INTERACTION OF FORMAL AND INFORMAL CREDIT MARKETS IN BACKWARD AGRICULTURE: A THEORETICAL ANALYSIS

Sarbajit Chaudhuri
Dept. of Economics
Calcutta University
56A, B.T. Road
Kolkata 700 050
India

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Address for communication: Dr. Sarbajit Chaudhuri, 23 Dr. P.N. Guha Road, Belgharia, Kolkata 700083, India. E-mail: sarbajitch@yahoo.com, sceco@caluniv.ac.in

ABSTRACT: In this paper, a model of interaction of formal and informal credit markets has been developed where the bank official (the ultimate provider of formal credit) faces a lending constraint. The bank official takes a bribe from the borrowers to disburse formal credit and he deliberately debars some potential borrowers from getting bank credit. Inadequate supply of formal credit and exclusion of a few borrowers by the official create a market for informal credit. The bank official and the moneylender (the supplier of informal credit) play a non-cooperative game in determining the bribing rate and the informal interest rate simultaneously. The central objective of the paper is two-fold. First, it shows that an agricultural credit subsidy policy may be counterproductive even when formal and informal credits are substitutes. This is contrary to the Gupta and Chaudhuri (1997) result that a credit subsidy policy is counterproductive only when the two types of credit are complementary to each other. Secondly, the paper considers two alternative ways of formulating a credit subsidy policy: (1) through an increase in the aggregate volume of formal credit supplied to the borrowers, keeping the formal sector interest rate at a reasonable level; and, (2) through a decrease in the rate of interest charged on this type of credit. The paper shows that if a credit subsidy policy is undertaken via the first path, it is actually able to lower the informal sector interest rate and improve both the agricultural productivity and welfare of the farmers. This result is crucial because all the earlier papers in this line have analyzed the effects of a credit subsidy policy through the second route and found it to be counterproductive in the presence of corruption in the distribution of formal credit.

Keywords: Farmer; moneylender; bank official; formal credit; non-cooperative game; informal interest rate; credit subsidy policy.

JEL Classification: Q15; D89.

INTERACTION OF FORMAL AND INFORMAL CREDIT MARKETS IN BACKWARD AGRICULTURE: A THEORETICAL ANALYSIS

1. INTRODUCTION:

There are two sources of rural credit in a developing 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 the professional moneylenders, landlords, traders, etc. There is now a growing theoretical literature[1] on rural credit, which takes into account interaction between the formal and the informal credit markets in determination of the interest rate in the informal credit markets. In the presence of subsidized formal credit, a market for informal credit exists either because the supply of formal credit is inadequate[2] or because formal credit is not available at the beginning of the crop cycle[3].

The theoretical literature on interaction between the formal and the informal credit markets consists of two types of theory. Chaudhuri and Gupta (1996), Gupta and Chaudhuri (1997), Gupta et al (1991) and Chaudhuri (1999) have analyzed interaction between the two credit markets in the presence of corruption in the loan delivery system in the formal credit market. For example, Chaudhuri and Gupta (1996) have provided a theory of informal interest rate determination when the market for informal credit is created by delayed disbursement of formal credit. In this model, the bank official controls the delay and he can be bribed by the farmer to reduce the delay. The bribing rate and the informal interest rate are determined from a non-cooperative game between the official and the moneylender. The main results of the paper are as follows. The informal interest rate and the effective formal interest rate (incorporating the bribe) are equal in equilibrium and agricultural price and credit subsidy policies raise the informal sector interest rate. But Gupta and Chaudhuri (1997) have found that the counter-productiveness of a credit subsidy policy can be shown only when formal and informal credits are complementary to each other (as found in the case of Chaudhuri and Gupta (1996)). But when these two types of credit are substitutes, a credit subsidy policy lowers the informal interest rate[4]. However, a price subsidy policy in both the cases raises the informal interest rate. In Gupta and Chaudhuri (1997) also, both the official and the moneylender act as followers and make simultaneous moves. However, in all these papers production uncertainty and the possibility of involuntary default on the part of the borrowers have been assumed away. Also, there is no asymmetric information between the formal and the informal sector lenders regarding the farmer's ability to repay loans.

On the other hand, there are now at least two important contributions in the literature, (namely, Bose (1998) and Jain (1999)), which have analyzed interaction between the formal and the informal credit markets under asymmetric information. Bose (1998) has developed a model of vertical linkage between the two

credit markets where the informal sector lenders act as financial intermediaries between the formal credit agency and the final borrowers of credit. Formal credit is available to two informal lenders who have asymmetric information regarding the borrowers' ability to repay loans and competition between them determines the interest rate in the informal credit market. If in such a situation a credit subsidy policy is undertaken, as the paper argues, it would enable the better-informed informal sector lender to attract more good borrowers with low probability of default towards him and leave more bad borrowers with high default probability for the other. As a consequence, the second lender may not find it profitable to continue the lending operation and may finally leave the credit market. In such a situation, the borrowing terms in the informal credit market will deteriorate. However, the policy of forging a vertical linkage between the formal and informal credit markets may fail to deliver the goods in a few situations of symmetric information as well. For example, Hoff and Stiglitz (1996) have argued that an expansion in the supply 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. Besides, Floro and Ray (1997) have shown that a credit flow to the lenders in the informal credit market may strengthen the ability and incentive of the informal lenders to collude among themselves, which would result in a worse terms faced by the borrowers in the informal credit markets.

Jain (1999), in contrast, has presented a model in which the formal sector's relative advantage of having cheaper lending cost is traded off against the informational advantage that lenders in the informal credit market enjoy. The paper describes the formal credit institution as a profit-maximizing monopoly institution, which screens borrowers by providing only partial financing for projects and compels them to rely onto the informal sector for the remaining portion of the loans. A government intervention in the form of imposing interest rate ceilings on the formal credit agency may lower the profitability of the formal credit agency and lead to deadweight loss to the society and leads to a redistribution of surplus from the formal agency to certain group of borrowers. But, it may drive the formal credit agency completely out of the market in the extreme case. Conversely, government regulation of informal sector activity raises the cost of lending of the informal sector and may actually improve social welfare by making room for the formal sector in accomplishing its screening more effectively.

It should be noted, however, that neither Bose (1998) nor Jain (1999) takes into account the specific nature of interaction between the formal and the informal sector credit markets, which plays an important role in determination of interest rate in the informal credit market.

Thus, in the existing theoretical literature on interaction of formal and informal credit markets, we find that the agricultural subsidy policies of the government may fail to achieve their desired objectives. In other words, these policies may in fact worsen the terms that the borrowers face in the informal credit market and

lower their welfare.

The present paper, following the line of Chaudhuri and Gupta (1996) and Gupta and Chaudhuri (1997), develops a model of interaction of formal and informal credit markets where the bank official (the ultimate provider of formal credit) faces a lending constraint. The bank official takes a bribe from the borrowers to disburse formal credit and he deliberately prohibits some potential borrowers from getting bank credit. Inadequate supply of formal credit and exclusion of a few borrowers by the official create a market for informal credit. So, the two types of credit are substitutes in this model. The bank official and the moneylender (the supplier of informal credit) play a non-cooperative game in determining the bribing rate and the informal interest rate simultaneously. The number of farmers receiving formal credit is also determined as a byproduct. The paper shows that lowering the formal sector interest rate raises the interest rate prevailing in the informal credit market. This is contrary to the result of Gupta and Chaudhuri (1997) that lowering the formal interest rate is counterproductive only when formal and informal credits are complementary to each other. Moreover, the present paper distinguishes between two alternative ways of formulating a credit subsidy policy. A credit subsidy policy may be undertaken either through: (1) an increase in the volume of formal credit supplied to the borrowers, keeping the formal sector interest rate at a reasonable level or through (2) a decrease in the rate of interest charged on this type of credit. Our main concern is with the effects of these policies on the informal interest rate since it is a lowering of this interest rate that constitutes the principal objective of a credit subsidization policy. The earlier papers in this area have not made such a comparative analysis between these two alternative ways of financing a credit subsidy policy, which is quite important from the point of view of policymaking. The paper shows that if a credit subsidy is undertaken via the first route, it is essentially able to lower the informal sector interest rate and improve both the agricultural productivity and welfare of the farmers. This result is imperative because the earlier papers in this line have predicted a credit subsidy policy to be counterproductive in the presence of corruption in the distribution of formal credit.

2. THE MODEL:

Consider a village economy where there are two sources of agricultural credit, formal and informal. There is a single formal credit agency (a bank). A bank official is given the task of distributing a given amount, C*, of bank credit to the farmers of the village. There are N numbers of identical borrowers (farmers) of formal credit. However, all of them may not get credit from the formal credit institution. The number of farmers among whom formal credit is distributed is controlled by the bank official and he takes a bribe from each farmer in order to disburse formal credit. The bribing rate, Z, (per unit of formal credit disbursed) and the number of farmers who obtain formal credit, n, are determined by the bank official and each of the n farmers receives[5] C_F (= C*/n) amount of formal credit. As the bank official demands a bribe, Z, per unit of bank credit, this amount is withheld as 'cut money' from the bank credit at the time of

disbursement. The net amount of formal credit reaching each of the n farmers is, therefore, $(1 - Z).(C^*/n)$, and it may fall short of the individual credit needs of the farmers. There is a moneylender in the picture too, who is the source of informal credit. In this model, the market for informal credit exists if all the potential borrowers do not get formal credit and/or the effective supply of formal credit to each farmer falls short of its demand at any given informal interest rate. So formal and informal credits are substitutes to each other in this set-up. The moneylender determines the informal interest rate, i. The procurement price of the crop, P, the aggregate supply of formal credit, C^*, and the formal sector interest rate, r, are the policy variables of the government.

There are two stages of the game. In the first stage, the bank official and the moneylender play a non-cooperative game and determine the bribing rate, Z, and the informal interest rate, i, simultaneously. The number of farmers getting formal credit, n, is also determined in this stage. In the second stage of the game, the farmer determines the amount of credit (formal plus informal or only informal) to be used in the production process.

For the sake of simplicity, we take credit as the only input in the production function. If C is the amount of credit application of the farmer, then Q(C) with $Q'(C) > 0$ and $Q''(C) < 0$ is the production function[6]. Any loan is paid back with interest at the end of the crop cycle. There is neither production uncertainty nor any possibility of default of loan. Also, there is no asymmetric information between the formal and the informal sector lenders, regarding the farmers' ability to repay loans.

Let us now turn to analyze the behaviour of the different economic agents one by one.

2.1 The Farmer's Behaviour

The farmers in this model can be classified into two groups: group I, consisting of n number of farmers to whom formal credit is available; and, group II, with the remaining (N – n) farmers who are denied formal credit. So, the latter group of farmers have to fall back entirely on informal credit for carrying out their farming activities.

If the official decides to disburse C_F $(= C^*/n)$ amount of formal credit to each of the farmers belonging to group I, the effective amount of formal credit that each of them receives is $C_F.(1–Z)$, where Z is the bribing rate per unit of formal credit. Now if the representative farmer in group I, decides to use C amount of credit (formal plus informal), he has to take $(C - C_F.(1–Z) \geq 0)$ amount of informal credit. He faces credit rationing and has to take some amount of informal credit if $(C - C_F.(1–Z) > 0)$. The income of the farmer is then given by

$$Y_F = P.Q(C) - (1+r)C_F - (1+i)[C - C_F.(1–Z)] \quad (1)$$

This is maximized through a choice of C and the first-order condition of maximization is given by

$P.Q'(C) = (1+i)$ (2)

and solving this we get the following demand function for loan (formal plus informal) of the representative farmer of group I.

$C = C(i, P)$ (3)

Here $((1+i)/P)$ is the real marginal cost of credit and the law of diminishing marginal productivity ensures the inverse relationship between the optimum use of credit and its real marginal cost. From (2) we can easily derive: $(\partial C/\partial i) = (1/PQ''(C)) < 0$ and $(\partial C/\partial P) = (-Q'(C)/P.Q''(C)) > 0$.

The demand function for informal credit of the representative farmer of group I, is given by

$C_M = C(i, P) - C_F(1-Z)$ (4)

This function is, however, valid for

$(1+i) \geq ((1+r)/(1-Z))$ (5)

where $((1+r)/(1-Z))$ is the effective price for formal credit (incorporating the bribe). The farmer will not take formal credit if this effective price is greater than the price of the informal credit.

On the contrary, the representative farmer of group II, takes his entire loan from the moneylender and he does not face any rationing in the informal credit market. It is easy to check that the first-order condition of maximization of his income is given by equation (2) and that his demand function for informal credit is given by (3).

2.2 The Official's Behaviour:

We consider a risk-neutral bank official who maximises his utility, which is a positive function of his income and a negative function of labour, L. The utility function is

$U = U(Y_O, L)$ (6)

and it satisfies all the usual properties.

The official distributes C* amount[7] of formal credit among n number of borrowers. So we write

$C^* = n.C_F$ (7)

where C_F is the amount of formal credit disbursed to each farmer.

The income of the official is

$Y_O = n.Z.C_F + X - p(N-n).K$. After using (7) it becomes

$Y_O = Z.C^* + X - p(N-n).K$ (8)

Here, Z.C* is the total bribe-income of the official and X is his exogenously given salary. p(.) is the probability of getting caught if the official does not disburse formal credit to all N potential borrowers and takes a bribe, and K stands for the penalty, he has to pay if he is caught. p is assumed to be a positive function of the number of potential borrowers who do not get formal credit. But it does not depend upon

the amount of bribe received. In defense, we may argue that the number of farmers actually receiving formal credit but not the amount of bribe received will show up in the official records and if all the potential borrowers do not receive formal credit, it may provide a basis of investigation.

The p(.) function satisfies the following properties:

(i) $p(0) = 0$ and $p(N) = 1$, (ii) $p'(.) > 0$; and, (iii) $p''(.) \geq 0$.

So the risk of paying a penalty does not arise only when every potential borrower gets formal credit. On the other hand, it is a sure event if no farmer gets formal credit. With an increase in the number farmers, left out from the purview of formal credit, p(.) increases at a non-decreasing rate. To keep our analysis simple, we take K to be exogenous.

We also consider the following functional relationship.

$L = L(n)$ with $L'(.) , L''(.) > 0$ (9)

This relationship can be explained as an inverted production function where the number of farmers to whom formal credit is disbursed is the output and the official's labour is the only input. L'(.) and L "(.) are positive since we assume positive and diminishing marginal productivity of labour[8].

The official in his maximization process also faces the constraint given by (5). The official maximizes (6) subject to the constraint (5) and equations (8) and (9). The official's instrumental variables are n and Z. He takes the informal interest rate, i, as datum. Y_O is a positive function of Z and U(.) is a positive function of Y_O. Also the right-hand side of the constraint (5) is an increasing function of Z. So given n, the maximization of U(.) with respect to Z automatically implies that the constraint (5) would be binding in equilibrium. So, in equilibrium we must have

$(1+i).(1-Z) = (1+r)$ (5.1)

Thus we have the following proposition.

PROPOSITION 1: The effective price of formal credit (incorporating the bribe) is equal to the price of informal credit in equilibrium.

Now maximising U(.) with respect to n, we get the following first-order condition.

$(\partial U/\partial Y_O).p'.K + (\partial U/\partial L).L'(.) = 0$ (10)

where $-((\partial U/\partial L)/(\partial U/\partial Y_0))$ is the marginal rate of substitution between income and labour. Solving equation (10) one can obtain

$n = n(Z, C^*)$ (11)

It can be easily shown[9] that $(\partial n/\partial Z) = -[p'(.).K.C^*.(\partial^2 U/\partial Y_O^2)/X] < 0$; and,

$(\partial n/\partial C^*) = -[p'(.).K.Z.(\partial^2 U/\partial Y_O^2)/X] < 0$

where $X = [-(\partial U/\partial Y_O).p''(.).K + (\partial U/\partial L).L''(.) + p'(.).p''(.).K^2.(\partial^2 U/\partial Y_O^2) + (L'(.))^2.(\partial^2 U/\partial L^2)] < 0.$ (12)

(+) (≥ 0) (–) (+) (+) (≥ 0) (–) (+) (–)

The reasons for n to be a decreasing function of both Z and C* are as follows. If Z and/or C* goes up, total income and hence the utility of the bank official also go up, given n. This produces an income effect, which lowers the labour-time, L, spent by the official in disbursing formal credit, as his utility, U(.), is a decreasing function of L. Now as L and n are positively related (see equation (9)), a decrease in L also implies a reduction in n.

Equation (5.1) is the reaction function of the official. This shows how the official reacts in terms of Z following a move by the moneylender in terms of i. The official raises Z when the moneylender raises the informal interest rate, i. So, the official's reaction curve, denoted OO, must slope positively in the i–Z space (see figure 1). The slope of his reaction curve is given by

$(di/dZ)_O = ((1+i)/(1-Z)) > 0.$

The official raises Z when the formal sector interest rate, r, falls, given the moneylender's informal interest rate, i. So the OO curve shifts out following a reduction of the formal interest rate, r. But it does not shift if the procurement price of the crop, P, changes since equation (5.1) does not contain P.

The FF curve in figure 1 represents equation (11), which shows the official's determination of n as a decreasing function of Z. If C* rises, the official lowers the value of n, given Z. So the FF curve shifts inward if C* increases. But it does not shift when r and/or P changes because n does not depend upon r and P.

(Space for figure 1)

2.3 The Moneylender's Behaviour:

The moneylender in this model does not face any lending constraint. His net interest income is given by

$Y_M = (i - g).[n.\{C(i, P) - C_F.(1 - Z)\} + (N - n).C(i, P)]$

where g is the opportunity interest rate of his loan and it is a constant. After simplification, it reduces to

$Y_M = (i - g).[N.C(i, P) - (1-Z).C^*]$ (13)

We should note that out of N potential borrowers, n, numbers of farmers are able to get formal credit and the rest do not get formal credit at all. So (N–n) numbers of farmers have to take informal credit from the

moneylender entirely. On the other hand, those who get formal credit have to bribe the bank official at the rate Z per unit of credit. This is held back by the official as cut money. The effective amount of formal credit that each of the n number of farmers gets is $(1-Z).C_F$. Thus, the aggregate demand for informal credit of the moneylender is the aggregate demand for credit of all the N borrowers at a given i less the effective amount of formal credit, $(1-Z).C^*$, injected into the system.

The moneylender maximizes Y_M with respect to i and he takes Z as given in the maximization process because both the moneylender and the official act as followers in this game. The first-order condition of maximization is

$$N.C(.) + (i - g).N.(\partial C(.)/\partial i) - (1-Z).C^* = 0 \qquad (14)$$

So, the marginal net interest income (with respect to i) of the moneylender must be equal to zero in equilibrium.

Equation (14) is the reaction function of the moneylender. As the official raises the bribing rate, Z, the aggregate demand for loan of the moneylender rises given C*. His marginal net interest income (with respect to i) also increases. Given the opportunity interest rate, g, the moneylender now charges a higher informal interest rate. So, equation (14) must represent a positively sloped curve, MM, in the i–Z space (see figure 1). This is the reaction curve of the moneylender. Its slope is given by

$$(di/dZ)_M = -(C^*/2N.(\partial C/\partial i)) > 0.$$

3. **Nash Equilibrium and Comparative Statics:**

This is a game between the bank official and the moneylender, both acting as followers. The Nash equilibrium is characterized by the intersection point of the two reaction curves, OO and MM (in figure 1). Here i* and Z* are the equilibrium values of the informal interest rate and the bribing rate, respectively. Once Z* is found, the equilibrium value of n can be read directly from the FF curve as n*. In this model, both OO and MM are positively sloped. So Nash equilibrium may be stable (see figure 1) or unstable. For obtaining comparative static results we consider the stable equilibrium point. It is easy to check that the stability of Nash equilibrium requires the following condition.

$(di/dZ)_O > (di/dZ)_M$. This implies that

$$((1+i)/(1-Z)) > -(C^*/2N.(\partial C/\partial i)) \qquad (15)$$

3.1 Effects of subsidy policies on the informal interest rate, the bribing rate and on the number of farmers receiving formal credit

For getting comparative static results, after totally differentiating equations (5.1) and (14) and solving by Cramer's rule one can obtain the following results[10].

$$(di/dr) = (C^*/\Delta) < 0;\ (di/dC^*) = ((1+r)/\Delta) < 0;\ (di/dP) = \{(1+i).N.(1+2i-g)/\Delta.P^2.Q''(C)\} \quad (16)$$

and,

$$(dZ/dr) = -\{2N.(\partial C/\partial i)/\Delta) < 0;\ (dZ/dC^*) = \{(1-Z)^2/\Delta\} < 0;\ (dZ/dP) = \{N.(1-Z).(1+2i-g)/\Delta.P^2.Q''(C)\} > 0 \quad (17)$$

where $\Delta = (1-Z).C^* + (1+i).2N.(\partial C/\partial i) < 0$ (follows from (15)).

If the procurement price of the crop, P, rises, the demand for loan of each farmer rises too. The official's reaction curve, OO, does not shift owing to a price subsidy policy because it represents equation (5.1), which does not contain P. However, the moneylender now faces a higher demand for his informal credit because C(.) is an increasing function of P. His marginal net interest income (with respect to i) rises and it enables him to raise the informal interest rate, i, given the bribing rate, Z, of the official. As a consequence, the MM curve of the moneylender in figure 1 shifts upward resulting in increases in both i and Z. An increase in P cannot shift the FF curve. But a higher Z leads to a decrease in n.

In this model a credit subsidy policy may be implemented in two different ways. It can be achieved either by (1) an increase in the volume of formal credit C* supplied to the farmers while keeping the formal interest rate, r, at a reasonable rate or by (2) a decrease in the rate of interest r charged on formal credit, without changing the total supply of formal credit, C*. The earlier papers in this area (e.g. Chaudhuri and Gupta (1996), Gupta and Chaudhuri (1997), Bose (1996) and Jain (1999)) have not made such a comparative analysis between these two alternative ways of financing a credit subsidy policy, which is quite important from the point of view of policymaking.

If given C*, the formal interest, r, is lowered, it relaxes the constraint on the bank official and he finds it possible to raise the bribing rate, Z, given the informal interest rate, i. This shifts the OO curve in figure 1 in the outward direction. However, the MM curve does not shift, as C does not depend upon r. In the new equilibrium, both i and Z take higher values. Why the moneylender is able to raise the informal interest rate is as follows. As the official raises the bribing rate, Z, the effective supply of formal credit into the system, (1–Z).C*, decreases given C*. Thus, the moneylender now faces a higher demand for informal credit given i. His marginal net interest income rises, which enables him to raise the interest rate he charges on informal credit. On the other hand, the FF curve remains unaffected owing to a reduction in r. But the equilibrium value of n decreases as Z increases following a reduction in r.

This refutes one of the Gupta and Chaudhuri (1997) results and proves the counterproductiveness of the credit subsidy policy even in a case where the formal and informal credits are substitute to each other.

On the other hand, if C* increases given r, the official's reaction curve, OO, does not shift. But due to an injection of more formal credit into the system, the moneylender now faces a lower demand for his informal credit, given i and Z. His marginal net interest income (with respect to i) decreases. This forces him to lower the informal interest rate, i, given Z. This shifts the MM curve to the right leading to a fall in both i and Z. Why i falls is quite clear. But a reduction in i also forces the official to lower the bribing rate, Z, he charges on formal credit in order to keep the effective price of formal credit (incorporating the bribe) equal to the price of the informal credit. Besides, as C* increases the FF curve shifts inward leading to a fall in n given Z. However, as Z falls in the new equilibrium, it exerts an upward pressure on n. So, the net effect of an increase in C* on n is ambiguous[11]. It depends upon the relative strengths of the two opposite effects. All these results are presented in the form of the following proposition.

PROPOSITION 2: A price subsidy policy and/ or a credit subsidy policy, where the latter is adopted through a reduction in the formal interest rate, raises both the informal interest rate and the bribing rate but lowers the number of farmers among whom formal credit is distributed. On the contrary, a credit subsidy policy, if undertaken via an increase in the aggregate supply of formal credit, lowers both the informal interest rate and the bribing rate in the new equilibrium. The effect on the numbers of farmers receiving formal credit, however, remains indeterminate.

3.2 Other Effects

The agricultural productivity of each farmer, Q(C), and the real cost of credit, G (= (1+i)/P) are inversely related. A reduction in the formal interest rate, r, raises the informal interest rate (see proposition 2), and hence, the real cost of credit, G. Q(C) falls as a consequence. On the contrary, an increase in the aggregate supply of formal credit, C*, lowers i and hence G. So Q(C) increases. On the other hand, the impact of a price subsidy policy on Q(C) is not so obvious. As P increases, i increases too. So the net effect on G is uncertain. However, it can be easily shown[12] that the proportionate increase of (1+i) is smaller than that of P if $E < 1$ where $E = -(C.Q''(C)/Q'(C))$ is the elasticity of the marginal product curve of credit. Hence, under the sufficient condition, $E < 1$, a price subsidy policy lowers the real cost of credit of the farmer and hence raises the agricultural productivity.

Applying the envelope theorem, it is easy to check that the income of each farmer, Y_F, rises (falls) following an increase (a decrease) in the aggregate supply of formal credit (in the formal sector interest rate) by decreasing (increasing) the real cost of borrowing, G. On the other hand, a price subsidy policy affects Y_F in two different ways. It raises Y_F directly by raising the total revenue of the farmer. But it

lowers Y_F indirectly by increasing the informal interest rate, and hence the per unit cost of borrowing. However, one can check[13] that the direct expansionary effect on Y_F outweighs the indirect contractionary effect if $E \leq 1$. Thus, Y_F rises following a price subsidy policy under the sufficient condition $E \leq 1$.

Applying the envelope theorem once more, one can verify that both the moneylender and the bank official are able to increase their income/utility following an increase in P and/or a decrease in r by raising both the informal interest rate, i, and the bribing rate, Z. On the contrary, an increase in C* lowers the aggregate demand for informal credit of the moneylender. The moneylender experiences a reduction in his income as he is now forced to reduce i. However, the official may be able to increase his utility even in this case. As C* rises both i and Z fall. But even with a decreased Z, the official's utility may increase if Z.C* increases. So, we can now state the following proposition.

PROPOSITION 3: A credit subsidy policy, adopted through a reduction in the interest rate on formal credit, leads to a decrease in the agricultural productivity. The farmer becomes worse off while both the formal and informal sector lenders become better off in the new equilibrium. On the contrary, if a credit subsidy policy is undertaken via an increase in the aggregate supply of formal credit, the agricultural productivity as well as the welfare of the farmers improve. The moneylender becomes worse off. However, the welfare of the bank official may improve. On the other hand, a price subsidy policy makes the bank official and the moneylender unequivocally better off. The agricultural productivity and the welfare of the farmer may also improve as a consequence.

3. Concluding Remarks:

The major thrust of policy in the sphere of agricultural credit of the government of a developing country has been its progressive institutionalization for feeding agriculture and rural development programs with adequate and timely flow of credit particularly towards the small and marginal farmers. However, the experiences with this policy are not really encouraging. Formal credit institutions often ration credit to small borrowers and only a small group of large farmers monopolizes the lion's share of formal credit. Among the factors inhibiting the small farmers from securing formal credit in time, Sarap (1991) has emphasized the lower bargaining strength of small farmers vis-à-vis large farmers, the bureaucratic and procedural formalities required, patronage, arbitrariness and corrupt practices of the officials, especially in the cooperatives. Theoretical papers like, Chaudhuri and Gupta (1996) and Gupta and Chaudhuri (1997) have shown how in the presence of corruption in the distribution of formal credit, a credit or a price subsidy policy may raise the interest rate in the informal credit market, lower agricultural productivity and make the farmers worse off. The formal and informal sector lenders adjust their behaviour to appropriate the maximum benefits of the subsidy policies.

Assuming that corruption in the distribution of formal credit cannot be removed administratively a pertinent question is whether one can recommend an alternative policy that can deliver the goods. Fortunately, the present note suggests an alternative way of administering a credit subsidy policy, which can achieve at least some of its desired objectives. Traditionally, a credit subsidy policy is adopted through lowering of the formal sector interest rate. However, the present paper distinguishes between two different ways of designing a credit subsidy policy. It can be achieved either by (1) an increase in the volume of formal credit supplied to the farmers while keeping the formal interest rate at a reasonable rate or by (2) a decrease in the rate of interest charged on formal credit, without changing the total supply of formal credit. The earlier papers in the theoretical literature did not make any such distinctions. The present paper has shown that if a credit subsidy policy is undertaken via the first route, it lowers the informal interest rate and leads to an unambiguous improvement in the welfare of the borrowers and their agricultural productivity. If a larger amount of formal credit is injected into the system, it lowers the demand for informal credit of the moneylender, which compels him to reduce the informal interest rate. Also, a reduction in the informal interest rate tightens the constraint on the bank official. As a consequence, the bribing rate also decreases. The agricultural productivity and the real income of the farmers also improve as the real cost of borrowing decreases. The informal sector lender becomes worse off. However, there are two disconcerting effects as well. Firstly, the bank official may be better off and secondly; the number of farmers receiving formal credit may not increase even in this case. Despite these two worrying results, the paper strongly suggests that if the government of a developing economy even in the presence of corruption in the distribution of formal credit goes on with its credit subsidization policy, it must be implemented through provision of more and more institutional credit over time at a reasonable interest rate. It should be kept in mind that if the formal interest rate is kept at a substantially low rate, it is not the borrowers but the bank official and the moneylender who will derive the ultimate benefits.

Endnotes:

1. See for example, Chaudhuri and Gupta (1996), Gupta and Chaudhuri (1997), Chaudhuri (1999), Gupta et al (1991), Bose (1998) and Jain (1999).
2. Several empirical studies, e.g., Vega (1981), Lele (1981), Braverman and Guasch (1988), Sarap (1991) etc. have pointed out that the provision of cheaper credit has seldom benefited the small borrowers, as the large farmers have pocketed the lion's share of formal credit and the formal sector lenders generally ration credit to small borrowers for various reasons. As a sequel, the small borrowers are still heavily dependent on informal credit for carrying out their farming activity.
3. For empirical evidence, see Sarap (1991), Bedbak (1986) etc.
4. Similar result is also available in Chaudhuri (1999), where the moneylender and the bank official play a cooperative game and jointly determine the informal interest rate and the volume of disbursement of formal credit.

5. See endnote 7 in this connection.
6. This is the line of Gangopadhyay and Sengupta (1987) and Gangopadhyay (1994). Any production function, which is well behaved, may be written as a function of the total expenditure, if inputs markets are perfectly competitive. Consequently this production function can be interpreted as a general production relationship with many inputs under competitive conditions.
7. There is no reason for the bank official to disburse less than the C* amount of formal credit. Given the values of n and Z, his bribe income will be the maximum when he distributes the entire amount of credit, available to him. Also, we note that his utility, U(.), is an increasing function of his income.
8. Gupta and Chaudhuri (1997) have also made this assumption. The credit delivery system is a complex process consisting of numerous formalities and procedures. The credit-disbursing official has to carefully study the loan application and other documents relating to ownership of land and or tenancy status of the borrower and estimate the credit need of the borrower. In many cases, the official has to visit the sites for various reasons. The larger the number of farmers receiving formal credit, the larger the number of files, the official has to look into and hence the larger amount of labour he has to give to disburse credit. Thus one can expect a positive relationship between the labour time spent by the official and the number of receivers of formal credit.
9. These results have been derived in appendix I.
10. See appendix II for detailed derivation of these results.
11. This has been shown mathematically in appendix III.
12. See appendix IV for mathematical proof.
13. See appendix V for the mathematical proof.

References:

Bardhan, P.K and Rudra, A. (1978): 'Interlinkage of land, labour, and credit relations: an analysis of village survey data in East India'. *Economic and Political Weekly*, 13, 367-84.

Bedbak, H. (1986): 'Institutional financing for priority sectors: an empirical assessment of delay and analysis of attitudes of agencies towards loanees'. *Indian Cooperative Review*, 24, 65-76.

Bell, C. (1990): 'Interactions between institutional and informal credit agencies in rural India'. *World Bank Economic Review* (3), 297-327.

Bose, P. (1998): 'Formal-informal sector interaction in rural credit markets', *Journal of Development Economics* 56, 265-80.

Braverman, A. and Guasch, J.L. (1986): 'Institutional aspects of credit cooperatives'. Working Papers: Agricultural Policy, Agriculture and Rural Development Department, Washington DC, World Bank.

Chaudhuri, S. and Gupta, M.R. (1996): "Delayed formal credit, bribing and the informal credit market in agriculture: A theoretical analysis", *Journal of Development Economics* 51, 433-49.

Chaudhuri, S. (1998): "Inadequate formal credit and the informal credit market in agriculture: A theoretical analysis", *Journal of Quantitative Economics* 14 (2).

Floro, M. S., and Ray, D. (1997): "Vertical Links Between Formal and Informal Financial Institutions," *Review of Development Economics* 1, 34-56.

Gangopadhyay, S. (1994), "Some issues in interlinked agrarian markets", in: K. Basu (ed.), *Agrarian Questions*, Oxford University Press.

Gangopadhyay, S. and Sengupta, K. (1987): "Small farmers, moneylenders and trading activity", *Oxford Economic Papers* 39, 333-42.

Gupta, M. R. and Chaudhuri, S. (1997): "Formal credit, corruption and the informal credit market in agriculture: A theoretical analysis", *Economica* 64, 331-43.

Hoff, K., and Stiglitz, J.E. (1997): "Moneylenders and Bankers: Price-Increasing Subsidies in a Monopolistically Competitive Market," *Journal of Development Economics* 52, 429-62.

Jain, S. (1999): "Symbiosis vs. crowding out: the interaction of formal and informal credit markets in developing countries", *Journal of Development Economics* 59, 419-444.

Lele, U. (1981): 'Co-operatives and the poor: A comparative perspective', *World Development* 9, 55-72.

Reserve Bank of India, 1962, *All India Rural Debt and Investment Survey 1961-62.*

Reserve Bank of India, 1981, *All India Rural Debt and Investment Survey 1981.*

Reserve Bank of India: *Report on Currency and Finance* (1989-90).

Rudra, A. (1982): *Indian Agricultural Economics: Myths and Realities.* Allied Publishers, New Delhi.

Sarap, K., (1991): *Interlinked Agrarian Markets in Rural India*. Sage Publications, New Delhi.

Vega, G.C. (1981): 'Interest rates policies, agricultural credit and income distribution in Latin America'. Second International Conference on the Financial Development in Latin America and Caribbeans, Caralolleda, Venezuela.

Appendix I:

Totally differentiating equation (10) and after rearranging terms one obtains

$$dn.[-(\partial U/\partial Y_O).p''(.).K + (\partial U/\partial L).L''(.) + p'(.).p''(.).K^2.(\partial^2 U/\partial Y_O^2) + (L'(.))^2.(\partial^2 U/\partial L^2)]$$
$$= -(p'(.)K.C^*.(\partial^2 U/\partial Y_O^2)).dZ - (p'(.)K.Z.(\partial^2 U/\partial Y_O^2)).dC^*.$$

So $(\partial n/\partial Z) = -[p'(.).K.C^*.(\partial^2 U/\partial Y_O^2)/X] < 0$ and $(\partial n/\partial C^*) = -[p'(.).K.Z.(\partial^2 U/\partial Y_O^2)/X] < 0$

(+) (−) (−) (+) (−) (−)

where $X = [-(\partial U/\partial Y_O).p''(.).K + (\partial U/\partial L).L''(.) + p'(.).p''(.).K^2.(\partial^2 U/\partial Y_O^2) + (L'(.))^2.(\partial^2 U/\partial L^2)] < 0.$ (12)

(+) (≥ 0) (−) (+) (+) (≥ 0) (−) (+) (−)

Appendix II:

After totally differentiating equations (5.1) and (14), rearranging terms and writing in a matrix notation we get the following.

$$\begin{pmatrix} (1-Z) & -(1+I) \\ 2N.(\partial C/\partial I) & C^* \end{pmatrix} \begin{pmatrix} di \\ dZ \end{pmatrix} = \begin{pmatrix} dr \\ (1-Z).dC^* + \{N.(1+2i-g)/P^2.Q''(C)\}.dP \end{pmatrix} \quad (A.1)$$

Now $\Delta = \{(1-Z).C^* + (1+i).2N.(\partial C/\partial i)\} < 0$ (follows from the stability condition of Nash equilibrium given by (15)).

Solving (A.1) by Cramer's rule we get the following.

$$di = (1/\Delta).\begin{vmatrix} dr & -(1+i) \\ (1-Z).dC^* + \{N.(1+2i-g)/P^2.Q''(C)\}.dP & C^* \end{vmatrix} \quad (A.2)$$

and

$$dZ = (1/\Delta).\begin{vmatrix} (1-Z) & dr \\ 2N.(\partial C/\partial i) & (1-Z).dC^* + \{N.(1+2i-g)/P^2.Q''(C)\}.dP \end{vmatrix} \quad (A.3)$$

From (A.2) and (A.3) the following results follow trivially.

$$(di/dr) = (C^*/\Delta) < 0;\ (di/dC^*) = ((1+r)/\Delta) < 0;\ (di/dP) = \{(1+i).N.(1+2i-g)/\Delta.P^2.Q''(C)\} \quad (16)$$

and,

$$(dZ/dr) = -\{2N.(\partial C/\partial i)/\Delta) < 0;\ (dZ/dC^*) = \{(1-Z)^2/\Delta\} < 0;\ (dZ/dP) = \{N.(1-Z).(1+2i-g)/\Delta.P^2.Q''(C)\} > 0 \quad (17)$$

Appendix III:

From (11) we note that $n = n(Z, C^*)$. After differentiating totally we get

$$dn = (\partial n/\partial Z).[(dZ/dr).dr + (dZ/dP).dP + (dZ/dC^*).dC^*] + (\partial n/\partial C^*).dC^* \quad (A.4)$$

Using (12 and (17) from (A.4) it follows that

$$(dn/dr) = (\partial n/\partial Z).(dZ/dr) > 0;$$

$$(-) \quad (-)$$

$$(dn/dP) = (\partial n/\partial Z).(dZ/dP) < 0; \text{ and,}$$

$$(-) \quad (+)$$

$(dn/dC^*) = (\partial n/\partial C^*) + (\partial n/\partial Z).(dZ/dC^*)$

$\quad\quad\quad (-) \quad\quad (-) \quad\quad (-)$

$= - \{p'(.).K.Z.(\partial^2 U/\partial Y_O^2)/X.\Delta\} - \{p'(.).K.C^*.(\partial^2 U/\partial Y_O^2).(1-Z)^2/X.\Delta\}$ (obtained after using (12) and (17))

Using (12) once more, one gets

$(dn/dC^*) = - \{p'(.).K.(\partial^2 U/\partial Y_O^2)/X\}.[Z + \{C^*.(1-Z)^2/\Delta\}]$

$= - \{p'(.).K.(\partial^2 U/\partial Y_O^2)/X.\Delta\}.[Z.(1-Z).C^* + \{Z.(1+i).2N/P.Q''(C)\} + C^*.(1-Z)^2]$

$= - \{p'(.).K.(\partial^2 U/\partial Y_O^2)/X.\Delta\}.[(1-Z).C^* + Z.(1+i).2N.(\partial C/\partial i)]$

After using (14) the above expression is reduced to

$(dn/dC^*) = - \{p'(.).K.N.(\partial^2 U/\partial Y_O^2)/X.\Delta\}.[C + \{(3i-2r-g)/P.Q''(C)\}]$ (A.5)

$\quad\quad\quad (+) \quad\quad (-) \quad\quad (-)(-) \quad\quad (+) \quad\quad (-)$

So, the sign of (dn/dC^*) is ambiguous.

Appendix IV:

Real cost of credit, $G = (1+i)/P$. So

$(dG/dP) = (1/P^2).[P.(di/dP) - (1+i)]$

After putting the value of (di/dP) from (16) it becomes

$P^2.(dG/dP) = (1+i).[\{N.(1+2i-g)/\Delta.P.Q''(C)\} - 1]$

$= \{(1+i)/\Delta.P.Q''(C)\}.[N.(1+2i-g) - (1-Z).C^*.P.Q''(C) - (1+i).2N]$ (obtained after using the expression for Δ)

Now using equation (14) and the expression for $(\partial C/\partial i)$ and after simplification it reduces to

$P^2.(dG/dP) = - \{N.(1+i)/\Delta.P.Q''(C)\}.[(1+i) + C.P.Q''(C)]$

$= - \{N.(1+i)/\Delta.Q''(C)\}.[Q'(C) + C.Q''(C)]$ (A.6)

$\quad\quad\quad\quad (-) \;\; (-) \quad\quad (+) \quad\quad (-)$

From (A.6) it follows that $(dG/dP) < 0$ if $[Q'(C) + C.Q''(C)] > 0$, i.e. if $E < 1$ where $E = - (C.Q''(C)/Q'(C))$.

Appendix V:

The income of the representative farmer is

$Y_F = P.Q(C) - (1+i).C$

Applying the envelope theorem we may write

$(dY_F/dP) = Q(C) - C.(di/dP)$ (A.7)

After substituting the expression for (di/dP) from (16), (A.7) can be rewritten as

$(dY_F/dP) = Q(C) - C.\{(1+i).N.(1+2i-g)/\Delta.P^2.Q''(C)\}$

$= (1/\Delta.P^2.Q''(C)).[Q(C).(1-Z).C^*.P^2.Q''(C) + P.Q(C).(1+i).2N - C.(1+i).N.(1+2i-g)]$

Using (14) one can write

$$(dY_F/dP) = (1/\Delta.P^2.Q''(C)).[Q(C).P^2.Q''(C).\{NC + (i-g).N.(\partial C/\partial I)\} + P.Q(C).(1+i).2N - C.(1+i).N.(1+2i-g)]$$

$$= (N/\Delta.P^2.Q''(C)).[Q(C).C.P^2.Q''(C) + P.Q(C).(i-g) + 2P.Q(C).(1+i) - C.(1+i).(1+2i-g)]$$

$$= (N/\Delta.P^2.Q''(C)).[Q(C).C.P^2.Q''(C) + P.Q(C).(2+3i-g) - C.P.Q'(C).(1+2i-g)] \quad \text{(after using (2))}$$

$$= (N/\Delta.P.Q''(C)).[P.Q(C).\{C.Q''(C) + Q'(C)\} + (1+2i-g).\{Q(C) - C.Q'(C)\}] \quad \text{(A.8)}$$

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

So, from (A.8) it follows that

$(dY_F/dP) > 0$ if $\{C.Q''(C) + Q'(C)\} \geq 0$ i.e. if $E \leq 1$.

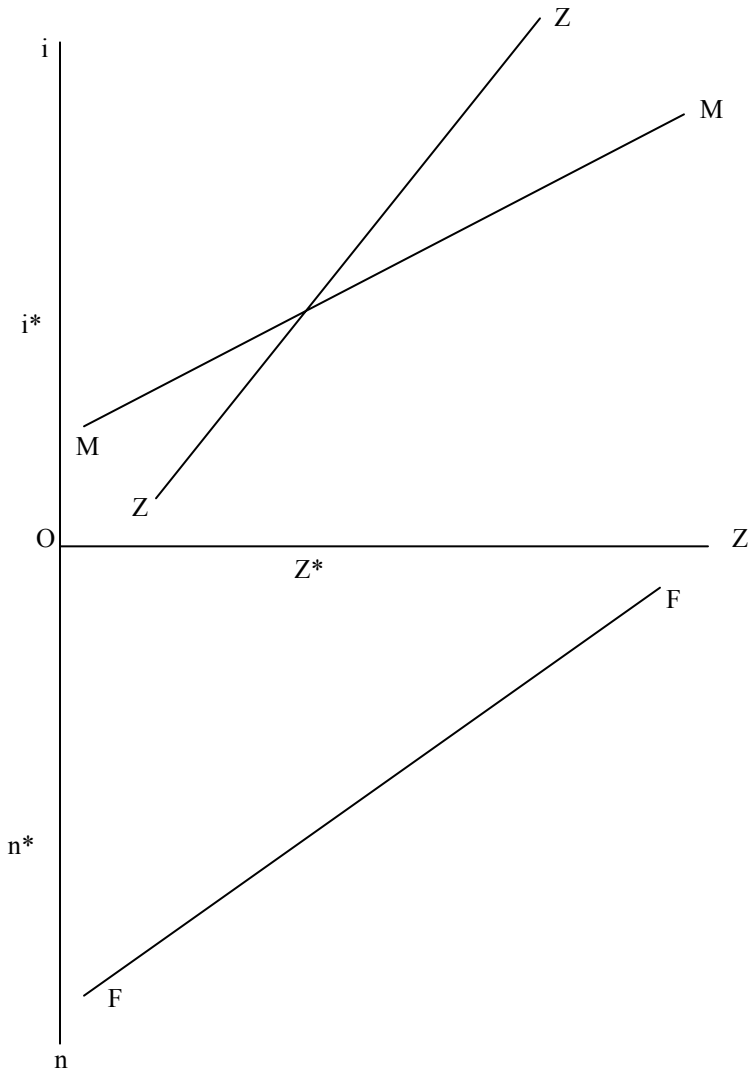

Figure 1: Stable Nash Equilibrium in the rural credit market.