Formal Credit, Corruption and the Informal Credit Market in Agriculture: a Theoretical Analysis

By Manash Ranjan Gupta and Sarbabit Chaudhuri
Jadavpur University, Calcutta, and Hooghly Mohsin College, West Bengal

Final version received 7 February 1996

The paper presents a theory of interest rate determination on informal credit in backward agriculture when there is a market for formal credit. The farmer has to bribe the official of the formal credit agency in order to get formal credit. The official and the moneylender play a non-cooperative game in choosing the amount of formal credit and the informal interest rate, respectively. The informal-sector interest rate and the effective formal-sector interest rate (incorporating the bribe) are equal in equilibrium. A reduction in the formal interest rate and/or an increase in the price of the product may lead to an increase in the equilibrium bribing rate and the informal interest rate when the formal credit and the informal credit are complementary to each other.

Introduction

There are two sources of credit available to the farmers in a less developed economy such as India: institutional and non-institutional. Non-institutional or informal sources include moneylenders, landlords, traders, friends and relatives; institutional or formal sources consist of cooperatives, commercial banks, regional rural banks, etc. In the initial stage of economic development (after independence), the share of the formal sector in total agricultural credit was very low. For example, in India in 1950–51 it was only 7%. However, the government of India then adopted a multi-agency approach to agricultural credit extension, consisting of co-operatives, commercial banks (after the historic nationalization of 17 commercial banks in 1969) and regional rural banks, in order to provide cheaper credit in sufficient amounts to farmers. As a result, the share of formal credit has increased, and in 1980–81 it amounted to 63% of total agricultural credit.

As the formal credit market is now an important source of agricultural credit, the interaction between formal and informal credit markets should play a significant role in the determination of the informal interest rate. Unfortunately, the recent theoretical literature on agricultural credit has not adequately treated this aspect.

In the presence of formal credit, a market for informal credit exists either because the supply of formal credit is inadequate or because formal credit is not available at the beginning of the crop cycle. A serious problem in the formal credit market is that the official of the formal credit institution, who is in charge of the disbursement of credit, often deliberately undertakes dilatory tactics with a view to forcing the offer of bribes from the farmers. These aspects have been pointed out by Adams and Vogel (1986), Bell (1990), Benjamin (1981), Chaudhuri (1993), Ghatak (1977, 1983), Ladman and Tinnermeier (1981), Lele (1981) and Sarap (1990a), among others.

This paper presents a theoretical analysis of interest rate determination in the informal credit market when the supply of formal credit is rationed by the
official of the formal credit institution. The simplified story is as follows. The representative farmer has two sources of credit: a formal source (controlled by a bank official) and an informal source (controlled by a moneylender). The formal and informal credit may be either substitutes or complements to each other. The supply of formal credit is controlled by an official, who takes a bribe from the farmer. The official has no control over the actual interest rate in the formal credit market which is administratively determined. However, the effective interest rate on formal credit must include the bribe and the official concerned determines the bribing rate. The moneylender, on the other hand, determines the interest rate he charges for informal credit. Thus, the official and the moneylender play a non-cooperative game, choosing the amount of formal credit and the informal interest rate, respectively, and the equilibrium in the credit market may be viewed as a Nash equilibrium.

This theoretical analysis leads to some interesting results. For example, the informal sector interest rate and the effective formal interest rate (incorporating the bribe) may be equal in equilibrium. Development policies such as an agricultural price subsidy policy and a credit subsidy policy in the formal sector may not ultimately succeed in reducing the informal interest rate and in improving the credit intensity of cultivation by small farmers when the formal credit is complementary to the informal credit. This can at least question the desirability of these policies which have been pursued by the government of India for a long time.

The plan of this paper is as follows. First, we consider the case where formal and informal credit are perfect substitutes. The model is described in Section I. The first part of that section describes the behaviour of the farmer. The reaction curves of the official and the moneylender are then derived in subsections (b) and (c), respectively. The determination of the equilibrium informal interest rate and the bribing rate is analysed in subsection (d). The effects of price and credit subsidy policies are analysed in subsections (e) and (f). The case where the two types of credit are complementary to each other is taken up in Section II. Section III considers the endogenous probability of detecting the corruption of an official. Concluding remarks are given in Section IV.

I. The Model

The model consists of three economic agents: the farmer, the official and the moneylender. There are two sources of credit: formal and informal. The rate of interest in the formal credit market and the price of the crop are denoted by $r$ and $P$, respectively, and these are exogenously given to the model because they are the policy variables of the government. Each of the three economic agents maximizes his own objective function with respect to his instrumental variable, and takes $r$ and $P$ as given in the maximization process.

There are two stages of the game. In the first stage, the official of the formal credit agency and the moneylender play a non-cooperative game, simultaneously determining the amount of formal credit and the rate of interest in the informal credit market. The size of bribe that the official charges the farmer is also determined in this stage. In the second stage of the game, the farmer determines the amount of informal credit to be used in the production process.
With exogenous changes in the values of the policy variables, i.e. \( P \) and \( r \), the equilibrium values of the endogenous variables are altered.

We now turn to the behaviour of each of the three agents.

(a) The farmer

The representative farmer produces his crop with the following production function:

\[
Q = F(B_I + B_F) \quad \text{with} \quad F' > 0 \quad \text{and} \quad F'' < 0,
\]

where \( B_I \) and \( B_F \) stand for the amounts of informal and formal loans, respectively. We assume these two types of credit to be perfect substitutes.

Let \( i \) and \( r \) be the rates of interest on the informal and formal credit, respectively. The farmer has to bribe the official of the formal credit institution in order to get the subsidized formal credit. Let \( Z \) be the bribing rate. Then the total cost of obtaining informal credit and formal credit, i.e. the cost of production, is given by

\[
B_I (1 + i) + B_F (1 + r + Z).
\]

If \( P \) stands for the price of the crop, then the profit of the farmer, \( Y_F \), is given by

\[
Y_F = PF(B_I + B_F) - B_I (1 + i) - B_F (1 + r + Z).
\]

The farmer maximizes income with respect to his only instrumental variable, \( B_I \). He is a price-taker in both the credit markets. Also, he has no control over the amount of the formal credit, \( B_F \), and the rate of bribing, \( Z \). So the first-order condition of maximization is given by

\[
P F' (B_I + B_F) = (1 + i),
\]

and solving this we get the following demand function for the loan (formal plus informal):

\[
B_I + B_F = G(i, P),
\]

where \( \partial G / \partial i < 0 \) and \( \partial G / \partial P > 0 \). Note that \( (1 + i) / P \) 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. The demand function for informal credit is given by

\[
B_I = G(i, P) - B_F.
\]

However, this is valid if and only if

\[
(1 + i) \geq (1 + r)(1 + Z),
\]

where \( (1 + r)(1 + Z) \) is the effective price of formal credit; and the farmer will never use formal credit if its effective price exceeds the price of informal credit, \( (1 + i) \).

(b) The official

We consider a risk-neutral official who maximizes his utility; and the utility is assumed to be a positive function of his expected income, \( Y_0 \), and a
negative function of labour, \( L \). So the utility function is

\[
(6) \quad U = U(Y_0, L),
\]

and it satisfies all the standard properties.

The expected income of the official is

\[
(7) \quad Y_0 = ZB_F + T - \nu K,
\]

where \( \nu \) is the probability of getting caught if the official takes a bribe\(^8\) and \( K \) is the fine the official has to pay if he is caught; \( T \) is his exogenously given salary, and \( ZB_F \) is the amount of his bribe income.

We also assume the following functional relationship:

\[
(8) \quad L = L(B_F) \quad \text{with} \quad L' > 0 \quad \text{and} \quad L'' > 0.
\]

This relationship can be explained as an inverted production function where the amount of credit disbursed, \( B_F \), is the output and the official’s labour is the only input. \( L' > 0 \) and \( L'' > 0 \) because we assume positive and diminishing marginal productivity of labour in this production function.\(^9\)

The official maximizes \( 6 \) subject to the constraint \( 5 \) and equations \( 7 \) and \( 8 \). The two instrumental variables in the maximization process are \( Z \) and \( B_F \). He takes the informal interest rate, \( i \), as given in the maximization process. The moneylender determines \( i \), and both the official and the moneylender act as followers in this non-cooperative game.

Note that \( Y_0 \) is a positive function of \( Z \) and \( U \) is a positive function of \( Y_0 \). Also, the right-hand side of the constraint \( 5 \) is a positive function of \( Z \). So, given \( B_F \), the maximization of \( U(\cdot) \) with respect to \( Z \) automatically implies that the constraint \( 5 \) will be binding in equilibrium. This leads to the following proposition:

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

Also, maximizing \( U(\cdot) \) with respect to \( B_F \), we get the following first-order condition:

\[
(9) \quad Z = \beta L'(B_F),
\]

where \( \beta = -[\partial U/\partial L/\partial U/\partial Y_0] \) is the marginal rate of substitution between income and labour and we assume it to be a constant.\(^10\)

As the constraint \( 5 \) is binding in equilibrium, \( 9 \) can be expressed as follows:

\[
(10) \quad (i - r)/(1 + r) = \beta L'(B_F).
\]

Equation \( 10 \) can be looked upon as the reaction function of the official. With respect to a change in \( i \) made by the moneylender, the official reacts through a change in \( B_F \) according to \( 10 \).
Since, by assumption, $L''(\cdot) > 0$, it can be easily shown, from (10), that $B_F$ is a positive function of $i$. So the reaction curve of the official, $OO$ in Figure 1, slopes positively. As the marginal productivity of labour is diminishing in the official's production function of credit disbursement and his marginal rate of substitution between income and labour is constant, the amount of credit disbursed by the official should vary positively with the effective price (the bribing rate). An increase in $i$ leads to an increase in the bribing rate, $Z$, because the constraint (5) is binding in equilibrium. So the official will raise $B_F$ when $i$ is increased (see Figure 1). This reaction curve shifts downwards when $r$ is reduced. This is because $i$ and $r$ should move in the same direction to keep (10) satisfied at the given value of $B_F$.

(c) The moneylender
The moneylender maximizes his net interest income, $Y_M$, with respect to $i$, given $Z$ and $B_F$. His net interest income is

$$Y_M = (i - g)[G(i, P) - B_F],$$

where $g$ is the opportunity interest rate of the moneylender. His optimum rate of interest, $i$, is a positive function of $P$ and a negative function of $B_F$. The higher the price of the crop is, given $B_F$, the greater will be the demand for informal credit and hence the higher will be the interest rate charged by the moneylender. Similarly, an increase in the amount of formal credit sanctioned by the official leads to a reduction in the demand for the informal credit, and consequently the moneylender lowers the interest rate in the informal credit market.

The $MM$ curve in Figure 2, which shows $i$ as a negative function of $B_F$, is the reaction curve of the moneylender. Given $B_F$, the moneylender raises $i$ when $P$ rises. So the $MM$ curve shifts upward when the price of the crop is increased.
(d) Nash equilibrium

Both the official and the moneylender act as followers in this non-cooperative game. The Nash equilibrium is attained at the point of intersection of the $OO$ and $MM$ curves (see Figure 3). Here $i^*$ and $B_F^*$ are the equilibrium values of the informal interest rate; the amount of formal credit, $Z^*$, is the equilibrium bribing rate charged by the official; and the $XX$ curve shows the official's equilibrium condition with respect to $Z$, i.e. constraint (5) with equality. At each point on the $XX$ curve, the effective price of the formal credit is equal to the price of the informal credit. We also assume a stable equilibrium point, i.e. a point where the slope of the $OO$ curve exceeds the absolute value of the slope of the $MM$ curve.

© The London School of Economics and Political Science 1997
(e) Price subsidy

If the government adopts a price subsidy policy, the farmer receives a higher effective price for the product. This means an increase in $P$. The $MM$ curve shifts upward in this case. But the $OO$ and $XX$ curves do not shift, because neither (10) nor (5) includes $P$. The equilibrium values of $i$, $BF$ and $Z$ increase as a consequence.

However, the rate of increase of the informal interest rate is less than the rate of increase of the product price. So $(1 + i)/P$ is reduced, and this raises the optimum use of credit (formal plus informal) and improves the agricultural productivity. The real income of the farmer, $(Y_f/P)$, is also increased because $(1 + i)/P$ is reduced.

We can summarize the major results in the form of the following proposition:

**Proposition 2.** (i) An increase in the price of the crop raises the equilibrium values of the informal interest rate, $i$, the use of formal credit, $BF$, and the bribing rate, $Z$. (ii) Both agricultural productivity and the income of the farmer are increased in this case.

However, the official extracts a part of the benefit of price subsidy policy, raising the bribing rate, $Z$. The moneylender also extracts a part of the subsidy through an increase in the informal interest rate. So the farmer cannot derive the entire benefits of the price subsidy policy. His dependence on the informal credit market and the rent-seeking behaviour of the official of the formal credit agency prevent him from deriving the entire benefit.

(f) Credit subsidy

The credit subsidy policy takes the form of a reduction in the formal interest rate, $r$. The $OO$ curve shifts downward in this case. Also, the $XX$ curve shifts towards the horizontal axis with a lower intercept as well as with a reduced slope, because $(1 + r)$ falls. But the $MM$ curve does not shift, because the formal interest rate does not enter the demand function for informal credit. So in the new equilibrium $BF$ rises and $i$ falls; but $Z$ may move in either direction depending on the degree of shift of the $XX$ curve.

Hence the real cost of credit, $(1 + i)/P$, is reduced, and this raises the credit intensity of cultivation as well as its productivity. Also, the income of the farmer increases when $r$ falls because

$$\frac{dY_f}{dr} = -(B_f + B_r)(di/dr) < 0.$$

Now we can establish the following proposition:

**Proposition 3.** (i) If the formal interest rate, $r$, is reduced, the new equilibrium is characterized by a lower interest rate on informal credit and a greater use of formal credit. However, the effect on the bribing rate remains indeterminate. (ii) Both agricultural productivity and the farmer’s income are increased in this case.

© The London School of Economics and Political Science 1997
The moneylender becomes worse off in this case because
\[
(dY_M/dr) = -(i - g)(dB_F/dr) > 0.
\]
The reduction in the formal interest rate raises the use of formal credit, and this causes a downward shift in the demand for informal credit which ultimately lowers the income of the moneylender.
But the official may find his income increased if he can raise the bribing rate in the new equilibrium; and in that case, the farmer may not derive the entire benefit of the subsidy policy, though his income is increased.

II. Complementary Relationship

In this section, the basic model of Section I(a) is modified in only one direction. We assume some degree of complementary relationship between \( B_I \) and \( B_F \) in the production function. The modified production function is now given by

\[
Q = F(B_I, B_F),
\]

satisfying all the standard properties including the special property that \( \partial^2 F/\partial B_I \partial B_F > 0 \). This special property implies that the marginal productivity of one input is a positive function of the amount of the other input used.
This complementary relationship between informal and formal credit can be justified when informal credit is available at the beginning of the crop cycle and formal credit is disbursed at some intermediate time. The expenditure on the inputs required in the initial phases of the production process can therefore be met only by recourse to informal credit, while the costs of inputs used in the later stages of production can be financed by formal credit. So if the inputs used in different stages of the production process involve a technically complementary relationship, then the derived production function should have a complementary relationship between formal and informal credit. Empirical evidence on the delayed disbursement of formal credit is available in the literature. Sarap (1990a) has found evidence of delay in disbursing formal credit to the small and marginal farmers in the villages of the Sambalpur district of Orissa. The empirical analysis of Chaudhuri (1993), in the case of two selected villages of West Bengal, shows up the same problem. This problem has also been observed by Bedbak (1986), who made a survey of a village of the Sonepur subdivision of Orissa.

When formal and informal credit involve a complementary relationship, i.e. when the marginal productivity of informal credit, \( B_I \), is positively related to \( B_F \), the demand for informal credit must be a positive function of \( B_F \). However, in the basic model of Section I, the demand for informal credit was a negative function of \( B_F \). So now the moneylender will raise the value of \( i \) when the official increases \( B_F \); and hence the moneylender’s reaction curve, \( MM \), will slope positively, whereas the \( MM \) curve was of negative slope in Section I. However, the official’s behaviour will remain unchanged.

With a positively sloped \( MM \) curve, the Nash equilibrium may be stable (see Figure 4(a)) or unstable (see Figure 4(b)). For comparative static exercises, we consider the stable equilibrium point. The effects of an increase in \( P \) on the equilibrium values of \( i, B_F \) and \( Z \) are similar to those in the basic model of Section I(d) because the \( MM \) curve shifts upward and the other two curves do...
not shift. But we get different results in the case of a reduction of the value of $r$. This causes a downward shift of the $OO$ curve. So, given the positively sloped $MM$ curve, we find a new equilibrium point with higher values of $i$ and $BF$. Also, the $XX$ curve shifts towards the horizontal axis and hence the value of $Z$ is also increased in the new equilibrium. Since $(1 + i)$ is the effective price of credit (both formal and informal), an increase in $i$ will in turn lower the income of the farmer, $Y_F$. So we can establish the following proposition:

**Proposition 4.** (i) A reduction in the interest rate on formal credit, $r$, leads to an increase in the equilibrium values of the informal interest rate, $i$, the use of formal credit, $BF$, and the bribing rate, $Z$. (ii) The farmer’s income, $Y_F$, is reduced in this case.

Therefore, in the presence of a complementary relationship between the informal and formal credit, the credit subsidy policy of the government, which takes the form of a reduced value of $r$, produces adverse effects on the
borrowers (farmers). One can justify such a complementary relationship given the delayed disbursement of formal credit.\textsuperscript{17,18}

III. ENDOGENOUS PROBABILITY OF PUNISHMENT

So far, we have assumed that the probability of detecting corruption of the official, $\nu$, is exogenously given. In this section, we endogenize it by assuming that the probability of detection is a positive function of the bribing rate. We consider the following functional relationship:

\begin{equation}
\nu = \nu(Z), \quad \text{with } \nu'(\cdot) > 0 \quad \text{and} \quad \nu''(\cdot) < 0.
\end{equation}

In this case, the behaviour of both the farmer and the moneylender remains unchanged. However, the official incorporates (12) into his optimization exercise. The first-order condition with respect to $B_F$, i.e. (9), remains the same. But the maximization with respect to the bribing rate, $Z$, may lead to a different equilibrium condition. Either constraint (5) will be binding, and hence Proposition 1 will remain valid, or there will be an interior solution, given by

\begin{equation}
B_F = \nu'(Z)K.
\end{equation}

We are now interested in this special case.

As constraint (5) is not binding, we cannot get (10) from (9) and hence cannot derive the $OO$ curve. On the other hand, the equilibrium values of $B_F$ and $Z$ are now solved from (9) and (13); and these equilibrium values are independent of the changes in the policy variables, $r$ and $P$, because they do not enter (9) and (13).

The informal interest rate, $i$, is determined by the moneylender\textsuperscript{19} maximizing $Y_M$, given by (11). Note that (11) contains only $P$, but not $r$. So a change in the formal interest rate does not affect the informal interest rate. However, with an increase in $P$, the demand for informal credit is increased and the moneylender raises the informal interest rate. The major results can be summarized in the form of the following proposition:

**Proposition 5.** Credit subsidization policy in the formal credit market has no effect on the equilibrium of the model. Price subsidy policy, on the other hand, raises the informal interest rate.

At this stage, we should mention that the results may be different with alternative specifications of the endogenous probability function.

IV. CONCLUSION

The paper has developed the following idea. A farmer has two types of credit source, formal and informal. Informal credit and formal credit may be either substitutes or complements to each other. The supply of formal credit is controlled by an official, who is bribed by the farmer to get credit. The official has no control over the formal interest rate, which is administratively determined; however, the effective interest rate for formal credit incorporates the bribe; and the official determines the bribing rate as well as the amount of formal credit to be disbursed. The moneylender, on the other hand, determines the informal interest rate. Thus, the official and the moneylender play a

© The London School of Economics and Political Science 1997
simultaneous-move, non-cooperative game, choosing the bribing rate and the informal interest rate simultaneously.

This game leads to some interesting results. For example, the informal interest rate and the effective formal interest rate (incorporating the bribe) are equal in equilibrium. There are some other results, which emphasize the need for reconsidering the desirability of the agricultural price and credit subsidization policies that have been administered in India for a long time. For example, these policies may raise the informal interest rate and the bribing rate if there is a complementary relationship between these two types of credit. However, the policies may not affect the bribing rate when the probability of detection of a corrupt official varies positively with the bribing rate.

Despite simplicity and abstraction,\(^{20}\) the theoretical analysis presented in this paper would seem interesting because its results establish a new theory of high interest rates in the informal credit market. The existing theoretical literature explaining such high interest rates emphasizes either the Lender’s Risk hypothesis (see Bottomley 1975) or the lender’s objective of trying to induce default and thereby establish control over the borrower’s assets (see Bhaduri 1977). This paper presents an alternative explanation of high informal interest rates, for which price and credit subsidy policies of the government are responsible.

ACKNOWLEDGEMENTS

We are indebted to a referee of this Journal for his comments on the earlier version of this paper. We alone are responsible for any remaining errors.

NOTES

1. This 7% of institutional credit came from cooperatives, the government and commercial banks. This figure is obtained from the All India Rural Debt and Investment Survey 1961–62, published by the Reserve Bank of India.


3. One indirect way of rationing formal credit is to control the time of disbursement; see e.g. Sarap (1990a, b), Bedbak (1986), Chaudhuri (1993).

4. Empirically, the moneylender is not the only source of informal credit. Traders, landlords (large farmers), friends, relatives, etc., often give loans to farmers. So the assumption that the moneylender is the only source of informal credit may look objectionable when moneylenders charge high interest rates and the others charge low interest rates. Bardhan and Rudra (1978) and Rudra (1982) point out that traders and landlords offer interlinked credit contracts at very low interest rates. But the empirical analysis of Sarap (1987) supplies some weak defences of this assumption. First, small and marginal farmers take nearly 80% of informal credit from the moneylenders (see his Table 12); second, the rates of interest charged by the traders, friends, relatives, etc., to small and marginal farmers are also very high and close to the moneylender’s interest rate (see his Table 9). Also, the All India Debt and Investment Survey (1981) of the Reserve Bank of India (1982) shows that, even in 1981, the moneylenders’ share of informal credit (16.1%) is higher than the combined share of the landlords and the traders (12%).

5. We consider the representative farmer from a pool of a large number of identical farmers.

6. This is a derived production function; see Gangopadhyay and Sengupta (1987).

7. The second-order condition is always satisfied because \(F''<0\).

8. In this section we assume \(\tau\) to be exogenously given; in Section III, \(\tau\) is endogenous to the model.

9. See n. 20 to justify this production function.

© The London School of Economics and Political Science 1997
10. This is a restrictive assumption. We use it to simplify the analysis. Note that Sen (1966) used it to explain surplus labour.

11. Using equations (2) and (3), Proposition 1; and the Envelope Theorem, we get this condition.

12. Comparable results are available in the rent-seeking literature. In a very different context, but still assuming that the official needs a bribe to make his job, Shleifer and Vishny (1992, 1993) show that increasing the official price leads unambiguously to a reduction in production and has different effects on the bribe depending on the slope of the demand function.

13. See equation (11) in Section I(c).

14. Equation (1a) represents a derived production function.

15. See Table 3 in Sarap (1990a).

16. In the two villages—Hazipur and Bara-shimuliya—farmers with less than 1.5 acres of land-holding had to wait for nearly eight weeks from the date of application to get formal credit.

17. Informal credit is available at any point of time in the crop cycle.

18. There are two other structural characteristics of a backward agricultural economy which can explain the complementary relationship between formal credit and informal credit. First, informal credit may be used to finance consumption in the lean season and formal credit may be used as production loan. In this case, an increase in the amount of formal credit will raise the income of the farmer and hence his demand for consumption loan (informal credit). Second, a part of the wage cost is often met in advance (especially in the lean season when the labourers have no alternative source of income). This may be financed by informal credit. If formal credit is used to finance the cost of non-labour inputs, then the complementary relationship between labour and non-labour inputs will establish a similar relationship between formal credit and informal credit.

19. The moneylender now behaves like a monopolist in the informal credit market.

20. Some of the assumptions of the model are restrictive. For example, equation (8), i.e. the inverted production function of the official, is more appropriate in a case where a higher disbursement of credit involves a larger number of farmers and the official has to look into a larger number of files. Besides, the probability of detection of corruption of the official should be a function of many policy variables.

REFERENCES


© The London School of Economics and Political Science 1997


© The London School of Economics and Political Science 1997