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A THEORY OF TWO-TIER INTERLINKAGE IN THE AGRICULTURAL CREDIT MARKET

Manash Ranjan GUPTA*

Abstract: A model of co-existence of interlinked credit-labour contract and interlinked credit-product contract in agriculture has been developed using the consumption-efficiency hypothesis of Leibenstein (1957). It is shown that the interest-rate in the interlinked credit-labour contract is lower than that in the interlinked credit-product contract.

1. INTRODUCTION

Two types of interlinkage are often observed in a backward agriculture: (i) Credit-labour interlinkage which implies that the agricultural worker takes loan from his employer and (ii) Credit-product interlinkage implying that the producer takes loan from the trader to whom he sells at least a part of his product.

A number of theoretical models have been developed explaining the existence and optimality of interlinked credit-labour contract.[1] However, in these models, the employer-cum-producer is not involved in a Interlinked credit-product contract with any trader. On the other hand, there is a theoretical paper explaining the existence and optimality of the credit-product interlinkage in terms of the imperfections in the credit-market.[2] But in this model, the representative producer is not involved in any interlinked credit-labour contract.

But the reality is more complicated than what is presented in the existing theoretical literature. It is often found that the same employer-cum-producer is on the one hand involved in interlinked credit-labour contract, and, on the other hand, involved in interlinked credit-product contract. The producer takes loan from the trader with the commitment that he will sell at least a part of his product to him and then uses that loan either in purchasing non-labour inputs or in giving further consumption-loan to the workers. So with the same producer, there is simultaneous existence of credit-product interlinkage and credit-labour interlinkage. Its empirical support is given in section 2 of the present paper.

The objective of this paper is to give an explanation of this simultaneous existence

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[1] See, for example, Basu (1983, 1987), Gupta (1987), Bardhan (1984), Gangopadhyay and Sengupta (1986) etc.

[2] See Gangopadhyay and Sengupta (1987).

of these two types of interlinkage using the 'Consumption-Efficiency Hypothesis' (CEH) of Leibenstein (1957). It attempts to explain the followings: (i) How does CEH explain the optimality of the co-existence of these two contracts? (ii) How are the two interest-rates—the rate of interest charged by the employer giving loan to worker and the interest-rate paid by him while taking loan from the trader-determined and related?

In section 2, we present the empirical picture of the nature and degree of interlinkage obtained from the survey reports of four villages. The basic theoretical model and its workings are presented in section 3. Concluding remarks are made in section 4.

2. THE EMPIRICAL REPORT

Four villages of West Bengal have been surveyed.[3] The village, Radhanagar, is in Bankura district. It is economically backward but well-communicated. Kouri, a village of Burdwan district, is economically advanced and poorly communicated. Jamtara, another village of Burdwan district, is economically advanced and well-communicated. The village, Feugram, is in Birbhum district. It is economically backward and poorly communicated.

All the landlord families have been surveyed in each of the four villages. A landlord family is defined as a family whose no member works as agricultural labourer and whose production is based on wage-labour. The number of landlord families in different villages are shown in the first row of Table 1.

TABLE 1. INTERLINKAGE IN DIFFERENT VILLAGES.

Village	Radhanagar	Kouri	Feugram	Jamtara
Number of landlord families	23	34	79	45
Number of landlord-families involved in credit-product interlinkage	14	17	46	38
Number of landlord families involved in credit-labour interlinkage	12	22	32	35
Number of X-types landlord families	12	14	32	32
Number of X-type landlord families using the loan taken from trader in giving loan to workers	12	14	28	25

Notes: X-type landlords are those who are involved in credit-labour interlinkages as well as credit-product interlinkage.

Source: Field-Survey.

[3] The survey has been done by Prof. S. K. Dutta of Durgapur Government College of West Bengal. He is doing research under the guidance of the present author.

The extents of credit-labour interlinkage and credit-product interlinkage in different villages are shown in the other rows of Table 1. One important observation (obtained from the fourth row of the Table 1) is that very high percentage of landlords in each of the villages are involved in credit-product interlinkage as well as credit-labour interlinkage. Another significant observation (obtained from the last row of the table) is that almost all the landlords of each village involved in both types of interlinkage use the loan taken from traders in giving loan to their workers.

Also we have the following empirical findings: (i) Selling prices faced by the producers in the free market and in the case of sale to the traders are the same. However, the traders make their payments in instalments. (ii) Loans in both types of contracts are observed to be interest-free. However, in the case of interlinked credit-product-contracts, implicit interest-rate appears to be positive because the traders make their payments to the producers (land-lord families) in instalments.

3. THE MODEL

The agricultural sector consists of two classes-Landlord-cum-capitalist farmers and the landless labourers. The agricultural labourer works and earns income only in the peak season. But he consumes in the lean period as well as in the peak period. So he finances his consumption in lean season through loan and pays back the loan plus interest to the lender in the peak period. He can, either work in the peak season at the market wage rate and take loan from the professional money lender[4] at a high interest rate, or, accept the landlord's offer of a credit-cum-labour contract in which the landlord himself supplies consumption-loan to the worker in the lean season with the commitment that the worker will work in the landlord's farm in the peak season. Similarly the landlord has also two possibilities. He can either let the worker take loan from the professional money-lender, or, offer the credit-cum-labour contract with the suitable terms of the contract. The first contract is called 'Non-interlinked credit-labour contract (NICLC); and the second contract is called 'Interlinked credit-labour contract' (ICLC).

There exists a group of traders to whom the landlord-cum-capitalist farmers can sell their products. While financing the loan given to workers, the landlord takes loan either from the professional money-lender or from the trader. If he takes loan from the professional money-lender, he can sell the product in the free market at the going market price. But when he takes loan from the trader, he is committed to sell a part of the product to the trader. The first is a 'Non-interlinked credit-product contract' (NICPC); and the second contract is called 'Interlinked credit-product contract' (ICPC).

[4] Note that it is a one-commodity model and the loan is given in terms of that commodity. We often use the term 'Money lender' in this paper. But there is no money in this model. The 'Money-lender' is defined as an institution who lends the individuals at a given interest-rate. Repayment of loan and interest is also made in terms of the same commodity.

3.1. *The Reservation Utility*

The representative worker earns an income, M, in the peak season in the case of NICLC; and consumes B and C in the lean period and peak period respectively. The utilitiy function of the worker,

$$U = U(B, C) \tag{1}$$

satisfies all the standard properties. Here B is the loan-financed consumption and g is the interest-rate when loan is taken from the professional money-lender. So the budget equation is

$$B(1+g) + C = M\,. \tag{2}$$

The first order condition of utility maximization is given by the following:

$$(U_B/U_C) = 1+g\,. \tag{3}$$

So in the case of a non-interlinked credit-labour contract (NICLC), the demand function for loan of the worker must satisfy equation (3).

Solving equations (2) and (3), we obtain the equilibrium values of B and C; and putting their values in the utility function given by (1), we obtain the level of indirect utility, $\bar{U}$. This indirect utility level of the worker derived from a non-interlinked credit-labour contract (NICLC) plays the role of 'Reservation Utility' when the landlord offers him an ICLC.

3.2. *The Worker in the ICLC*

Let r be the interest rate on consumption loan and W be the wage rate of the worker in the interlinked credit-labour contract. So the budget equation of the worker in the case of an ICLC is given by the following:

$$B(1+r) + C = W\,. \tag{4}$$

The worker maximizes the utility function $U(B, C)$ subject to this budget constraint; and the first-order condition of utility-maximization is the following:

$$(U_B/U_C) = 1+r\,. \tag{5}$$

Now solving equations (4) and (5) we can obtain the following demand function for consumption loan of the worker:

$$B = B(r, W)\,. \tag{6}$$

If the consumption-loan is a normal good, $B_r < 0$ and $B_W > 0$. These imply that the price-effect is negative and the income-effect is positive.

Putting the equilibrium values of B and C in the utility function, we obtain the indirect utility, U^*; and this is a function of the interest-rate, r, and the wage-rate, W. Mathematically,

$$U^* = U^*(r, W) \quad \text{with} \quad \left(\frac{\partial U^*}{\partial r}\right) < 0 \quad \text{and} \quad \left(\frac{\partial U^*}{\partial W}\right) > 0\,. \tag{7}$$

Using Roy's identity, it can be shown that, in equilibrium

$$B = -\frac{(\partial U^*/\partial r)}{(\partial U^*/\partial W)}. \tag{8}$$

The farmer will accept an ICLC if the level of indirect utility of the worker in the ICLC, U^*, does not fall short of the 'Reservation Utility,' $\bar{U}$. Mathematically,

$$U^*(r, W) \geqslant \bar{U}. \tag{9}$$

This is the 'Reservation-Utility' constraint the employer faces whie offering an ICLC to the worker.

3.3. *The Consumption Efficiency Hypothesis*

We consider the following nutritional efficiency function:

$$h = h(B) \quad \text{with} \quad h'(B) > 0 \quad \text{and} \quad h''(B) \gtreqless 0 \quad \text{for} \quad B \lesseqgtr B^*. \tag{10}$$

So the increase in the level of consumption of the worker in the lean season (financed by loan) raises his nutritional efficiency in the peak season. Here h represents the nutritional efficiency per worker in the peak season. However, the rate of increase in the efficiency rises upto a certain level of consumption, say B^*; and then starts falling. Here

$$E = h'(B)/(h(B)/B)$$

is the elasticity of nutritional efficiency with respect to the level of consumption. Using the restrictions on the curvature of the nutritional efficiency function, one can easily show the followings:

(i) E is a negative function of B; and

(ii) $E \gtreqless 1$ for $B \lesseqgtr B^*$.

This positive relationship between consumption and nutritional efficiency was first emphasized by Leibenstein (1957) and this hypothesis has been considered in a number of studies.[5] Note that the existing literature on Consumption-Efficiency Theory considers a one-period world and hence assumes an instantaneous relationship between the level of consumption and efficiency. Since we have a two period world in our model, we introduce a one period lag into this relationship which is closer to reality.

3.4. *The Employer's Problem in ICLC*

In an 'Interlinked Credit-Labour Contract.' (ICLC), the income of the landlord (capitalist farmer) includes profit and the net interest income. The landlord produces the product (food) with labour as the only factor of production. Let Q be the level of output and N be the number of workers employed. The production-function is given by the following:

[5] See, for example, Agarwala (1979), Bliss and Stern (1978), Dasgupta and Ray (1986), Gupta (1989), Mirrlees (1975), Stiglitz (1976) etc.

$$Q=Q(hN) \quad \text{with} \quad Q'(\cdot)>0 \quad \text{and} \quad Q''(\cdot)<0\,. \tag{11}$$

Here hN is the volume of labour-use in efficiency unit.

Let P_1 be the price of food at which the producer (landlord) sells the product. We assume that $P_1=1$. The fraction of food sold in the free market is denoted by $\$$. So $(1-\$)$ fraction is sold to the traders. As the landlord faces the same selling price in both the cases, the profit of the landlord (capitalist producer) in terms of food, by Π, is given by the following:

$$\Pi=Q(h(B)N)-WN\,. \tag{12}$$

The gross interest-income of the landlord from the ICLC is given by $(1+r)BN$ where r is the interest-rate at which the landlord gives loan to workers. However, in the lean season, the landlord (producer) does not have any lonable fund of his own. He finances the loan given to workers taking loan either from the trader at the rate of interest, i, or from the professional money-lender at the rate of interest, g. So the net interest income of the producer is $(r-i)BN$ when he takes loan from the traders, i.e., when he is involved in the ICPC. But this net interest-income is $(r-g)BN$ in the case of NICPC.

Let Y_L be the income of the landlord (producer). Hence,

$$Y_L=\Pi+B(r-i)N \tag{13}$$

in the case of ICPC. The landlord determines the rate of interest (at which loan is given to the workers), wage-rate and the level of employment. So Y_L is maximized with respect to r, W, and N subject to the demand function for loan of the worker, given by equation (6), and the 'Reservation Utility Constraint' given by the inequality (9).

When the landlord (producer) takes loan from the professional money-lender at the interest-rate, g, his total income is given by the following:

$$Y_L=\Pi+B(r-g)N\,. \tag{13.1}$$

3.5. *Equilibrium Conditions*

This is a constrained maximization problem and one has to maximize the Lagrangian given by the following:

$$L=\Pi+B(r-i)N+(U^*(r, W)-\bar{U}) \tag{14}$$

where Π is given by equation (12) and B is given by equation (6). Maximizing the Lagrangian with respect to N, the number of workers to be employed, one can obtain the following first-order condition:

$$Q'(\cdot)h(B)=W-B(r-i)\,. \tag{15}$$

Here the L.H.S. represents the marginal productivity of worker and the R.H.S. represents the wage plus interest cost of the employer (landlord) per unit of

employment.

Also maximizing L with respect to W and r, one can derive the following equation from the first-order conditions. (Derivations are given in the Appendix (A)).

$$Q'(\cdot)h'(B)=i-r\,. \tag{16}$$

Here the L.H.S. represents the marginal contribution of consumption loan on the production of the landlord (producer) and the R.H.S. stands for the cost per unit of loan.

As $h'(B)>0$ and $Q'(\cdot)>0$, it is obvious that $i>r$. This leads to the following proposition:

PROPOSITION 1. *The rate of interest in the ICLC is lower than the rate of interest in the ICPC.*

This is consistent with our empirical findings because the interlinked credit-labour contracts are interest-free. But the implicit interest-rates appear to be positive in the case of interlinked credit-product contracts because the traders make their payments to the producers in instalments.

Also using equations (15) and (16), we have, the following:

$$E=\frac{h'(B)B}{h(B)}=\frac{i-r}{(W/B)+(i-r)}<1\,. \tag{17}$$

Here, we can prove the following proposition:

PROPOSITION 2. *The elasticity of nutritional efficiency with respect to the level of consumption of the worker is less than unity in equilibrium.*

This is an important result in this paper because the existing theoretical works[6] show that this elasticity is equal to unity in equilibrium.

Using this equilibrium condition (17), we are to derive the relationship between B and i. We know that E is a negative function of B (shown in the section 3.3); and the equation (6) shows that B is a negative function of r. Also, from equation (17), we have,

$$\frac{1-E}{E}=\frac{(W/B)}{i-r}\,. \tag{18}$$

We assume that $(B(1+r)/W)$ is a constant[7]. Hence as B rises, r falls and (W/B) also falls. So, given i, the R.H.S. of equation (18) should fall when B rises. On the other-hand, the L.H.S. of equation (18) should be a positive function of B because E and B are inversely related. So in order to maintain the equality, any rise in B should be accompanied by a fall in i. Similarly, i should rise due to a

[6] See, for example, Bliss and Stern (1978), Mirrlees (1975), Stiglitz (1976) etc.

[7] This can be justified when the utility function of the worker is of Cobb-Douglas type.

fall in B to keep the equation (18) undisturbed. This helps us to establish the following proposition:

PROPOSITION 3. *B and i are inversely related. This proposition has the following implication. The lower the rate of interest at which the landlord (producer) can borrow, the higher will be the consumption-loan given to the representative worker which ultimately leads to a higher level of labour-productivity.*

Using the Mean-value theorem, it can be shown from equation (14) that

$$(\partial L/\partial i) = -BN < 0 . \tag{19}$$

So we can prove the following:

PROPOSITION 4. *The lower (higher) the rate of interest at which the producer can borrow, the higher (lower) is his total income.*

Note that, if we put g in place of i in equation (13), we get the equation (13.1). So if $i<g$, then the landlord (producer) derives higher income from the ICPC than that from the NICPC. So the landlord will prefer a ICPC to a NICPC when the rate of interest in the ICPC is lower than that charged by the professional money-lender.

Also we have shown that $r<i$. So when $i<g$, we have $r<g$. So the optimal interest rate of the landlord (producer) charged to the worker is less than the interest rate charged by the professional money-lender. So if $i<g$, the landlord will prefer the ICLC to NICLC. So when $i<g$, the landlord prefers a two-tier interlinked contract.

3.6. *The Trader*

Is the equilibrium value of i necessarily lower than the value of g? The answer is to be obtained analysing the behaviour of the trader because the trader chooses the value of i, the rate of interest in the ICPC.

In an ICPC, the trader has also two sources of income: (i) profit from trading and (ii) net interest income. If $\$$ fraction of the product is sold to the trader at the price $P_1 = 1$ and the trader sells it at a price $P_2 > 1$, then the profit from trading is $(P_2-1)Q(h(B)N)(1-\$)$. The trader takes loan from the professional money-lender at the rate of interest, g, and gives it to the landlord (producer) at the rate of interest, i. So his net interest-income per unit of loan is $(i-g)$. So the income of the trader in the ICPC, denoted by Y_T, is given by the following:

$$Y_T = (P_2-1)Q(h(B)N)(1-\$) + (i-g)BN . \tag{20}$$

This is maximized with respect to i and $\$$ subject to the equations (15) and (16) from which we can derive B and N as functions of i.

Maximizing Y_T with respect to $\$$ for $0 \leqslant \$ \leqslant 1$, it can be easily shown that optimum $\$ = 0$ because

$$(\partial Y_T/\partial \$) = -(P_2-1)Q(h(B)N) < 0 . \tag{21}$$

This leads to the following proposition:

PROPOSITION 5. *The trader finds it profitable to purchase the entire output of the producer if he accepts an ICPC.*

The income of the landlord (producer), Y_L, is independent of the value of $\$$ because he faces the same selling price in both the cases. So the choice of the value of $\$$ is entirely left to the trader.

While maximizing Y_T with respect to i, the trader should face the following constraint: $i \leqslant g$. This is because the landlord (producer) will not prefer a ICPC if $i > g$.

Note that,

$$(\partial Y_T/\partial i) = (P_2 - 1)(1 - \$)Q'(\cdot)(d(h(B)N)/di) + BN + (i-g)(dBN/di) .$$

We know that B and i are inversely related. If N and i are also inversely related,[8] then we have the followings:

(i) $(dBN/di) < 0$; and (ii) $(d(h(B)N)/di) < 0$ [$\because$ $h'(B) > 0$] .

Also, if an interior solution to the maximization problem exists, then the first-order condition is the following:

$$(dY_T/di) = 0$$

or,

$$(P_2 - 1)(1 - \$)Q'(\cdot)(d(h(B)N)/di) + BN(1 - ((i-g)/i)\hat{E}) = 0 . \qquad (22)$$

Where, $\hat{E} = -(dBN/di)(i/BN) > 0$ is the interest-elasticity of demand for loan in the ICPC.

Note that the equation (22) may be satisfied at $i < g$ only if the first-term of the L.H.S. is negative and this necessary condition is satisfied if $(d(h(B)N)/di) < 0$. However, it is not sufficient because (22) may be satisfied even at $i = g$ with $(d(h(B)N)/di) < 0$.

4. CONCLUSION

In this paper, we have analysed a setting in which the traders and landlords (capitalist farmers) may enter interlinked credit and output contracts, and landlords and labourers may enter interlinked credit and labour contracts. The co-existence of these two types of interlinkage is ultimately related to the factors determining the rate of interest charged by the trader. The landlord finds an interlinked credit-labour contract profitable when the consumption-loan given to the worker increases his productivity. However, he is involved in both types of interlinked contracts when the trader charges a rate of interest lower than that in the non-

[8] The inverse relationship is not necessarily true. See Appendix B.

interlinked credit-product contract.

The recent developments in interlinked literature consider an interlinked contract as a collateral substitute, and an effective monitoring and contract enforcement device by reducing information asymmetries. This paper presents an alternative explanation using the Consumption-Efficiency Hypothesis. Obviously it will not be attractive to those who share the feelings of Rosenzweig (1988) that the consumption-efficiency relationship has no relevance to any known population on this planet. Still the consumption-efficiency relationship has been used in explaining many of the institutional features of a backward agriculture. The present exercise should be viewed as a new member of that club.

APPENDIX (A)

While maximizing L with respect to W and r, we have the following first order conditions:

$$Q'(\cdot)h'(\cdot)B_W \cdot N + N(r-i)B_W - N + \lambda U_W = 0 \tag{A.1}$$

and,

$$Q'(\cdot)h'(\cdot)B_r N + N(r-i)B_r + BN + \lambda U_r = 0\,. \tag{A.2}$$

From (A.1), we have,

$$\lambda = \frac{N - B_W(r-i)N - Q'(\cdot)h'(\cdot)B_W N}{U_W} \tag{A.3}$$

and putting into (A.2), we have

$$\begin{aligned} &BN + (r-i)NB_r + N\cdot(U_r/U_W) - (U_r/U_W)B_W(r-i)N \\ &\quad - Q'(\cdot)h'(\cdot)B_W N(U_r/U_W) + Q'(\cdot)h'(\cdot)B_r N = 0\,. \end{aligned} \tag{A.4}$$

We know, from equation (8), that

$$-B = (U_r/U_W)\,.$$

Hence, from equation (A.4), we have,

$$(r-i)(B_r + B\cdot B_W) + Q'(\cdot)h'(\cdot)(B_r + BB_W) = 0 \tag{A.5}$$

Here, $(B_r + B\cdot B_W)$ is the substitution effect and is always negative. Hence,

$$Q'(\cdot)h'(\cdot) + r - i = 0$$

which is our equation (16) in section 3.5.

APPENDIX (B)

We consider the equation (16), given by

$$Q'(\cdot)h'(B)=i-r\,.$$

Hence,

$$Q''(\cdot)\cdot\frac{d(h(B)\cdot N)}{di}\cdot h'(B)+Q'(\cdot)h''(B)\left(\frac{dB}{di}\right)=1-\left(\frac{dr}{dB}\right)\left(\frac{dB}{di}\right)$$

or,
$$\frac{d(h(B)\cdot N)}{di}=\frac{1-\left(\frac{dr}{dB}\right)\left(\frac{dB}{di}\right)-Q'(\cdot)h''(B)\left(\frac{dB}{di}\right)}{Q''(\cdot)h'(B)}\,.$$

Here the denominator of the R.H.S. is always negative. So the sign of the L.H.S. is always determined by the sign of the numerator of the R.H.S.

Here $((i-r)/h'(B))$ is the marginal cost of employing an worker. If this falls (rises) with decrase in i, then $Q'(\cdot)$ also falls (rises) and hence $h(B)\cdot N$ rises (falls). When $h(B)\cdot N$ rises with fall in i, an inverse relationship between N and i may be obtained.

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