INTERACTIONS BETWEEN TWO INFORMAL SECTOR LENDERS AND INTEREST RATE DETERMINATION IN THE INFORMAL CREDIT MARKET: A THEORETICAL ANALYSIS

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ABSTRACT: The paper provides a theory of interest rates determination in the informal credit market in backward agriculture highlighting the interactions between two informal sector lenders (a professional moneylender and a trader-interlocker) and explains the prevalence of different interest rates in the rural credit market. The trader and the moneylender play a non-cooperative game in choosing the extent of interlinkage and the non-interlinked informal interest rate, respectively. In the interlinked credit-product contract, the trader offers the interlockees a product price equal to the open market price and his entire surplus comes from his activities in the credit market. These results are completely opposite to those found in the existing literature on interlinkage. A price subsidy policy reduces the extent of interlinkage chosen by the trader while a credit subsidy policy may raise it. Besides, the subsidy policies unequivocally raise the non-interlinked informal interest rate of the moneylender but may lower the welfare of the farmers and the agricultural productivity. In this context, an alternative credit policy of forging a vertical linkage between the formal and informal credit markets has been considered. It has been found that a credit subsidy policy under the new system is able to raise the agricultural productivity and improve the welfare of the farmers by ameliorating their borrowing terms in the credit market.

Keywords: Trader, Moneylender, Formal credit, Informal credit, Interlinkage, Interest rate, Nash equilibrium, Subsidy policy, Vertical linkage.
JEL classification: Q14; D89.

INTERACTIONS BETWEEN TWO INFORMAL SECTOR LENDERS AND INTEREST RATE DETERMINATION IN THE INFORMAL CREDIT MARKET: A THEORETICAL ANALYSIS

1. Introduction:

There are two sources of agricultural credit in a less developed economy such as India: the formal credit market, where loans come from the nationalized banks and cooperative credit societies; and, the informal credit market, where loans are advanced by professional moneylenders, traders, landlords etc. The share[1] of formal credit in Indian agriculture has increased from 7 percent in 1950-51 to 63 percent in 1981-82. But despite an adequate supply of formal credit in many cases[2] the small and marginal farmers in India depend on informal credit not least because formal credit is not available in time.

There is empirical evidence of delay in disbursing formal credit. Sarap (1991) has observed that the small and marginal farmers face substantial delay in getting formal (short term) credit[3]. Sarap's empirical analysis is restricted to the villages of Sambalpur district of Orissa, India. The empirical analysis of Chaudhuri (1993) in the case of two selected villages of West Bengal, points out the same problem[4]. This problem has also been observed by Bedbak (1986) who made a survey of a village of the Sonepur subdivision of Orissa.

There may be several factors responsible for the delayed disbursement of formal credit to the small and marginal farmers. Among those factors, Sarap (1991) has emphasized factors such as the lower bargaining strength of the small farmers vis-à-vis large farmers, the bureaucratic and procedural formalities required, patronage, arbitrariness and the corrupt practices pursued by the officials of the formal credit agencies. There are two theoretical papers by Chaudhuri and Gupta (1996) and Gupta and Chaudhuri (1997) which have provided theories of determination of the informal interest rate considering the interactions between the formal and informal sector lenders and bribe-taking by the formal sector lender. Unfortunately, neither of these two papers analyzes the interactions between the different informal sector lenders and provides explanation for the prevalence of different interest rates in the rural credit market.

There are often more than one informal sector lenders in the rural credit market. Their mutual interactions play an important role in determination of the interest rates in the informal credit market. These rates take on a wide range of values, often within the same area[5]. In the rural credit market, on the one hand, there are the professional moneylenders who charge exorbitantly high interest rates and on the other, there are the traders and landlords who offer interlinked contracts and charge subsidized interest rates.

The present paper is devoted to a theoretical analysis of interest rates determination in the informal credit market taking into consideration interactions between two informal sector lenders when the market for informal credit is created by delayed disbursement of formal credit. The simplified story is the following. In the rural credit market there are a finite number of small farmers with each of them facing an exogenous delay in securing formal credit. There are two informal sector lenders – a professional moneylender and a trader. Each farmer may take informal credit either from the moneylender, repay the entire loan with interest when he receives formal credit and sell his product to government agencies at the procurement price or may be involved in an interlinked credit-product contract with the trader where he takes the production loan for the entire period from the trader and is bound to sell his output to the trader. The terms of the contract, namely the interest rate and the product price that the farmer receives are determined by the trader. The trader determines the extent of interlinkage i.e. the number of farmers with whom he comes into interlinked credit-product contract (ICPC), given the moneylender's interest rate while the moneylender determines the interest rate charges on informal credit given the size of interlinkage chosen by the trader. Thus the moneylender and the trader play a non-cooperative game, choosing the size of interlinkage and the informal interest rate charged by the moneylender, and the equilibrium in the credit market may be viewed as a Nash equilibrium.

This theoretical analysis leads to some interesting results. For example, in the interlinked contract, the trader earns zero trade profits. His entire income accrues from his activities in the credit market where he charges an interest rate, higher than his opportunity interest rate. All these results are contradictory to the standard results available in the literature on interlinkage that the trader supplies subsidized credit to the interlockees and his entire surplus comes from the product market (see Gangopadhyay and Sengupta (1987) and Chaudhuri and Gupta (1995b)). Also a price subsidy policy of the government reduces the extent of interlinkage chosen by the trader while a credit subsidy policy and / or a reduction in the delay of disbursement of formal credit may raise it. Besides, a price and / or a credit subsidy policy raises the informal interest rate of the

moneylender but may lower the interest rate in the interlinked contract. So these policies are likely to widen the disparities between the two interest rates prevailing in the informal credit market. More importantly, the subsidy policies, designed to benefit the farmers, may worsen the welfare of the farmers as the informal sector lenders adjust their behaviour to appropriate the advantages of these policies.

In this context, we have also considered an alternative credit policy where formal credit is not disbursed to the farmers directly. The informal sector lenders are treated as financial intermediaries between the formal credit agencies and the borrowers. The supply of subsidized formal credit to the informal sector lenders is expected to increase the degree of competitiveness among them, which may help to improve the borrowing terms faced by the small and marginal farmers. This can be thought of as a policy of forging a 'vertical linkage' between the formal and informal credit systems. We have found that under this new credit scheme, a credit subsidy policy succeeds in reducing the informal interest rate of the moneylender, ensuring better borrowing terms to the farmers in the credit market and in improving their welfare.

2. The Model:

The model consists of N number of identical small farmers, one moneylender and one grain-trader in the village retail market. There are two sources of rural credit: formal and informal. The agricultural crop-cycle is described by the time horizon [0,1]. The farmers do not get formal credit at the beginning of the crop-cycle. Formal credit is available at time $T^* > 0$ such that $T^* \in [0,1]$. So the farmers have to depend upon informal credit for carrying out their farming activities. The moneylender and the trader are the two sources of informal credit. The farmers may take informal credit either from the moneylender at the beginning of the crop-cycle and repay the entire informal loan plus interest accrued on it at time T^* when he receives formal credit or may be involved in credit-product interlinkage with the trader where the informal credit for the entire crop-cycle is supplied by the trader. In the former case, each farmer is free to sell[6] his output to the State Purchasing Bodies (SPBs)[7] at the procurement price, P_f, and this we call a non-interlinked credit-product contract (NICPC). On the contrary, in the latter case, each farmer is bound to sell his product to his creditor at a price determined by the latter. This we call an interlinked credit-product contract (ICPC).

For the sake of simplicity, credit is considered as the only input of production[8]. The relationship between the farmer's output and the available credit, C, is given by $Q = Q(C)$ with $Q'(.) > 0$ and $Q''(.) < 0$. The total number of farmers in the credit market is normalized to unity.

2.1 *The Reservation Income from NICPC*

At the beginning of the crop-cycle the farmer takes C amount of informal credit from the moneylender at the interest rate i per period. At time T*, when formal credit is available, he will take the amount $((1+iT^*).C)$ of formal credit to repay the loan of the moneylender. Formal credit is held for the time interval [T*,1]. So if r is the interest rate on formal credit, the cost on formal credit is given by $[(1+r.(1-T^*))(1+iT^*)C]$, where $[(1+r(1-T^*))(1+iT^*)]$ is the effective price of formal credit over the entire crop-cycle.

The farmer maximizes his profit, defined as the excess of sales revenue over the interest cost. The demand function for loans is obtained from his profit-maximizing behaviour. The profit of the farmer, Y_F, is given by

$$Y_F = P_f.Q(C) - [(1+r(1-T^*))(1+iT^*)].C \qquad (1)$$

The procurement price of the crop, P_f, and the formal interest rate, r, are administratively determined. Y_F is maximized with respect to C and the first-order condition of maximization is given by

$$P_f.Q'(.) = [(1+r(1-T^*))(1+iT^*)] \qquad (2)$$

Equation (2) states that the VMP of credit must equal the effective price of formal credit over the entire crop-cycle. The optimum amount of credit application of each farmer, denoted C*, is found by solving equation (2) as folows: $C^* = C^*(P_f, i, r, T^*)$. C* is an increasing function of P_f and a decreasing function of both i and r. C* is also a decreasing function of T* if $1 \geq 2T^*$ (see appendix I). Now putting $C = C^*$ into equation (1) we obtain the reservation income of each farmer as the following.

$$Y_F^* = P_f.Q(C^*) - [(1+r(1-T^*))(1+iT^*)].C^* \qquad (3)$$

The reservation income of the farmer plays a crucial role when the trader offers him an ICPC. No farmer will accept an ICPC if the terms of the contract fail to ensure an income of at least Y_F^*.

2.2 The ICPC

In an ICPC, the farmer takes his entire production loan from the trader at the interest rate k_1 per period and in turn he is bound to sell his entire output to the latter at a price P_1 per unit. The income of the farmer with an ICPC is given by

$$Y_F = P_1.Q(C) - (1+k_1).C \qquad (4)$$

This is maximized with respect to C. The first-order condition of maximization is

$$P_1.Q'(C) = (1+k_1) \qquad (5)$$

The farmer's optimum demand for credit is found by solving equation (5) as: $C^0 = C^0(P_1, k_1)$. Inserting $C = C^0$ into (4) one gets the optimum level of income of the farmer as the following.

$$Y_F^0 = P_1.Q(C^0) - (1+k_1).C^0 \qquad (6)$$

The farmer will accept an ICPC if and only if

$$Y_F^0 \geq Y_F^* \qquad (7)$$

With an ICPC, the income of the trader includes trade profits and net interest income. The trader purchases $Q(C^0)$ amount of output from each farmer at a price P_1 per unit and sells it in the open market at the price P_T and thus earns $(P_T - P_1).Q(C^0)$ amount of trade profits. Besides his net interest income from each farmer is $(k_1 - k).C^0$, where k is the opportunity interest rate of the trader. So his total income, denoted Y_T, is given by

$$Y_T = n.[P_T.Q(C^0) - (1+k).C^0 - Y_F^0] \qquad (8)$$

where n is the fraction of total number of farmers with whom the trader comes into interlinkage. Y_T is maximized through a choice of P_1 and k_1 and subject to the reservation income constraint of each farmer given by (7).

We here follow a principal-agent framework with the trader as the principal and each farmer as the agent. The principal maximizes the joint income (his income plus that of each farmer) through a choice of C^0. The farmer behaves efficiently and gets only his reservation level of income out of the maximized joint income since the trader has sufficient instruments at his disposal, namely P_1 and k_1 to push the former to the reservation income level and to appropriate the remaining surplus from the contract. So in equilibrium we must have

$$Y_F^0 = Y_F^* \qquad (9)$$

Given the current state of the literature on the principal-agent models applied to the agrarian sector, all the above results are well established in the literature. See for example, Gangopadhyay

and Sengupta (1987), Chaudhuri and Gupta (1995a,b), Gangopadhyay (1994), Chaudhuri (1996) etc.

An ICPC is optimal to the trader since it yields a higher level of income vis-à-vis an NICPC[9]. This implies that given P_T and k, there will occur a corner solution i.e. n = 1 in equilibrium. Thus in equilibrium the demand for loan that the moneylender faces will be zero unless the marginal cost of funds of the trader increases with an increase in the loaned amount [10] i.e. $k = k(nC^0)$ with $k'(.) > 0$ and $k''(.) = 0$ [11].

This leads to the following proposition.

PROPOSITION 1: A necessary condition for the moneylender to face a positive demand for informal credit is that the opportunity interest rate of the trader must be an increasing function of the loaned amount.

When k is an increasing function of the loaned amount, the first-order condition of maximization of Y_T (after using equation (9)) is given by

$$P_T.Q'(C^0) = 1 + k(nC^0) + k'(.).nC^0 \qquad (10)$$

Thus the trader equates the VMP of credit to his marginal cost of the loan in equilibrium. In equation (10) $((1 + k(nC^0) + k'(.).nC^0)/P_T)$ is the real marginal cost of credit. As P_T increases or n decreases the real marginal cost decreases. The law of diminishing marginal productivity of credit ensures an inverse relationship between the optimum use of credit and its real marginal cost. So C^0 increases as P_T increases or n decreases and vice versa (see appendix I). The trader's income maximizing C^0 can be found as a function of P_T and n from equation (10). Equations (5) and (9) are then solved simultaneously to find out the optimum values of the terms of the contract as functions of the size of interlinkage, n.

Using (3), (8) and (9) the trader's total income is rewritten as

$$Y_T = n.[P_T.Q(C^0) - (1+k(nC^0)).C^0 - P_f.Q(C^*) + (1+iT^*).(1+r(1-T^*)).C^*] \qquad (8.1)$$

The trader maximizes Y_T with respect to n. The informal interest rate of the moneylender, i, is treated as given in the maximization process because both the trader and the moneylender act as followers in this game. Maximizing Y_T with respect to n, we get the following first-order condition.

$$(\partial Y_T/\partial n) = P_T.Q(C^0) - (1+k(.))C^0 - P_f.Q(C^*) + (1+iT^*)(1+r(1-T^*))C^* - k'(.).n.(C^0)^2 = 0 \quad (11)$$

or, $P_T.Q(C^0) - (1+k(.))C^0 - k'(.).n.(C^0)^2 = Y_F^*$ (11.1)

The second-order condition of maximization is also satisfied i.e. $(\partial^2 Y_T/\partial n^2) < 0$ (see appendix I).

Equation (11.1) states that the marginal gain of the trader of interlinking one additional farmer must equal the reservation income of the latter. This is shown in figure 1 where aY_T is the marginal income curve of the trader. This a negatively sloped curve since the marginal income of the trader decreases with an increase in the value of n (note that from the second-order condition of income maximization of the trader, $(\partial^2 Y_T/\partial n^2 < 0)$). OC is the reservation income of the farmer. This curve is horizontal because Y_F^* is independent of n. In figure 1, b is the equilibrium point where the equilibrium condition given by equation (11) is satisfied. n^0 is the equilibrium level of interlinkage. Δabc is the measure of surplus income appropriated by the trader by interlinking n^0 fraction of the total number of farmers.

(Space for figure 1)

Now using equations (2), (3), (5), (6) and (9) we can write

$$P_1.[Q(C^0) - Q'(C^0).C^0] = P_f.[Q(C^*) - Q'(C^*).C^*] \quad (14)$$

Also by equations (2), (3), (10) and (11) one can write

$$P_T.[Q(C^0) - Q'(C^0).C^0] = P_f.[Q(C^*) - Q'(C^*).C^*] \quad (15)$$

Since $P_T > P_f$ (implying imperfection in the product market) from (14) and (15) it follows that

$[Q(C^0) - Q'(C^0).C^0] < [Q(C^*) - Q'(C^*).C^*]$

or, $Q(C^0) < Q(C^*)$. So when the opportunity cost of the loan of the trader is an increasing function of the loaned amount and there is imperfection in the product market, the ICPC is less productive (from the viewpoint of agricultural productivity) vis-à-vis an NICPC.

By (14) and (15) it now follows that

$$P_1 = P_T \quad (16)$$

So in an ICPC the trader offers the farmer a price of the crop which is equal to its open market price. Thus the trader earns zero trade profit in this model. His gains from interlinkage (Δabc in figure 1) entirely come from his dealings in the credit market. It then trivially follows that $(1+iT^*)(1+r(1-T^*)) < k_1 > k(nC^0)$ i.e. the interest rate on the informal credit in the ICPC must be

greater than both the opportunity cost of the loan of the trader and the effective price of credit in the NICPC over the entire crop-cycle.

The above results are quite significant because these are contradictory to the proposition of the Gangopadhyay and Sengupta (1987) paper that the trader supplies credit to the farmer at a subsidized interest rate and offers a price of the crop which is less than the open market price. Such contradictions basically originate from the differences in the assumption regarding the opportunity interest rate of the trader between these two models. While in Gangopadhyay and Sengupta (1987) this opportunity interest rate was taken as datum, in the present paper it has been assumed as an increasing function of the loaned amount. Therefore, the trader in the present case unlike the Gangopadhyay and Sengupta (1987) case does not find any incentive to supply subsidized credit to the farmers and improve agricultural productivity. The above results are presented in the form of the following proposition.

PROPOSITION 2: In the ICPC the trader offers the farmer a price of the crop which is equal to its open market price and charges an interest rate that is greater than both the opportunity cost of the loan of the trader and the effective interest rate on formal credit (over the entire crop-cycle) in an NICPC.

Equation (11.1) is the reaction function of the trade, which shows how the trader will react in terms of n following a change in i by the moneylender.

If the moneylender raises his interest rate on informal credit i, the reservation level of income of each farmer Y_F^* decreases (see appendix I). Thus Y_F^* curve in figure 1 shifts downward. The trader raises n to satisfy equation (11.1). Thus n increases when i increases. Hence the trader's reaction curve TT, representing equation (11.1) must slope positively in the i–n space (see figure 2).

When P_f increases and / or r decreases Y_F^* increases. The Y_F^* curve in figure 1 shifts upward. The trader lowers n given the moneylender's interest rate, i. Thus the TT curve shifts upward to the left as P_f increases and / or r decreases. If T* is lowered the effective price of formal credit over the entire crop-cycle decreases and as a consequence Y_F^* increases if $1 \geq 2T^*$ (see appendix I). So the Y_F^* curve in figure 1 shifts upward. The trader's income maximizing value of n increases given i. The reaction curve of the trader, TT, shifts upward to the left as T* decreases.

3. The Moneylender's Behaviour in an NICPC and Reaction Curve

The demand for informal credit that the moneylender faces at the beginning of the crop-cycle from each farmer is C*. But informal credit is held by the farmer for the time interval [0,T*], because at time T*, formal credit is available and the farmer pays back the informal loan with interest. Let g = g((1–n).C*) be the opportunity rate of return of funds of the moneylender and g′(.) > 0 and g″(.) = 0. Here (1–n) is the number of farmers who take informal credit from the moneylender. Then the aggregate net interest income of the moneylender is

$$Y_M = (iT^* - g((1-n)C^*).C^*T^*(1-n) = (i - g(.))C^*T^*(1-n) \quad (12)$$

The moneylender maximizes Y_M with respect to i, given n because both the moneylender and the trader act as followers in this game. Maximizing Y_M with respect to i, we get the following first-order condition[12]:

$$C^* - g'(.)(1-n)C^*.(\partial C^*/\partial i) + (i - g)(\partial C^*/\partial i) = 0 \quad (13)$$

Equation (13) states that the marginal net interest income (with respect to i) of the moneylender must be equal to zero in equilibrium. When the trader raises the extent of interlinkage n, the marginal net interest income (with respect to i) of the moneylender falls since g′(.) > 0; g″(.) = 0 and $(\partial C^*/\partial i) < 0$. So the moneylender now lowers the interest rate he charges on informal credit. So i decreases when n increases. Hence equation (13) should represent a negatively sloped curve in the i–n space and this is the reaction curve of the moneylender. It is denoted by MM (see figure 2).

We note that C* is an increasing function of P_f , a decreasing function of both i and r and also a decreasing function of T* if $1 \geq 2T^*$. So if the procurement price P_f increases and / or the formal interest rate r decreases and / or the delay of the disbursement of the formal credit decreases, the demand for informal credit C* increases. Even at the same value of n, the marginal net interest income (with respect to i) of the moneylender increases. Thus the moneylender raises the informal interest rate i. This implies that the MM curve in figure 2 shifts upward to the right following a reduction in r and / or T* and / or an increase in P_f [see appendix II for the derivations].

4. Nash Equilibrium and Comparative Static Exercises:

This is a game between the trader and the moneylender, both acting as followers. Nash equilibrium is attained at the point of intersection of the two reaction curves. This is shown in figure 2. The equilibrium point e is unique since the trader's reaction curve is always positively sloped and the MM curve always slopes negatively. We assume that the slope of the TT curve exceeds the absolute value of the slope of the MM curve. This ensures that the equilibrium point e in figure 2 is stable.

(Space for figure 2)

4.1. *Effects of Price and Credit Subsidy Policies and a reduction of Delay in Disbursement of Formal Credit on the Moneylender's interest rate and the Extent of Interlinkage*

A price subsidy policy implies an increase in the procurement price of the crop received by the farmers in an NICPC, P_f. On the other hand, a credit subsidy policy means lowering the interest rate on formal credit r. Besides if the government undertakes a policy to reduce the delay of disbursement of formal credit, T* takes a lower value.

If P_f increases and /or r decreases and /or T* decreases the TT curve shifts upward to the left. The MM curve, on the other hand, shifts upward to the right. The new equilibrium point lies to the north of the previous one. In all these cases, the informal interest rate charged by the moneylender i takes a higher value. This establishes the following proposition.

PROPOSITION 3: A price and /or a credit subsidy policy unambiguously raise the informal interest rate of the moneylender. A reduction in the delay of disbursement of formal credit also raises the moneylender's interest rate if $1 \geq 2T^*$.

An increase in P_f and /or a decrease in r raises the reservation level of income of each farmer, Y_F^*, directly. However these policies also raise the informal interest rate of the moneylender (see proposition 3) which reduces Y_f^* indirectly. In the case of a price subsidy policy the direct expansionary effect on Y_F^* outweighs the indirect contractionary effect. So Y_F^* increases as P_f increases which in turn raises the marginal cost of interlinkage of the trader while the marginal

gain from interlinkage remains unchanged. Thus the trader finds it profitable to reduce the extent of interlinkage. So n decreases as P_f increases. However, in the case of a credit subsidy policy, the direct expansionary effect on Y_F^* is greater than (equal to) (less than) the indirect contractionary effect on Y_F^* if and only if $E^{13} < (=) > 1$ where $E = (- C^*.Q''(C^*)/Q'(C^*))$ is the elasticity of the marginal product curve of credit. Thus the extent of interlinkage falls (remains unchanged) (increases) due to a credit subsidy policy if and only if the elasticity of the marginal product curve of credit is less than (equal to) (greater than) unity.

If the farmer receives formal credit earlier, the value of T* falls. A fall in T* raises Y_F^* directly if $1 \geq 2T^*$. It also raises the moneylender's interest rate, i, which reduces Y_F^* indirectly. The direct expansionary effect on Y_F^* is outweighed by the indirect contractionary effect if the elasticity of the marginal product curve of credit, E, is greater than or equal to unity. So if $1 \geq 2T^*$ and $E \geq 1$, the net marginal gain of the trader from interlinkage rises which raises the extent of interlinkage in the new equilibrium. So we have the following proposition[14].

PROPOSITION 4: (i) A price subsidy policy always lowers the extent of interlinkage, (ii) a credit subsidy policy lowers (does not change) (raises) the extent of interlinkage if and only if $E < (=) > 1$, and, (iii) a reduction in the delay of disbursement of formal credit raises the extent of interlinkage if $1 \geq 2T^*$ and $E \geq 1$.

4.2 *Effects on the Informal Interest Rate in the ICPC:*

The price of the crop in the ICPC, P_1, does not change as P_f (or r or T*) changes. This is because $P_1 = P_T$ always and P_T is a parameter in the system. However, the interest rate in the ICPC k_1 changes due to a change in P_f (or r or T*). Differentiating both sides of equation (5) with respect to P_f (or r or T*) we can easily derive the following results.

$$(dk_1/dP_f) = P_1.Q''(C^0)(\partial C^0/\partial n)(dn/dP_f) < 0 \qquad (14.1)$$
$$(-) \quad (-) \quad (-)$$

$$(dk_1/dr) = P_1.Q''(C^0).(\partial C^0/\partial n).(dn/dr) \qquad (14.2)$$
$$(-) \quad (-)$$
$$< (=) (>) 0 \text{ if and only if } (dn/dr) < (=) (>) 0$$

or if and only if E > (=) (<) 1

where $E = (-C^0.Q''(C^0)/Q'(C^0))$ is the elasticity of the MP curve of credit.

and, $(dk_1/dT^*) = P_1.Q''(C^0)(\partial C^0/\partial n)(dn/dT^*)$ (14.3)

< 0 if (i) $E \geq 1$

and (ii) $1 \geq 2T^*$

The credit intensity of cultivation of any farmer in the ICPC C^0 is a decreasing function of the extent of interlinkage n. As the procurement price of the crop, P_f, increases, n decreases which in turn raises C^0. But from equation (5) it follows that C^0 can increase only when the rate of interest on informal credit in the ICPC, k_1, is lowered (note that P_1 is a constant). So k_1 is lowered when P_f increases. On the other hand, as the formal interest, r, decreases due to a credit subsidy policy n falls (remains unchanged) (rises) if and only if E < (=) (>) 1. As a consequence k_1 is lowered (kept unchanged) (raised) if and only if E < (=) (>) 1.Besides a fall in the delay of disbursement of formal credit T* raises n if $E \geq 1$ and $1 \geq 2T^*$. If these sufficient conditions are met n rises which in turn reduces C^0 and as a consequence k_1 has to rise. So we have the following proposition.

PROPOSITION 5: (i) A price subsidy always lowers the interest rate in the ICPC, (ii) a credit subsidy policy lowers (does not change) (raises) the interest rate in the interlinked contract if and only if E < (=) (>) 1and, (iii) a reduction in the delay of disbursement of formal credit raises the informal interest rate k_1 if $E \geq 1$ and $1 \geq 2T^*$.

4.3 Effects of Subsidy Policies on the Welfare of the Farmers and Agricultural Productivity

The farmers always remain on their reservation income level. So the effects of the subsidy policies on the welfare of the farmers are equivalent to the effects of these policies on their reservation level of income. Applying the envelope theorem, from (3) one can derive the following expressions.

$(dY_F^*/dP_f) = Q(C^*) - (1+r.(1-T^*)).C^*.T^*.(di/dP_f)$)

and, (+)) (15)

$(dY_F^*/dr) = -[(1-T^*)(1+iT^*) + (1+r.(1-T^*).T^*.(di/dr)].C^*$)

(−)

The signs of both (dY_F^*/dP_f) and (dY_F^*/dr) are ambiguous. The reservation income of each farmer, Y_F^* is a positive function of the procurement price of the crop and a negative function of both the formal and informal interest rates. An increase in the procurement price of the crop, P_f or a decrease in the formal interest rate, r raises Y_F^* directly. However, an increase in P_f or a decrease in r leads to an increase in the informal interest rate of the moneylender, i (see proposition 3) which in turn produces an induced contractionary effect on Y_F^*. Thus the net effect of the subsidy policies on Y_F^* is uncertain. Also as i increases due to the subsidy policies, the effect on the real marginal cost of credit, $((1+r(1-T^*))(1+iT^*)/P)$ is uncertain. As a consequence the effect of the subsidy policies on the agricultural productivity, $Q(C^*)$ is ambiguous. This leads to the following proposition.

PROPOSITION 6: A price and /or a credit subsidy policy may not be able to raise the reservation level of income (and hence the welfare) of the farmers and the agricultural productivity.

It is a matter of deep concern that in the presence of any credit market distortion (e.g. a delay in disbursement of formal credit) the subsidy policies of the government designed to benefit the farmers may not benefit them at all as the two lenders in the informal credit market – the trader (interlocker) and the moneylender adjust their behaviour to appropriate the advantages of these policies. Thus there is little justification to continue with the subsidy policies in the presence of any distortion in the formal credit market. Chaudhuri and Gupta (1996) has also come to the same broad conclusion in the presence of strategic delay in the distribution of formal credit and bribe-taking by the official of the formal credit agency. We here have, however, been able to show the perverse effects of the subsidy policies even without considering the case of strategic delay (and hence the bribe-taking by the bank official).

5. An Alternative Credit Policy:

Any credit market imperfection in backward agriculture, e.g. the existence of a delay in disbursement of formal credit, cannot be solved administratively in the presence of the existing power structure of the rural society (see Sarap (1991)). Thus if our objective is to provide credit to the small and marginal farmers at a subsidized rate we need an alternative credit policy which will be able to deliver the goods even in the existing circumstances. There is no doubt that the informal sector lenders are in a better position to forward and recover loans from the small

borrowers than formal credit agencies are. So an alternative credit policy may be not to try to replace the informal credit system horizontally by the formal one, but to encourage the informal sector lenders by enhancing their credit worthiness with adequate supply of subsidized credit. The informal sector lenders e.g. traditional moneylenders, large landowners or grain traders are in a much better position to put up collaterals: from the view point of the formal credit agencies they are good credit risks. The supply of subsidized formal credit to the informal sector lenders (existing or potential) is expected to aggrandize the degree of competitiveness among them which helps to improve the borrowing terms faced by the small and marginal farmers who do not have access to the formal credit system. This can be thought of as a policy of forging 'vertical' links between the informal and formal credit systems. This is, by no means, a new idea. This policy has already been applied to the agricultural sector of Philippines with some success (see Umali (1990)). We shall, in this section of the paper, judge the effectiveness of such an alternative credit policy on the borrowing terms faced by the farmers and their welfare and on the agricultural productivity of the economy.

Let us consider a situation where subsidized formal credit is not disbursed directly to the farmers and a fraction β of the total amount of credit advanced by each informal sector-lender[15] (the trader and the moneylender) is met by taking a loan from the formal credit agency at an interest rate r per period. The value of β is administratively determined. In this case the reservation income of each farmer is

$$Y_F^* = P_f.Q(C^*) - (1+i).C^* \qquad (3.1)$$

Note that the farmer takes his entire loan from the moneylender and sells his product to the state purchasing bodies at the procurement price, P_f.

The income of the trader-interlocker would be

$$Y_T = n.[P_T.Q(C^O) - (1 + k((1-\beta).nC^O)(1-\beta)C^O - (1+r)\beta C^O - Y_F{}^O] \qquad (8.1)$$

Here nC^O is the total amount of credit advanced by the trader, β fraction of which is obtained from the formal credit agency at the interest rate r per period and for the remaining $(1-\beta)$ fraction, the opportunity interest rate is $k((1-\beta)nC^O)$ per period. When Y_T is maximized with respect to C^O, the previous first-order condition (equation (10)) would be replaced by the following.

$$P_T.Q'(C^O) = (1-\beta).(1+k(.)) + k'(.).(1-\beta)^2.nC^O + (1+r)\beta \qquad (10.1)$$

Note that the productivity of each farmer in the ICPC, C^O now increases if r decreases following a credit subsidy policy.

When Y_T is maximized with respect to n given i, the previous first-order condition (equation (11.1)) would now be replaced by

$$P_T.Q(C^O) - (1+k(.)).(1-\beta)C^O - (1+r)\beta C^O - k'(.).n.((1-\beta)C^O)^2 = Y_F^* \qquad (11.2)$$

This is the new reaction function of the trader. From (11.2) we should note that as previously this is also represented by a positively sloped curve (TT) in the (i,n) space and that the TT curve shifts upward to the left as P_f increases (see figure 2). Also as r falls due to a credit subsidy policy, the marginal gain of the trader from interlinking one additional farmer (the left-hand side of (11.2)) increases while the reservation income of the farmer, Y_F^* does not change. So the trader would increase n, the extent of interlinkage given the moneylender's interest rate, i. Hence the reaction curve of the trader, TT (in figure 2) shifts to right following a credit subsidy policy.

On the other hand, the moneylender's income in this case is given by

$$Y_M = [i - \beta.r - (1-\beta).g((1-\beta)(1-n)C^*)](1-n)C^* \qquad (12.1)$$

The moneylender maximizes Y_M with respect to i, taking n as datum. The new first-order condition is

$$C^* + [i - \beta r - (1-\beta).g(.)].(\partial C^*/\partial i) - (1-\beta)^2.g'(.).(1-n).C^*.(\partial C^*/\partial i) = 0 \qquad (13.1)$$

Equation (13.1) is the new reaction function of the moneylender. One can check that like the previous case, it is also represented by a negatively sloped curve MM in figure 2) and the MM curve shifts upward to the right following a price subsidy policy. However, as the formal interest rate, r, decreases due to a credit subsidy policy, the marginal net interest income of the moneylender (with respect to i) decreases. So to satisfy equation (13.1) i decreases as r decreases. This implies that the MM curve shifts downward to the left due to a credit subsidy policy.

Owing to a credit subsidy policy the TT curve shifts to the right while the MM curve shifts downward to the left (in figure 2). As a consequence, the equilibrium informal interest rate of the moneylender, i decreases due to a credit subsidy policy. From (3.1) one can check that the reservation level of income and hence welfare of each farmer increases as i decreases following a credit subsidy policy. As their reservation income level increases, the borrowers also face better terms in the interlinked contracts offered by the trader. This will also raise the agricultural productivity in both interlinked and non-interlinked systems since the real marginal cost of credit decreases. However, the effects of a price subsidy policy on the informal interest rate, agricultural

productivity and on the farmers' welfare are qualitatively the same as before. So we have the following proposition.

PROPOSITION 7: A policy of forging a vertical linkage between the formal and informal credit markets in backward agriculture leads to (i) a decrease in the informal interest rate of the moneylender and hence an improvement in the borrowing terms of the farmers in the credit market, (ii) an unequivocal improvement in the welfare of the farmers and, (iii) an increase in agricultural productivity.

6. Concluding Remarks:

In this paper we have presented a theory of interest rates determination in the informal credit market when there is a market for informal credit. The paper analyzes interactions between two informal sector lenders and provides explanation for the prevalence of different interest rates in the rural credit market. There are two informal sector lenders in the model – a trader-cum-interlocker and a pure moneylender. A farmer may take credit either from the moneylender and sell his product to the state purchasing bodies at the procurement price of the crop or accept the offer of an ICPC by the trader. The trader determines the number of farmers with whom he comes into interlinkage given the moneylender's interest rate while the moneylender, on the other hand, determines the interest rate charges on informal credit and hence the reservation income of each farmer, given the size of interlinkage chosen by the trader. The trader and the moneylender then play a non-cooperative game, both acting as followers. This game leads to some interesting results. For example, in the interlinked contract, the trader earns zero trade profits. His entire income accrues from the credit market where he charges an interest rate, greater than his opportunity cost of the loan. All these results are contradictory to the standard results available in the literature on interlinkage that the trader supplies subsidized credit to the interlockees and his entire surplus comes from his activities in the product market (Gangopadhyay and Sengupta (1987)). The unusual results in this model are due to the fact that the trader's opportunity cost of credit is an increasing function of the volume of credit advanced by the trader-cum-interlocker to his clients. Also a price subsidy policy of the government reduces the extent of interlinkage chosen by the trader while a credit subsidy policy and / or a reduction in the delay of disbursement of formal credit may raise it. Besides, a price and /or a credit subsidy policy raises the informal interest rate of the moneylender but may lower the interest rate in the interlinked contract. So these policies are likely to widen the disparities between the two interest rates

prevailing in the informal credit market. More importantly, the subsidy policies, designed to benefit the farmers, may worsen the welfare of the farmers and lower agricultural productivity as the informal sector lenders adjust their behaviour to appropriate the benefits of these policies. If there is any imperfection in the formal credit market, the subsidy policies may produce perverse results (see Chaudhuri and Gupta (1996)).

In this context, we have considered an alternative credit policy[16] where formal credit is not disbursed to the farmers directly. The informal sector lenders are treated as financial intermediaries between the formal credit agencies and the borrowers. The supply of subsidized formal credit to the informal sector lenders (existing or potential) will increase the degree of competitiveness among them which helps to improve the borrowing terms faced by the small and marginal farmers. This can be thought of as a policy of forging a 'vertical' linkage between the informal and formal credit systems. We have found that under this new credit scheme, a credit subsidy policy succeeds in reducing the informal interest rate of the moneylender, raising the agricultural productivity, ensuring better borrowing terms to the farmers in the credit market and in improving their welfare. It is, of course, true that the informal sector lenders also do reap a part of the benefits of the credit subsidy policy, but this policy certainly is able to enhance competitiveness between the lenders and thereby compel them to pass on some of the benefits to the borrowers which the traditional credit policy fails to deliver.

There are, however, a few criticisms against the policy of vertical linkage. For example, Hoff and Stiglitz (1996) have argued that an expansion of formal credit to the informal credit market would pave the way for the entry of new informal sector lenders into the market which, in turn, would make loan recovery more difficult leading to an increase in the costs of loan enforcement for every lender. As a consequence, the informal sector interest rates may go up instead of falling. Against this criticism, we may argue that the informal sector lenders, generally do not lend to those borrowers over whom they do not possess some control (see Aleem (1993), Ray (1998)). Besides, Floro and Ray (1997) have shown that a credit flow to the lenders in the informal credit market exerts downward pressure on informal interest rates and raises total credit outlay by the informal sector lenders when the lenders are engaged in myopic competition among them. However, this policy may strengthen the ability and incentive of the informal sector lenders to collude among themselves which would result in a worse terms faced by the informal borrowers. In defense, we may refer to a recent paper by Chaudhuri and Dwibedy (1998), where it has been shown that even if the informal sectors lenders are allowed to collude and maximize their joint

income, the resulting informal sector interest rate would still be lower than that under the traditional credit policy. So there is still merit in advocating in favour of this credit policy and that is why it has been successfully followed in Philippines over the last few decades. There is an urgent need for further discussions, seminars and research in this area.

Footnotes:

1 It includes cooperatives, government and commercial banks. These figures are obtained from the All India Rural Debt and Investment Survey 1961-62 and 1981, published by the Reserve Bank of India.

2 This is not true for the whole of the rural economy of India. In many cases, the informal credit market exists because the supply of formal credit is inadequate.

3 See table 3, chapter 3 of Sarap (1991).

4 In the two villages, Hazipur and Bara-shimuliya, farmers with less than 1.5 acres of land-holding had to wait for eight weeks to get loans from the date of application.

5 See Basu (1998), chapter 13.

6 The small farmers are denied accessibility to the open (wholesale) market of the crop, which is accessible to the trader. This implies imperfection in the product market. This may be due to many factors. See Rudra (1982), chapter 3 for details.

7 Assume that the government conducts the procurement of the crop – a practice followed in India in the case of food-grains and some commercial crops.

8 Any production function that is well behaved may be written as a function of the total expenditure provided input-markets are perfectly competitive. Consequently the production function can be interpreted as a general production relationship with many inputs under competitive conditions.

9 See Chaudhuri and Gupta (1995a,b) and Chaudhuri (1996) for the proof.

10 The lenders in the rural credit market generally borrow funds from the urban sector and re-lend it to the borrowers in the rural credit market. The assumption that the opportunity cost of funds of the rural lenders is an increasing function of the loaned amount may be justified by using the 'Lender's risk hypothesis'. On the other hand, if a lender in the rural credit market uses his owns funds for lending, he may alternatively invest his money in any profitable production activity with diminishing returns to credit. If the lender now withdraws larger and larger sums from production, the marginal product of credit in the alternative use

increases and, therefore, the opportunity cost of the lender's funds also rises. Besides, it is beyond any doubt that there must be some cost associated with the formation of interlinked contracts e.g. cost relating to collection of information about the clients and enforcement of contracts that are quite high in a backward rural economy. g(.) captures all such costs. The larger the size of interlinkage the higher will be the above associated costs. Thus the assumption $g'(.) > 0$ is fully justified.

11 This is a simplifying assumption. This means that the opportunity cost of funds of the lender is a linear function of the loaned amount.

12 The second-order condition of maximization is satisfied by the assumption that $g''(.) = 0$ and ignoring the third-order derivative of the production function.

13 For the production functions: $Q = \log C^b$ and $Q = (\log C)^{(1/b)}$; $b > 1$, E is equal to unity and greater than unity, respectively. But for the Cobb-Douglas type production function, e.g. $Q = A.(C)^{\beta}$; $A > 0$, $1 > \beta > 0$, E is less than unity.

14 Interested readers can check these results or can obtain the mathematical proofs from the author on request.

15 Here $0 < \beta < 1$. This implies that the moneylender and the trader face credit constraint in the formal credit market.

16 Another approach may be to actually design credit institutions at the micro level that will take advantage of local information in innovative ways. The leading example of small-scale lending or micro-finance is the Grameen Bank of Bangladesh. See Ray (1998), ch.14 and Basu (1997), ch.13 in this context.

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Appendix I:

1.Totally differentiating equation (10) one can easily derive

$$(\partial C^0/\partial n) = (2k'(.)C^0) / [P_T.Q''(C^0) - 2k'(.).n] \qquad (A.1)$$

$$(+) \qquad (-) \qquad (+)$$

$$< 0.$$

So C^0 is a decreasing function of n.

2. Differentiating equation (11) with respect to n we get the second-order condition for maximization of Y_T as

$$(\partial^2 Y_T/\partial n^2) = -2k'(.)(C^0)^2 - 2k'(.)n.C^0(\partial C^0/\partial n)$$

$$= -2k'(.)C^0.[C^0 + (2nk'(.)C^0/(P_T Q''(C^0) - 2k'(.).n))] \qquad \text{(using A.1)}$$

$$= -[2P_T k'(.)(C^0)^2 Q''(C^0)/(P_T Q''(C^0) - 2k'(.)n)] \qquad (A.2)$$

$$< 0.$$

So the second order condition for maximization of Y_T holds.

3. Totally differentiating equation (2) and after replacing C by C* one can derive the following results:

$$\left.\begin{aligned} &(\partial C^*/\partial i) = [(1+r(1-T^*))T^*/P_f.Q''(C^*)] < 0 \\ &(\partial C^*/\partial r) = [(1-T^*)(1+iT^*)/P_f Q''(C^*)] < 0 \\ &(\partial C^*/\partial T^*) = [((i-r) + i.r(1-2T^*))/P_f Q''(C^*)] < 0 \text{ if } 1 \geq 2T^* \\ &(\partial C^*/\partial P_f) = -(Q'(C^*)/P_f Q''(C^*)) > 0 \end{aligned}\right\} \quad (A.3)$$

4. Using the envelope theorem, from equation (3) we can derive the following results:

$$(\partial Y_F^*/\partial P_f) = Q(C^*) > 0$$

$$(\partial Y_F^*/\partial i) = -(1+r(1-T^*))C^*T^* < 0$$

$$(\partial Y_F^*/\partial r) = -(1+iT^*)C^*(1-T^*) < 0 \qquad (A.4)$$

$$(\partial Y_F^*/\partial T^*) = -[(i-r) + i.r(1-2T^*)] < 0 \text{ if } 1 \geq 2T^*$$

So the reservation level of income of each farmer Y_F^* is an increasing function of P_f but a decreasing function of both i and r. Y_F^* and T* are inversely related if $1 \geq 2T^*$.

Appendix II:

Putting the value of $(\partial C^*/\partial i)$ from (A.3) into equation (13) we get

$$C^*[P_f.Q''(C^*) - g'.(1-n)T^*(1+r(1-T^*))] + (i-g)T^*(1+r(1-T^*)) = 0 \qquad (13.1)$$

Totally differentiating equation (13.1) we get

$$[(\partial C^*/\partial i).di + (\partial C^*/\partial P_f)dP_f + (\partial C^*/\partial r)dr + (\partial C^*/\partial T^*)dT^*].[P_fQ''(C^*) - g'.(1-n)T^*(1+r(1-T^*))] + C^*[Q''(C^*)dP_f + g'.T^*(1+r(1-T^*))dn - g'.(1-n)T^*(1-T^*)dr - g'.(1-n)(1+r(1-T^*))dT^*] + T^*(1+r(1-T^*))di - g'.T^*(1+r(1-T^*)).[- C^*dn + (1-n)(\partial C^*/\partial P_f)dP_f + (1-n)(\partial C^*/\partial r)dr + (1-n)(\partial C^*/\partial i)di + (1-n)(\partial C^*/\partial T^*)dT^*] + (i-g)T^*(1-T^*)dr + (i-g).(1+r.(1-2T^*))dT^* = 0$$

$$\text{or, } i_2di + n_2dn + p_2dP_f + r_2dr + t_2dT^* = 0 \qquad (A.5)$$

$$\text{where, } i_2 = (\partial C^*/\partial i)[P_fQ''(C^*) - 2g'.(1-n)T^*(1+r(1-T^*))] + T^*(1+r(1-T^*))] > 0$$

(–) (–)

$$n_2 = 2g'.C^*T^*(1+r(1-T^*)) > 0$$

$$p_2 = (\partial C^*/\partial P_f)[P_f.Q''(C^*) - 2g'.(1-n)T^*(1+r(1-T^*))] + C^*.Q''(C^*) < 0$$

(+) (–) (+) (–)

$$r_2 = (\partial C^*/\partial r)[P_fQ''(C^*) - 2g'.(1-n)T^*.(1+r(1-T^*))] - C^*.g'.(1-n)T^*(1-T^*) + (i-g).T^*.(1-T^*)$$

Using (13), it can be rewritten as

$$r_2 = (\partial C^*/\partial r)[P_f.Q''(C^*) - 2g'.(1-n)T^*.(1+r(1-T^*))] - C^*T^*(1-T^*)(dC^*/di) > 0$$

(–) (–) (+) (–)

$$t_2 = (\partial C^*/\partial T^*).[P_fQ''(C^*) - 2g'.(1-n)T^*.(1+r(1-T^*))] - C^*T^*(1-2T^*)(dC^*/di) > 0 \quad (\text{if } 1 \geq 2T^*)$$

(–) (–) (+) (–)

Now, $(di/dP_f)\big|_{MM} = -(n_2/i_2) < 0$

(+) (+)

$(di/dP_f)\big|_{n=const} = -(p_2/i_2) > 0$

$(-)(+)$

$(di/dr)\big|_{n=const} = -(r_2/i_2) < 0.$

$(+)\ (+)$

and, $(di/dT^*) = -(t_2/i_2) < 0$ if $1 \geq 2T^*$.

$(+)\ (+)$

Therefore, the MM curve is negatively sloped. The MM curve shifts upward to the right as P_f increases and /or r decreases. It also shifts upward to the right as T* decreases if $1 \geq 2T^*$.

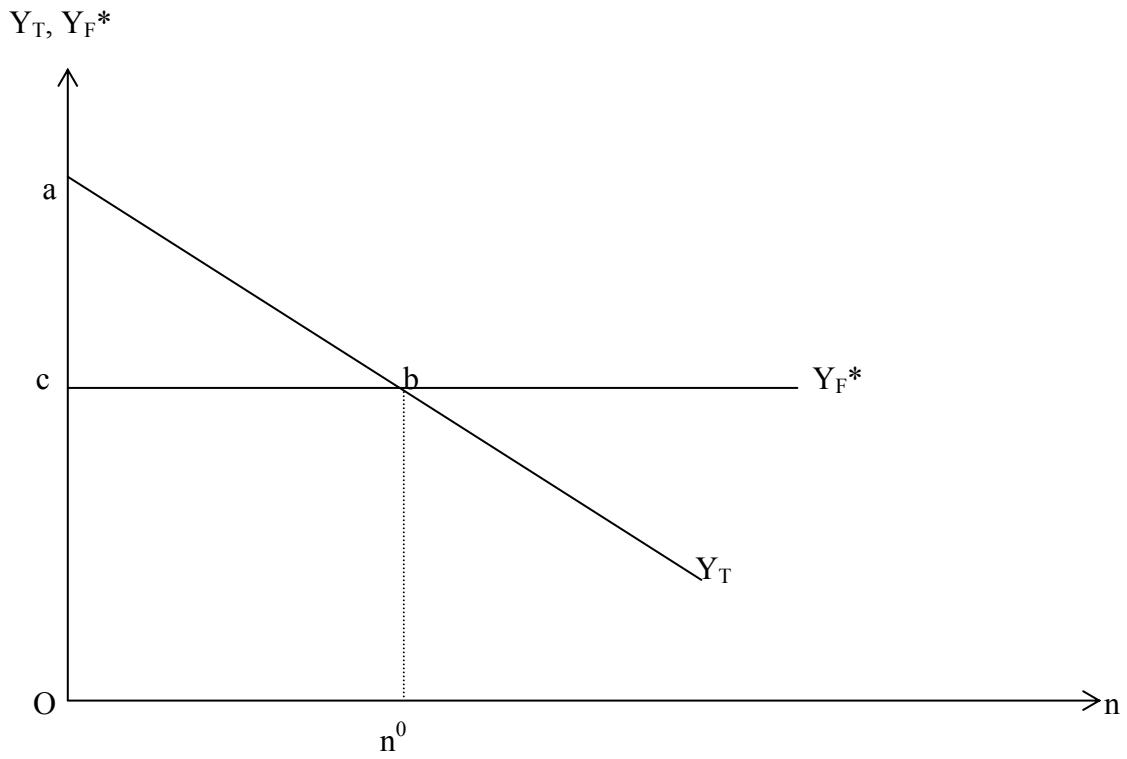

Figure 1: Trader's Equilibrium Size of Interlinkage for a given i.

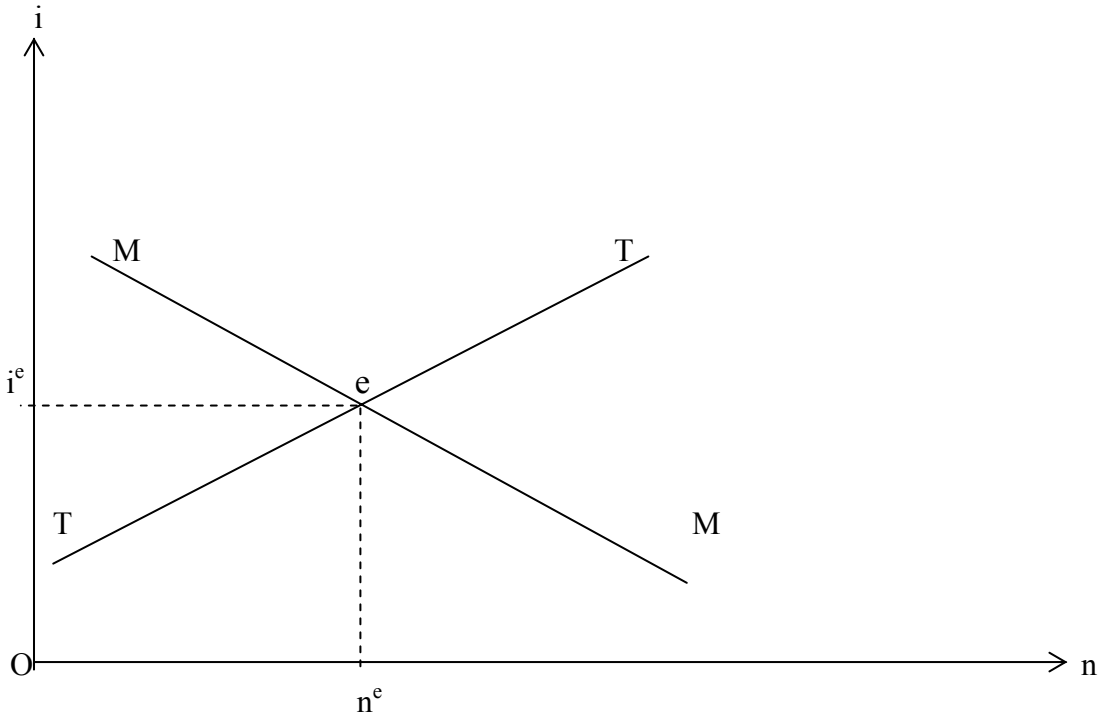

Figure 2: Determination of Equilibrium n and i.