.

This follows from observing that the participation constraint for the laborer requires:

$$E[g(\hat{w}_1^{D})] \leq E[\tilde{w}_1^{D} - \tilde{w}_1^{O}]$$

and that, under the optimal contract,

$$E[g(\tilde{w}_1^{D})] = E[\tilde{w}_1^{D} - \tilde{w}_1^{O}]$$

by Lemma 1.

End of proof.

Proof of Lemma 2.

(i) $G_1(\hat{w}_1^D) + G_2(\hat{w}_1^D, \hat{w}_2^D) = M + 0 = M$

(ii) $G_1(\hat{w}_1^D) + G_2(\hat{w}_1^D, \hat{w}_2^D) = \hat{w}_1^D + M - \hat{w}_1^D = M$

(iii) $G_1(\hat{w}_1^D) + G_2(\hat{w}_1^D, \hat{w}_2^D) = \hat{w}_1^D + \tilde{w}_1^O - \overline{w}_1^O + M - \hat{w}_1^D - \tilde{w}_1^O + \overline{w}_1^O = M$

(iv) $G_1(\hat{w}_1^D) + G_2(\hat{w}_1^D, \hat{w}_2^D) = \hat{w}_1^D + \tilde{w}_1^O + M - \hat{w}_1^D - \tilde{w}_1^O = M$

(v) If $\hat{w}_2^D \geq w_2^*$:

$$G_1(\hat{w}_1^D) + G_2(\hat{w}_1^D, \hat{w}_2^D) = \hat{w}_1^D + \tilde{w}_1^O + M - \hat{w}_1^D - \tilde{w}_1^O = M$$

If $\hat{w}_2^D < w_2^*$:

$$\begin{aligned} G_1(\hat{w}_1^D) + G_2(\hat{w}_1^D, \hat{w}_2^D) &= \hat{w}_1^D + \tilde{w}_1^O + \hat{w}_2^D + \tilde{w}_2^O - \overline{w}_2^O \\ &= \hat{w}_1^D + \tilde{w}_1^O + \hat{w}_2^D + \tilde{w}_2^O - \hat{w}_2^D - \tilde{w}_2^O + M - \hat{w}_1^D - \tilde{w}_1^O \\ &= M \end{aligned}$$

End of proof.

Proof of Proposition 2.

The proof follows the following steps:

1. the truth-telling (or incentive-compatible) constraints for the laborer household are satisfied;
2. the contractual repayment is always feasible;
3. the contract satisfies the individual rationality (or participation) constraints for both the laborer household and for the landlord;
4. the payoff for the landlord is maximized.

Step 1: Incentive compatibility.

This follows directly from Lemma 2:

$$G_1(\hat{w}_1^D) + G_2(\hat{w}_1^D, \hat{w}_2^D) = M = G_1(\tilde{w}_1^D) + G_2(\tilde{w}_1^D, \tilde{w}_2^D) \qquad \forall (\hat{w}_1^D, \hat{w}_2^D) \neq (\tilde{w}_1^D, \tilde{w}_2^D)$$

In the rest of the proof it is therefore assumed that incentive compatibility holds.

Step 2: Feasibility.

It is necessary to prove that:

(a) $\tilde{w}_1^D + \tilde{w}_1^O \geq G_1(\tilde{w}_1^D)$

(b) $\tilde{w}_1^D + \tilde{w}_1^O + \tilde{w}_2^D + \tilde{w}_2^O \geq G_1(\tilde{w}_1^D) + G_2(\tilde{w}_1^D, \tilde{w}_2^D) = M$ by Lemma 2.

(c) $\overline{w}_1^O \geq 0$ if $\tilde{w}_1^D \in S_1$ (*i.e.*, discounted labor is supplied at time t=1)

(d) $\overline{w}_1^O \leq \tilde{w}_1^O$ if $\tilde{w}_1^D \in S_1$

(e) $\overline{w}_2^O \geq 0$ if $(\tilde{w}_1^D, \tilde{w}_2^D) \in S_2$ (*i.e.*, discounted labor is supplied at time t=2)

(f) $\overline{w}_2^O \leq \tilde{w}_2^O$ if $(\tilde{w}_1^D, \tilde{w}_2^D) \in S_2$

Proof of (a)

(i) $\tilde{w}_1^D + \tilde{w}_1^O > \tilde{w}_1^D \geq M = G_1(\tilde{w}_1^D)$

(ii) $\tilde{w}_1^D + \tilde{w}_1^O > \tilde{w}_1^D = G_1(\tilde{w}_1^D)$

(iii) $\tilde{w}_1^D + \tilde{w}_1^O \geq \tilde{w}_1^D + \tilde{w}_1^O - M = G_1(\tilde{w}_1^D)$

(iv) $\tilde{w}_1^D + \tilde{w}_1^O = G_1(\tilde{w}_1^D)$

(v) $\tilde{w}_1^D + \tilde{w}_1^O = G_1(\tilde{w}_1^D)$

Proof of (b)

(i) $\tilde{w}_1^D + \tilde{w}_1^O + \tilde{w}_2^D + \tilde{w}_2^O > \tilde{w}_1^D \geq M$

(ii) $\tilde{w}_1^D + \tilde{w}_1^O + \tilde{w}_2^D + \tilde{w}_2^O > \tilde{w}_1^D + \tilde{w}_2^D \geq \tilde{w}_1^D + w^D \geq M$

(iii) $\tilde{w}_1^D + \tilde{w}_1^O + \tilde{w}_2^D + \tilde{w}_2^O > \tilde{w}_1^D + \tilde{w}_1^O + \tilde{w}_2^D \geq \tilde{w}_1^D + w^O + w^D \geq M$

(iv) $\tilde{w}_1^D + \tilde{w}_1^O + \tilde{w}_2^D + \tilde{w}_2^O \geq \tilde{w}_1^D + 2w^O + w^D \geq M$

(v) $\tilde{w}_1^D + \tilde{w}_1^O + \tilde{w}_2^D + \tilde{w}_2^O \geq 2w^O + 2w^D \geq M$ by (15)

Proof of (c) (iii) $\overline{w}_1^O = \tilde{w}_1^D + \tilde{w}_1^O + w^D - M$

$\geq \tilde{w}^D + w^O + w^D \geq M \geq R$ by (12)

> 0

(iv),(v) $\overline{w}_1^O = 0$

Proof of (d) (iii) $\overline{w}_1^O = \tilde{w}_1^D + \tilde{w}_1^O + w^D - M$

$= \tilde{w}_1^D - (M - w^D - \tilde{w}_1^D)$

$< \tilde{w}_1^D$ since $(M - w^D - \tilde{w}_1^D) > 0$

(iv),(v) $\overline{w}_1^O = 0$

Proof of (e) (v) $\tilde{w}_2^D < w_2^*$:

$\overline{w}_2^O = \tilde{w}_2^* + \tilde{w}_2^O - (M - \tilde{w}_1^D - \tilde{w}_1^O)$

$= M - \tilde{w}_1^D - \tilde{w}_1^O + \tilde{w}_2^O - M + \tilde{w}_1^D + \tilde{w}_1^O$

$= \tilde{w}_2^O$

> 0

Proof of (f) (v) $\tilde{w}_2^D < w_2^*$:

$\overline{w}_2^O = \tilde{w}_2^O$ from the proof of (e) (v)

$\leq \tilde{w}_2^O$

Step 3. Individual rationality.

Landlord: it is necessary to prove that equation (10) holds.

$E[G_1(\tilde{w}_1^D) + G_2(\tilde{w}_1^D, \tilde{w}_2^D)] = M$ by Lemma 2

$\geq R$ by (12)

Household: it is necessary to prove that equation (11”) holds. This follows immediately from Lemma 2.

Step 4. The expected payoff to the landlord is maximized.

From (11”), it must be

$$E[G_1(\tilde{w}_1^D) + G_2(\tilde{w}_1^D, \tilde{w}_2^D)] \leq M$$

From Lemma 2,

$$E[G_1(\tilde{w}_1^D) + G_2(\tilde{w}_1^D, \tilde{w}_2^D)] = M$$

End of proof.

References

Banerji, Sanjay (1995), "Interlinkage, Investment and Adverse Selection", *Journal of Economic Behavior and Organization*, Vol. 28, pp. 11-21.

Bardhan, P.K. (1984), *Land, Labor and Rural Poverty; Essays in Development Economics*, New York, Columbia University Press.

Bardhan, Pranab, and A. Rudra (1978), "Interlinkage of Land, Labor and Credit Relations: An Analysis of Village Survey Data in East India", *Economic and Political Weekly*, vol. 13, pp. 367-384.

Bardhan, Pranab, and A. Rudra (1980), "Terms and Conditions of Sharecropping Contracts: An Analysis of Village Survey Data in India", *Journal of Development Studies*, Vol. 16, pp. 287-302.

Bardhan, Pranab, and A. Rudra (1981), "Terms and Conditions of Labor Contracts in Agriculture: Results of a Survey in West Bengal 1979", *Oxford Bulletin of Economics and Statistics*, Vol. 43, pp. 89-111.

Bardhan, Pranab, and Christopher Udry (1999), *Development Microeconomics*, Oxford, Oxford University Press.

Basu, Kaushik (1997), *Analytical Development Economics*, Cambridge (MA), MIT Press.

Basu, Kaushik, Clive Bell and Pinaki Bose (2000), "Interlinkage, Limited Liability and Strategic Interaction", *Journal of Economic Behavior and Organization*, Vol. 42, pp. 445-462.

Bell, Clive (1988), "Credit Markets and Interlinked Transactions", chapter 16 in H. Chenery and T.N. Srinivasan (eds.), *Handbook of Development Economics*, Vol. I, Amsterdam, North-Holland.

Bell, Clive, and T.N. Srinivasan (1985), "An Anatomy of Transactions in Rural Credit Markets in Andhra Pradesh, Bihar and Punjab", World Bank, mimeographed.

Bhaduri, A. (1973), "Agriculture Backwardness under Semi-Feudalism", *Economic Journal*, Vol. 83, pp. 120-137.

Bhaduri, A. (1977), "On the Formation of Usurious Interest Rates in Backward Agriculture", *Cambridge Journal of Economics*, Vol. 1, pp. 341-352.

Braverman, A., and Joseph Stiglitz (1982), "Sharecropping and Interlinking in Agrarian Markets", *American Economic Review*, Vol. 72, pp. 695-715.

Braverman, A., and T.N. Srinivasan (1981), "Credit and Sharecropping in Agrarian Societies", *Journal of Development Economics*, Vol. 9, pp. 289-312.

Chakrabarty, Debajyoti, and Ananish Chaudhuri (2001), "Formal and Informal Sector Credit Institutions and Interlinkage", *Journal of Economic Behavior and Organizations*, Vol. 46, pp. 313-325.

Chang, Chun (1990), "The Dynamic Structure of Optimal Debt Contracts", *Journal of Economic Theory*, Vol. 52, pp. 68-86.

Diamond, Douglas W. (1984), "Financial Monitoring", *Review of Economic Studies*, Vol. 51, No. 3, July, pp. 393-414.

Gale, Douglas, and Martin Hellwig (1985), "Incentive-Compatible Debt Contracts: The One-Period Problem", *Review of Economic Studies*, Vol. 52, pp. 647-663.

Mansuri, G. (1997), "Credit Layering in Rural Credit Markets: Theory and Evidence from Pakistan", PhD Dissertation, Boston University.

Mas Colell, A., M.D. Whinston, and J. Green (1995), *Microeconomic Theory*, Oxford, Oxford University Press.

Mitra, P. (1983), "A Theory of Interlinked Rural Transactions", *Journal of Public Economics*, Vol. 20, pp. 169-191.

Ray, Debraj (1998), *Development Economics*, Princeton, Princeton University Press.

Reserve Bank of India (1977), *Indebtedness of Rural Households and Availability of Institutional Finance*, Bombay, Reserve Bank of India.

Rudra, A. (1984), "Local Power and Farm Level Decision Making", in M. Desai, S.H. Rudolph and A. Rudra (eds.), *Agrarian Power and Agrarian Productivity in South Asia*, Berkeley, University of California Press.

Stark, Oded (1984), "Rural-to-Urban Migration in Less Developed Countries: A Relative Deprivation Approach", *Economic Development and Cultural Change*, Vol. 32; reprinted as Chapter 7 in Stark (1991).

Stark, Oded, and J. Edward Taylor (1989), "Relative Deprivation and International Migration", *Demography*, Vol. 26.

Townsend, R.M. (1979), "Optimal Contracts and Competitive Markets with Costly State Verification", *Journal of Economic Theory*, Vol. 21, pp. 1-29.

Von Pishke, J., D.W. Adams and Donald (1983), *Rural Financial Markets in Developing Countries*, Baltimore, Johns Hopkins University Press.