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#### THE EFFECT OF CREDIT LIBERALIZATION ON SMALL -FARM HOUSEHOLDS: THE CASE OF BANGLADESH

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## The Effect of Credit Liberalization on Small-Farm Households: The Case of Bangladesh

Anwar Ahmed and J.O.S. Kennedy

## **1** Introduction

In Bangladesh, as in most LDCs, the provision of subsidized credit from institutional sources for crop production only is an important part of government strategy to boost production, farm income and improve income distribution among farming households. In recent years, the substantial expansion of institutional credit for agriculture over a vast institutional base has been brought about in various ways. The main policy instruments adopted include lending targets and guidelines, refinance facilities and government guarantees to the lending institutions. In addition to interest rate ceilings, maximum credit limits have also been fixed by the Government. The aim has been to prevent concentration of loans among the large farm households. However, in spite of these sincere efforts on the part of the Government and the Bangladesh Bank (Central Bank), the small and marginal farmers who constitute the vast majority (73 per cent) of farm households have remained outside the benefits of cheap credit provided from the institutional agencies. On the contrary, empirical evidence shows that concessional loans have largely benefited the medium and large farm households in rural Bangladesh. A similar picture emerges from other developing countries (Ruttan).

These developments have raised serious doubts about the existing financial policy pursued by governments in LDCs in order to promote growth of the economy, and speed agricultural development. In the early seventies, McKinnon and Shaw came up with the thesis that the finance market in most LDCs suffers from 'financial repression' (i.e., the use of prices and controls to limit the development of finance markets) which works against the growth and development of the economy. They argued that the only way to get rid of the financial repression syndrome is to remove government interventions in the finance market. In particular, ceilings on interest rates provide an unwarranted stimulus to current consumption at the expense of savings, encourage the pursuit of low return investment projects, and lead to an inefficient allocation of scarce loanable funds. Raising interest rates will result not only in increased savings and loanable funds, and a more efficient allocation of these funds through the financial intermediaries, but also in higher economic growth. Following this new wisdom, a number of rural credit theorists over the last 15 years argued that the traditional financial policy, particularly those resulting in low and/or negative interest rates on deposits and lending, works against rather than promotes production, income and equity objectives in rural areas (Gonzalez-Vega; Adams; Vogel; Ladman and Tinnermeier). They suggest, therefore, that more flexible interest rates could be a key factor in improving the performance of the rural finance market. Moreover, higher interest rates will pave the way for better access to institutional credit among the small-farm households in LDCs.

The aim of this paper is to analyse the impact of short-term credit on the resource allocation of farming households in general and small-farm households in particular in order to explore the following policy issues: i) the effect of relaxation of the existing credit ceilings as well as interest rate restrictions on the income and welfare of small-farm households; and ii) the effect of raising the interest rate on loan demand at the farm and aggregate level. In the past several credit impact studies have been conducted in LDCs but most of these studies focused on the farm business only. This study aims to overcome some of the deficiencies of the past credit impact studies.

#### 2 Modelling the Farm Households

An important problem in analysing of the impact of borrowing on the farm households is that they are complex units simultaneously making production, consumption, saving and borrowing decisions. Moreover, given the fungibility in farm households' cash flow management (Von Pischke and Adams), it is difficult to separate the effect of loans on the farm from those

on the household. In recent years there has been an upsurge of interest among researchers in modelling the complex behaviour of farm households based on the theoretical underpinnings provided by Nakajima and Becker. In the current literature of farm household models this is termed a separable or recursive approach (Singh, Squire, and Strauss). This approach assumes that production decisions always precede consumption decisions, with farm households treated as profit maximizers in production and utility maximizers in consumption The essential feature underlying this approach of farm household decision-making is that market exists for all commodities that are both produced and consumed, with the household being a price-taker in each one, and that such commodities are homogenous (Strauss). However, if any market is incomplete or imperfect, then the recursive condition may break down and the household's decision making about production, consumption, saving and borrowing may be interdependent. It is widely believed that credit markets in most LDCs including Bangladesh are imperfect (Bandyopadhyay; Saleem; Fernando; Rashid). In order to model farm household decision-making with respect to interdependent production, consumption, savings, borrowing and ron-farm labour supply, we require a constrained optimization or programming approach. Several studies of loan impact in the past have used some type of mathematical programming technique but most studies have captured only limited aspects of household decision making (David and Meyer) In the light of Chayanov's theory of peasant economy (Thorner, Kerbley and Smith), a 'Multi-activity' household model is designed with the purpose of explaining decisions on production, consumption, savings, borrowing, lending, and labour allocation to own farm, other farm (casual labour selling) and non-farm activities. The planning horizon for the model extends over a period of two crop seasons (one year). This planning period was divided into four planning periods in order to examine how farm households allocate their resources throughout the year.

## 3 Method to Deal with Aggregation Bias

In order to minimize costs in model building the representative farm approach has been used in this study. However, the problems of aggregation error involved in the use of representative farms are well documented (Day; Sheehy and McAlaxander; Sharples). Day first proposed a set of conditions for eliminating aggregation bias in LP studies. Although Day's conditions are sufficient for eliminating aggregation bias, these were seen as highly restrictive, and alternative methods were proposed by several authors to relax them (Lee; Miller; Buckwell and Hazell; Kennedy). The method used in this study was proposed by Kennedy.

This method also requires that all farms within a representative group have the same objective function and technical coefficients but the ratios of farm resources available vary on account of the size of farms. The underlying assumption is that the availability of each of the m farm resources specified is either constant or increases approximately linearly with farm size  $\delta$ . In other words, the availability of the i-th resources  $r_i$  for i = 2,...,m may be expressed in the form  $r_i = a_i + b_i \delta$ , where  $a_i$  and  $b_i$  are constants. If the availability of any resource  $r_j$  does not vary with size significantly then  $b_j = 0$ . As  $\delta$  is varied through the range of farm sizes, resource availability ratios  $r_i/r_h$  will change if  $a_i$  or  $a_h \neq 0$ . Thus if the results of regressing resource availabilities on farm size are built into an LP matrix and available land (as the measure of farm size) is varied parametrically, basis changes will occur in the LP run when resource ratios reach critical values. Estimates of aggregate supply are then obtained by scaling the solution vector at each basis, using information on the number of farms within the ranges of sizes for which no basis change occurs.

The derivation of aggregate supply requires the solution of the following LP problem:

$$Maximize c'x_k$$

subject to

$$A \boldsymbol{x}_{k} \leq \left[ \begin{array}{c} \delta \\ r \end{array} \right]_{k} \qquad k = 1, \dots N$$

where

x is an (nx1) vector of activities;

c is the corresponding (nx1) vector of net revenues;

k denotes the k-th farm;

r is an ((m-1)x1) vector of resource levels;

A is an (mxn) matrix of technical coefficients; and

N is the number of farms.

The aggregate supply vector, S, is defined as  $\sum_{k=1}^{n} x_k$ . If r can be written as a linear function of  $\delta$  (farm size),

$$r = a + b\delta + e$$

then, ignoring the error term vector e, the equivalent formulation for obtaining the estimate of aggregate supply by running one LP parameterizing  $\delta$  is:

subject to

\* \* \*

.

$$Ax - \left[\begin{array}{c}1\\b\end{array}\right]\delta \leq \left[\begin{array}{c}0\\a\end{array}\right]$$

This procedure permits both the determination of the number of representative farm categories within the type group, and of the cut-off points for demarcating each category. Moreover, a particular advantage of this method is that the number and limits of farm size categories are determined endogenously. In this way the method provides an efficient operational means for reducing aggregation bias. In this study, the following resources were assumed to vary with farm size: 1) irrigated land; 2) family labour; 3) family draft power; 4) hired farm labour; 5) initial cash; 6) borrowing from institutional sources; 7) minimers consumption requirements; and 8) minimum planted area.

## 4 Utility Function

Several empirical studies suggest that the various natural and socio-political sources of risk to which farm households are exposed can have important impacts on resource allocation decisions, particularly among the small-farm households in LDCs (Dillon and Anderson; Wolgin; Wiens). Consequently in risk situations, the objective function for farm households is defined as expected utility a function of expected net income and standard deviation (or some other measure of risk) of net income. The decision rule used in this study is similar to Baumol's expected gain-confidence limit (E,L) criterion, where  $L = E_{(y)} - \phi \sigma_{(y)}$  and  $\phi$  is a risk aversion parameters. The basic source of risk encountered by the farm households is attributed to the fluctuations in expected gross margins of crop activities. However instead of the covariance matrix of activity gross margins, the measure of variation used is the mean absolute deviation (MAD) proposed by Hazell. In this formulation  $\sigma_y = \Delta MAD_y$ .<sup>1</sup> By defining a new variable  $\psi = \Delta \phi$ , the objective function of the model is:

Maximize 
$$E(U) = E(y) - \psi MAD_y$$

which has been solved to determine the risk efficient farm plans of the farm households.

#### 5 Non-food Consumption Expenditure

The specification of non-food consumption expenditure of farm households in the model is a major departure from most of the credit impact studies based on programming techniques (Nasim; Rosegrant and Herdt). In most of the previous studies non-food consumption was specified as a fixed proportion out of income or net revenue. However, according to Engel's Law, the proportion of expenditure devoted to non-food items increases with a rise in household income. In order to accommodate Engel's Law in our model, we assumed consumption of non-food items is an increasing function of household income. Consequently, we estimated a quadratic equation of the following form using household expenditure survey data from the Bangladesh Bureau of Statistics:<sup>2</sup>

$$CNF = a + bY + cY^2$$

where CNF, is the consumption expenditure of non-food items and Y, is the total income in Taka respectively. The results of the estimated regression equation are as follows:

$$CNF = 369 + 0.20Y + 0.0000029Y^{2}$$
  
(1.24) (6.70)<sup>\*</sup> (5.20)<sup>\*</sup>  
 $\overline{R}^{2} = 0.91$ 

 $<sup>{}^{1}\</sup>Delta = \sqrt{\frac{\Pi T}{2(T-1)}}$  is Fisher's correction factor to convert the sample MADs to an estimate of the population standard deviation and II is the mathematical constant whose value is approximately 22/7 (Hasell and Scandisso).

<sup>&</sup>lt;sup>2</sup>The data used for the estimation are taken from the tapes of the Household Expenditure Survey of Bangladesh 1981-92, the results of which are summarised in Bangladesh Bureau of Statistics (1986b). For this study, only data from rural areas of the Central region were used in the estimation.

#### \*Significant at 1 per cent level

The figures in parentheses are estimated 't' values. It can be observed that the consumption of non-food items increases with income at an increasing rate. The function was incorporated in the LP matrix by approximating the fitted quadratic by three linear segments which relate to the lower, middle, and higher income groups of farm households. These are stated in the following equations:

$$CNF = \theta_1 \sum_{t=1}^{4} NY_t$$
 for  $\sum_{t=1}^{4} NY_t \le UY1$ 

$$CNF = \theta_1(UY1) + \theta_2(\sum_{t=1}^4 NY_t - UY1) \quad for \ UY1 < \sum_{t=1}^4 NY_t \le UY2$$

$$CNF = \theta_1(UY1) + \theta_2(\sum_{t=1}^4 UY2 - UY1) + \theta_3(\sum_{t=1}^4 NY_t - UY2) \text{ for } \sum_{t=1}^4 NY_t > UY2$$

where

 $NY_t$  = Net income flow in period t.

 $\theta_1$  = Marginal propensity to consume non-food items for lower income group with less than or equal to Taka 7,800 which was set at 24 per cent.

 $\theta_2$  = Marginal propensity to consume non-food items for middle income group between Taka 7,801-Taka 14,400 which was set at 28 per cent.

 $\theta_3$  = Marginal propensity to consume non-food items for higher income group with more than or equal to Taka 14,401 which was set at 34 per cent.

UY1 =Upper bound income for lower income group (Taka 7,800).

UY2 =Upper bound income for middle income group (Taka 14,400).

#### 6 Non-farm Income

It is by now widely recognized that a significant proportion of rural households in most LDCs generate additional income by allocating their labour to non-farm and other 'ncome generating activities (Anderson and Leiserson; Shand; Mukhopadhyay and Lim). Some of the previous studies used non-farm income as an exogenous variable (Rosegrant and Hard; Singh and Ahan). Consequently, these models fail to capture the substitution of the family labour to non-farm activities as well as potential leakage of short-term loans into non-farm activities. In particular, the inclusion of non-farm activities introduces a range of additional decisions with respect to borrowing and the allocation of household labour. Empirical evidence from Bangladesh (Hossain; Rahman and Hossain) indicates that the main rural non-farm activities particularly among small farm households are crop trading, industrial goods trading, peddling, shopkeeping and cottage industries. Most of these activities also require working capital. For simplicity as well as for exposition, we have taken 'trading' as a generic non-farm activity in the model. Farm households decision on labour allocation between farm and trading activity are endogenously determined. 1

## 7 Sources of Data and the Study Area

The data on fixed resources available on the farm were obtained from a sample survey conducted during the months of August 1983 through January, 1984. The survey was conducted by the Bangladesh Bank (Central Bank) in order to evaluate the performance of the Special Agricultural Credit Programme (SACP) launched in 1977. The statistical investigation was based on multi-stage random sampling. Altogether 680 farm households were surveyed from four geographical regions (division) of the country. However, the present study is based on the data relating to 96 farm households. The area covered comprises four administrative districts - Dhaka, Mymensingh, Jamalpur, and Tangail in the Central region, called Dhaka Division. This region appears to have similar cropping pattern, physiography, and climate. In addition to the fixed resources available on the farm, the application of LP requires an accurate estimate of input-output coefficients and prices of inputs and outputs. These information was not available from the survey. Considering the limitations of the survey data, for this study the input-output coefficients were estimated in terms of typical or representative farms in the Central region of the country. These data were obtained from a number of farm management studies conducted in the Central region as well as from the Bangladesh Bureau of Statistics. The input-output coefficients for the trading activity were obtained from a study by Hossain. The gross margins series of each crop is obtained as the product of historical prices and yields. These series have been deflated by the consumer price index

of rural people of the Central region published by the Bureau in order to express those in 1982-83 prices.

To incorporate risk-averse behaviour in the model, it is necessary to have estimates of  $\psi = \Delta \phi$ . The risk-aversion coefficients ( $\phi$ ) were obtained from a study by Shahabuddin, Mestelman and Feeny.

#### 8 The Effect of Risk Aversion

In order to investigate the effects of risk on resource allocation decisions, the MOTAD model of the 'Multi-activity' farm households has been solved for different values of risk-aversion coefficients ( $\psi$ ). Solutions are obtained for nine size categories of farm households.<sup>3</sup> The crop hectarages for each solution are then aggregated over all farms in a group which it represents, and these results are aggregated for the region as a whole. Table 1 shows the effect of different  $\psi$  values on the optimal land use pattern at the aggregate level.

In risk neutral ( $\psi = 0$ ) situations, the area of transplanted *aman* rice in the summer season is unrealistically high while in the case of *aus* rice and broadcast *aman* rice the area is unrealistically low. When allowance is made for risk-aversion it can be seen that farm plans are responsive to different  $\psi$  values, a feature reflected in the diversification from transplanted *aman* rice into *aus* and broadcast *aman* rice as  $\psi$  increases. Similarly in the case of winter crops, the area of *boro* rice (HYV) and potato (HY<sup>V</sup>) are closer to the base year level with  $\psi = 1$ . On the other hand,  $\psi$  values exert no effect on the optimal hectarages of wheat (HYV), oilseeds, and pulses.

The last column in Table 1 contains the base-year (1983-84) hectarages under different crops in the Central region. By comparing the model solutions for different  $\psi$  values with the base-year quantities, we have a basis for selecting the 'best fit' value of  $\psi$ . The association tests used is the <u>d-statistic</u>, which is a nonparametric "goodness-of-fit" test for measuring the distance between two points (Romero and Rehman). The test statistic is:

<sup>&</sup>lt;sup>3</sup>The Bangladesh Census of Agriculture 1982-83 (Bangladesh Bureau Statistics, 1986a) provides information on the number of farm households for ten categories of farm sizes. The small farms (between 0.02 and 1.0 ha) are sub-divided into four groups, medium farms (between 1.01 and 3.0 ha) into two groups and large farms (more than 3.0 ha) into four groups.

Crops		Base yea					
	0.0	0.50	1.0	1.50	2.0	2.5	quantity
Summer			*******	000	hectar	es	******
Aus rice	0	37	250	0	0	0	70
T.Aman rice	1739	1720	999	772	698	224	83
B.Aman rice	47	27	536	1011	1077	1077	31
Jute	0	1	0	0	0	0	14
Winter							
Boro rice (HYV)	346	438	358	336	328	328	36
Boro rice (local)	208	115	193	215	226	226	11-
Wheat (HYV)	174	174	174	174	174	174	7(
Potato (HYV)	18	7	43	<b>49</b>	5 <b>2</b>	36	3
Oilseeds	71	71	71	71	69	67	4
Pulses	89	89	89	89	89	89	4
Tobacco	2	2	2	0	0	0	
d statistic	1197	1164	568	1013	1067	1076	1997 - Sala a sugara sugar

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$$d = \left(\sum_{j=1}^n (x_j^{\cdot} - x_j)^2\right)^{1/2}$$

where  $x_j^*$  are the base-year hectarages and  $x_j$  are predicted from the model. The last row of Table 1 reports the the values of d-statistic. On the basis of the values of d-statistic, the 'best fit' occurs when  $\psi = 1$ . In one district of the Central region, 98 per cent of the sample households have an average  $\psi$  value of -1.00. Hence, the risk-aversion rule ( $\psi = 1$ ) is used 'o explore the effect of credit liberalization policy.

#### 9 Analysis and Results

#### 9.1 Interest Rates and the Viability of Small Farms

Under the existing institutional system, the per hectare norms of credit for different crops and the maximum amount of credit to a borrower for crop production only are fixed by the Government. The rate of interest has been fixed by the Government at 16 per cent (nominal) per annum for institutional loans since 1983. In view of double-digit inflation prevailing in the country, the base interest rate for institutional loans used in this study is a real rate, set at 6 per cent per annum (nominal 16 per cent).<sup>4</sup> There are also limits on borrowing from informal sources. For informal loans, the interest rate was set at 60 per cent per annum (nominal 70 per cent). In order to investigate the effect of credit liberalization, two experiments are conducted. First, farm households are allowed to borrow the restricted amount from both institutional and informal sources for any purpose at a 6 per cent and 60 per cent real rate of interest (base rate). Second, farm households are allowed to borrow unlimited amount from institutional sources for any purpose at the deregulate, rate of interest. Optimal solutions were obtained for different farm sizes by parametric variation of land area (as the measure of farm size) according to the procedure outlined in section 3. Thirtyseven basis changes were obtained for farm sizes up to 10 hectares when farm households were allowed to borrow the restricted amount from both institutional and informal sources. Similarly, Thirty basis changes were obtained when farm households were allowed to borrow unlimited amount

<sup>&</sup>lt;sup>4</sup>The real rate r = ((1 + i/1 + P)) - 1, where i is the nominal rate, and P the change in price level

from institutional sources. However for simplicity as well as to reduce computational burden seven selected basis changes (farm plans) are considered here for analysis. The cut-off points for viable farm households are 0.39 hectares and 0.26 hectares in the case of restricted and unlimited borrowing. In the case of unlimited borrowing, farms with less then 0.26 hectares are non-viable in the sense that they cannot generate z cash surplus after meeting their minimum food and non-food consumption requirements. There are about 0.64 million farm households with less than 0.26 hectares and they constitute 39 per cent of small farms and 29 per cent of all farms in the Central region. The results are hardly surprising. In Bangladesh about 57 per cent of rural households are moderately poor (under-nourished) and a further 38 per cent are extremely poor (Osmani).

In order to investigate the effect of interest rates on the income of farm households, the real rate of interest was varied manually from 3 to 30 per cent.<sup>4</sup> Considering the interest rate structure of the informal credit market, it is assumed that a 30 per cent upper limit is likely to equate the supply and demand for funds in Bangladesh when the institutional credit market is deregulated. The effect of interest rates on the income of different categories of farm households<sup>6</sup> is presented in Table 2. To reiterate, the objective function for farm households is the maximization of utility. For farm households with 0.26 hectares, when the interest rate is between 3 and 6 per cent, they cannot generate a cash surplus after meeting their minimum food and non-food consumption requirements. For interest rates above 6 per cent there are no feasible solutions. For farm households with 0.33 hectares (the average size of small-farm is 0.37 hectare in Bangladesh) when the interest rate is increased from 3 to 15 per cent, the net household income falls to zero. Although the farm households with 0.33 hectares that any slight falls in yield due to exogenous factors such as floods, drought "tc., would make them non-viable. Farm households with between 0.50 and 0.80 hectares are viable but unlimited

<sup>&</sup>lt;sup>5</sup>It was not possible to investigate the impact of higher interest rates on the optimal organization of farm households by varying the interest rate parametrically. The problem is that the borrowing coefficients appear both in the objective function as well as in the cash-flow rows, but a parametric variation of the interest rate in the objective function will have no effect on the cash-flow rows.

<sup>&</sup>lt;sup>6</sup>The Bangladesh Censur of Agriculture defined small farms as having an operated area between 0.02 and 1.0 hectares, medium farm between 1.01 and 3.0 hectares and large farms above 3 hectares

Interest	Farm size (ha)									
rates (%)	0.26	0.33	0.50	0.80	1.50	2.50	3.50			
	an a				********	*****	nde Theorem and the second second			
	Unregulated Credit Market									
3	10	364	1,162	2,527	,5607	9,740	13,787			
60	0	221	1,069	2,477	5,560	9,695	13,771			
10	infe	63	1,032	2,412	5,498	D,938	13,752			
15	infe	0	906	2,567	5,960	9,884	13,729			
20	infe	infe	777	2,504	5,913	10,179	13,705			
25	infe	infe	841	2,475	5,282	9,485	13,682			
30	infe	infe	742	2,466	5,282	9,483	13,677			
			Regula	ited Cred	lit Mar	ket				
6@	infe	infe	1,007	2,659	5,476	9,670	13.677			

Table 2: Impact of Interest Rates on the Income of the 'Multi-activity' Farm Households for the Credit Market Regulated and Unregulated

Note: @ = Base rate; infe = Infeasible

borrowing above 6 per cent leads to a reduction in their income. If we assume that after deregulation of finance market the equilibrium rate of interest would be in the range of 6 to 30 per cent, the results suggest that farm households with less than 1 hectares (small Farms) are worse off when the credit market is deregulated while farm households with more than 1 hectares (medium and large farms) are better off.

#### 9.2 Aggregate Demand for Institutional Credit

From a policy viewpoint, aggregate demand for credit of farm households at the deregulated rate of interest is very important. However, lack of information on the number of farms at

Alexandra de Maria de Caral de	1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 -	All					
Interest	0.26	0.41	0.61	1.01	2.01	3.01	Farms
rate(%)	to	lo	to	to	to	to	
	0.40	0.60	1.0	2.0	3.0	4.0	
		*******	M	illion '	Taka	*******	***
3	1,174	947	620	598	172	19	3,530
6	1,183	955	624	598	172	19	3,531
10	746	737	593	598	172	18	2,864
15	524	750	525	309	142	18	2,358
18	441	758	525	399	97	18	2,238
20	383	764	288	192	97	18	1,742
25	220	696	229	0	30	18	1,193
30	80	585	2	0	0	0	667
		***	*******	Millio	15	****	
No. of							
farms	0.29	0.31	0.38	0.39	0.12	0.04	1.53

Table 3: 'Multi-activity' Households' Aggregate Demand for Credit under Risk in the Central Region

each basis change made it impossible to estimate the demand for credit of farm households through linear interpolation. The Bangladesh Census of Agriculture (Bangladesh Bureau of Statistics, 1986a) provided information on the number of farm households for ten categories of farm sizes. Since there is no borrowing in solutions for farm households with more than 4 hectares, we have taken six categories of farm households in our analysis up to 4.0 hectares. Aggregate demand for credit is then obtained by multiplying the level of credit indicated in the optimal solution for each mean farm size (see Table 2) by the number of farms in the class interval. The estimated aggregate demand for credit of different categories of farm households and the aggregate for the Central region are presented in Table 3. For farm households with between 0.26 and 0.40 hectares the demand for credit declines by 93 per cent from Taka 1,774 million to Taka 80 million. This happens because the number of viable farm households with between 0.26 and 0.40 hectares declines by 90 per cent from 0.29 million to 0.03 million when the interest rate is increased from 3 to 30 per cent. In other words, farm households with 0.37 hectares and less are non-viable when the interest rate is increased from 3 to 30 per cent. Another interesting feature to be noted is that for the farm households with between 0.61 and 4.0 hectares (a section of small, and medium and large farms in rural Bangladesh) the demand for credit falls to zero when the rate of interest is increased beyond 25 per cent per annum.<sup>7</sup> The last column of Table 3 shows the aggregate demand for credit of all farm households in the Central region. The results indicate that when the rate of interest is increased from 3 to 30 per cent, the aggregate demand for credit declines by 81 per cent from Taka 3,530 million to Taka 667 million.

It may be noted that the concept of elasticity is valid only in the case of continuous functions. The demand schedules derived from the LP models are discontinuous or stepped functions. The discontinuities in demand schedules occur whenever there is a change in the basis of the LP as the interest rate is varied. Following Batterham and Majid, it is assumed that the mid-points of the vertical segments of the steps are most stable with respect to interest rate change. These points are, therefore, taken as 'observations' for estimating the following regression equation:

#### B = g + hi

where B is the optimal amount of borrowing, and i is the rate of interest. The estimated values of demand elasticities which are obtained by fitting seven straight line demand functions are presented in Table 4. For farm households with between 0.26 and 0.40 hectares, the demand for credit is inelastic for interest rates up to 10 per cent (nominal 20 per cent) per

<sup>&</sup>lt;sup>7</sup>It may be noted that there is some insignificant positive variation in the optimal borrowing for the farm households with between 0.26 and 1.0 hectares when the rate of interest is increased from 3 per cent to 6 per cent. The explanation is that these households (i.e., the small farms) can generate a surplus cash in the second and third quarters which they can lend at an interest rate of 2 per cent per annum (12 per cent in nominal terms). As the rate of interest rises, the cost of borrowing in the first quarter also increases. The increased cost of borrowing affects their surplus cash in the second and third quarters and consequently they end up borrowing slightly more in the fourth quarter in order to maintain the production, consumption and working capital requirements for undertaking non-farm activities.

	and the second second second	All					
Interest	0.26	0.41	0.61	1.01	2.01	3.01	Farms
r te(%)	to	to	to	to	to	to	
	0.40	0.60	1.0	2.0	3.0	4.0	
	••		Po	int Elas	ticitie	5	*****
3	0.11	0.05	0.10	0.12	0.11	0.06	0.09
6	0.26	0.12	0.23	0.29	0.25	0.13	0.22
10	0.54	0.22	0.46	0.62	0.50	0.24	0.43
15	1.10	0.37	0.89	1.35	1.01	0.41	0.83
18	1.69	0.48	1.31	2.22	1.53	0.54	1.18
20	2.32	0.57	1.71	3.27	2.04	0.65	1.52
25	6.92	0.83	3.74	22.65	5.24	0.97	3.03
30	9.21	1.20	17.9	inf	inf	1.44	9.21
Slope(b)	-41.1	-18.3	-24.5	-29.0	-7.2	-0.45	-118.0
Constant(a)	1173	1005	776	757	214	23	3914

Table 4: Elasticities of the Demand for Credit under Risk in the Central Region

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annum. Interestingly, for the farm households with between 0.41 and 0.61 hectares (a section of small farms) and between 3.01 and 4.0 hectares (large farms), the demand for credit is inelastic in the range of interest rates from 3 to 25 per cent. The overall results suggest that the demand elasticities increase for all the categories of farm households when the interest rate is increased from 3 to 30 per cent. However, the magnitude differs across farm sizes. For policy interest, the last column of Table 4 shows the elasticities of aggregate demand for credit in the Central region. For interest rates from 3 to 15 per cent the demand for credit is inelastic. The results suggest that depending on the flow of additional funds to the agricultural sector after deregulation of the finance market, the equilibrium rate of interest would be in the range of 6 to 30 per cent in real terms. The results are interesting but we need further information about the demand parameters for the non-agricultural sector and the supply parameters for aggregate supply of funds from institutional sources in order to estimate the free market equilibrium rate of interest and hence the welfare gain and losses for both agricultural and non-agricultural borrowers.

However, it may be mentioned that the existing results are based on the assumption that farm households, particularly the small farm households, should be allowed to borrow for production, consumption and undertaking non-farm activities. Without such provision the farm households with less than 0.75 hectares (results are not shown here) which constitute the vast majority (63 per cent) are nonviable. The question is whether in a liberalized market the lending institutions will enhance distributional justice or not. In other words, in a liberalized market will the lending institutions finance a non-viable farm? The fact is that financial institutions are not using only the interest rate to allocate credit i.e., giving loans to those borrowers willing to pay the highest interest rate. It is generally accepted that banks take into consideration a number of variables when evaluating the creditworthiness of a borrower. Most important characteristics are commonly referred to as five C's of credit: capacity, capital, collateral, character, and conditions (Gustafson). The credit rationing and information-theoretic literature holds the view that bank-farm differences in the perception of uncertainty with regard to productive return, asymmetric information, moral hazard and adverse selection problems associated with financing, particularly the small farry households may not induce the lending institutions to supply credit even if they are willing to pay higher interest rates (Stiglitz and Weiss; Virmani; Carter). In particular, if the small farm households fail to provide assets acceptable as collateral to banks, credit market may not exist for them. Empirical evidence from Bangladesh also supports this view. In order to provide credit to the small and marginal farm households under the Special Agricultural Credit Programme the Government adopted a much simplified loan procedure. In particular, no collateral securities are insisted upon for getting loans under the programme. Despite such mersures only 3.5 per cent of farm households with less than 0.5 hectares were able to obtain a loan under the programme (Bangladesh Bank, 1985).

#### **10** Conclusions and Limitations

In this study we have used the 'Multi-activity' farm household model to examine some of the controversial policy issues of rural finance in LDCs. We have attempted to model the way in which farm households behave in earning family income from different sources and in allocating family labour and other resources to farm, non-farm and other income generating activities in Bangladesh. We have modelled farm households as risk-averse in their decision making. The results of the analysis reveal that unlimited borrowing at the deregulated rate of interest from institutional sources leads to a reduction in the income of small farm households. Depending on the supply parameters for aggregate supply of funds from institutional sources and the demand parameters for the non-agricultural sector after deregulation, it appears that the equilibrium rate of interest would be in the range of 6 to 30 per cent in real terms. This implies that after deregulation of the finance market the small farm households are worse off while the medium and large farm households are better off. The major assets of small-farm households are family labour. If the small households cannot provide assets acceptable as collateral to banks, they are unlikely to be able to access the institutional credit market. While subject to further empirical confirmation, it appears that the liberalization of financial institutions may not achieve distributional justice or equity objective under the existing agrarian structure of rural Bangladesh.

A number of shortcomings of this study deserve mention. First, in modelling farm households a major problem encountered was the vailability of input-output data relating to nonfarm activities usually required in linear programming analysis. Consequently, for simplicity as well as for exposition we have taken 'trading' as the non-farm activity for all farm households. In reality, several types of non-farm activities are undertaken by different categories of farm households. A particular shortcoming was the lack of MAD estimates for non-farm activities. In this study they were treated as riskless. Second, in Bangladesh natural calamities such as floods and droughts often destroy the capital stocks and current plantings of farm households. This type of unexpected event may occur several times during a life-time. Farmers are likely to increase their demand for short and medium-term credit. The influence of stochastic events is recognized to the extent that we use the average or expected values to specify the crop production vectors. Third, one of the most controversial policy issues in rural finance is the determination of the equilibrium rate of interest. The demand for credit has been analysed in our study by focussing, rather narrowly, on the agricultural borrowers only. However, in a free market, the equilibrium rate of interest is determined by the interaction of demand for credit of both agricultural and non-agricultural sectors with the aggregate supply of loanable funds. What is needed, therefore, is a macro approach in order to determine the equilibrium rate of interest for rural credit. In spite of these limitations, the study has quantified the likely impact of the relaxation of rural credit regulations on farm households of different sizes. It is hoped they will be of interest to policy makers involved in rural finance, and will lead to further research.

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#### REFERENCES

- Adams, D.W. "Physical Examinations for Rural Financial Markets in Low Income Countries", Savings and Development, 7(1983):303-317.
- Anderson, D. and M.W. Leiserson. "Rural Non-Farm Employment in Developing Countries", Economic Development and Cultural Change, 28(1980):227-248.
- Bandyopadhyay, A.K. Economics of Agricultural Credit: With Special Reference to Small Farmers in West Bengal, New Delhi: Agricole Publishing Academy, 1984.

Bangladesh Bank. Annual Report 1983-84, Dhaka, Bangladesh.

- Bangladesh Bank. An Evaluation of the Special Agricultural Credit Programme: A Production Oriented Programme Among the Farm Population in Bangladesh, Department of Research and Agricultural Credit Department, Dhaka, Bangladesh, 1985.
- Bangladesh Bureau of Statistics. The Bangladesh Census of Agriculture and Livestock: 1983-84, Ministry of Planning, Government of Bangladesh, 1986a.
- Bangladesh Bureau of Statistics. Report of the Bangladesh Household Expenditure Survey 1981-82, Ministry of Planning, Government of Bangladesh, 1986b.
- Batterham, R.L. and A.A. Majid. "The Demand for Seasonal Rural Credit Under Conditions of Risk: A Case Study in Bangladesh", Savings and Development, 11(1987):291-304.
- Baumol, W.J. "An Expected Gain-Confidence Limit Criterion for Portfolio Selection", Management Science, 10(1963):174-182.
- Becker, G.H. "A Theory of Allocation of Time", Economic Journal, 75(1965):493-517.

- Buckwell, A.E. and P.B.R. Hazell. "Implications of Aggregation Bias for the Construction of Static and Dynamic Linear Programming Supply Models", Journal of Agricultural Economics, 23(1972):119-134.
- Carter, M.R. "Equilibrium Credit Rationing of Small Farm Agriculture", Journal of Development Economics, 28(1988):83-103.
- David, C.C. and R.L. Meyer. "Measuring the Farm Level Impact of Agricultural Loans", in J. Howell (ed), Borrowers and Lenders: Rural Financial Markets and Institutions in Developing Countries, London: Overseas Development Institute, 1980.
- Day, R.H. "On Aggregating Linear Programming Models of Production", Journal of Farm Economics, 45(1963):797-813.
- Dillon, J.L. and J.R. Anderson. "Allocative Efficiency in Traditional Agriculture and Risk", American Journal of Agricultural Economics, 53(1971):26-32.
- Fernando, N.A. "The Interest Rate Structure and Factors Affecting Interest Rate Determination in the Informal Rural Credit Market in Sri Lanka", Savings and Development, 12(1988): 249-266.
- Gonzalez-Vega, C. "Credit-rationing Behavior of Agricultural Lenders: The Iron Law of Interest-Rate Restrictions", in D.W. Adams, D.H. Graham, and J.D. Von Pischke (eds), Undermining Rural Development With Cheap Credit, Boulder: Westview Press, 1984.
- Gustafson, C.R. "Credit Evaluation: Monitoring the Financial Health of Agriculture", American Journal of Agricultural Economics, 71(1989):1145-1151.
- Hazell, P.B.R. "A Linear Alternative to Quadratic and Semivariance Programming for Farm Planning Under Uncertainty", American Journal of Agricultural Economics, 53(1971):53-62.

Hazell, P.B.R. and P.L. Scandizzo. "Risk in Market Equilibrium Models for Agriculture" in R.D. Norton and M.L Solis (eds), The Book of CHAC: Programming Studies for Mexican Agriculture. Baltimore: Johns Hopkins University Press, 1983. 1

ġ.

- Hossain, M. Credit for the Rural Poor: The Experience of Grameen Bank in Bangladesh, Bangladesh Institute of Development studies, Dhaka, 1984.
- Kennedy, J.O.S. "Using Regression Analysis to Reduce Aggregation Bias in Linear Programming Supply Models", Australian Journal of Agricultural Economics, 19(1975):1-11.
- Ladman, J.R. and R.L. Tinnermeier. "The Political Economy of Agricultural Credit: The Case of Bolivia", American Journal of Agricultural Economics, 63(1981):66-72.
- Lee, J.E. "Exact Aggregation A Discussion of Miller's Theorem", Agricultural Economics Research, 18(1966):58-61.
- McKinnon, R.I. Money and Capital in Economic Development, Washington D.C.: Brooking Institution, 1973.
- Miller, T.A. "Sufficient Conditions for Exact Aggregation in Linear Programming Models", Agricultural Economics Research, 18(1966):52-57.
- Mukhopadhayay, S and C.P. Lim (eds). Development and Diversification of Rural Industries in Asia, Kuala Lumpur: Asian and Pacific Development Centre.
- Nakajima, C. Subjective Equilibrium Theory of the Farm Household, Amsterdam: Elsevier, 1986.
- Naseem, M. "Credit Availability and the Growth of Small Farms in the Fakistan Punjab", Food Research Institute Studies, 14(1975):65-80.

- Osmani, S.R. Food Deprivation and Undernutrition in Rural Bangladesh, Working Paper No. 82, World Institute for Development Economics Research, Helsinki, 1990.
- Rahman, A. and S.M Hossain. "Demand Constraints and the Future Viability of Grameen Bank Credit Programme - An Econometric Study of the Expenditure Pattern of Rural Households", Bangladesh development Studics, 16(1988):1-20.
- Rashid, M.H. Informal Credit and Interest Rates in an Underdeveloped Rural Community: A Case Study of Bangladesh, Unpublished Ph.D. Thesis, Boston University, 1983.
- Romero, C. and Rehman, T. Multiple Criteria Analysis for Agricultural Decisions, Amsterdam: Elsevier, 1989.
- Rosegrant, M.W. and R.W. Herdt. "Simulating the Impacts of Credit Policy and Fertilizer Subsidy on Central Luzon Rice Farms", American Journal of Agricultural Economics, 63(1981):655-665.
- Ruttan, V.W. "Assistance to Expand Agricultural Production", World Development, 14(1986):39-63.
- Saleem, S.T. "On the Determination of Interest Rates in Rural Credit Markets: A Case Study of Sudan", Cambridge Journal of Economics, 11(1987):165-172.
- Shahabuddin, Q., S. Mestelman, and D. Feeny. "Peasant Behaviour Towards Risk and Socio-Economic and Structural Characteristics of Farm Households in Bangladesh", Oxford Economic Papers, 38(1986):122-130.
- Shand, R.T. "Off-Farm Employment in the Development of Rural Asia: Issues", in R.T. Shand (ed), Off-Farm Employment in the Development of Rural Asia, Vol. I, Canberra: National Centre for Development Studies, Australian National University, 1986.

- Sharples, J.A. "The Representative Farm Approach to Estimation of Supply Response", American Journal of Agricultural Economics, 51(1969):353-361.
- Shaw, E.S. Financial Deepening in Economic Development. New York: Oxford University Press, 1973.
- Sheehy, S.J. and McAlexander, R.H. "Selection of Representative Benchn ark Farms for Supply Estimation", *Journal of Farm Economics*, 47(1965):681-695.
- Singh, I. and C.Y. Ahn. "A Dynamic Multi-Commodity Model of the Agricultural Sector: A Regional Application in Brazil", European Economic Review, 11(1978):155-179.
- Singh, I. L. Squire, and J. Strauss (eds). Agricultural Household Models: Extension, Applications, and Policy, Baltimore: Johns Hopkins University Press, 1986.
- Stiglizz, J.E. and A. Weiss. "Credit Rationing in Markets with Imperfect Information", American Economic Review. 71(1981):393-410.
- Strauss, J. "The Theory of Comparative Statics of Agricultural Household Models: A General Approach", in I. Singh, L. Squire and J. Strauss (eds), Agricultural Household Models: Extension, Applications, and Policy, Baltimore: Johns Hopkins University Press, 1986.
- Thorner, D., Kerblay, B. and Smith, R.E.F. (eds). A.V. Chayanov on the Theory of Peasant Economy, Madison: University of Wisconsin Press, 1986.
- Virmani, A. The Nature of Credit Markets in Developing Countries: A Framework for Folicy Analysis, World Bank Staff Working Papers, No. 524, 1982.
- Vogel, R.C. "Subsidized Interest Eates and the Rationing of Agricultural Credit in Developing Countries", in Problems and Issues of Agricultural Credit and Rural Finance, Agricultural Credit Department, Bangladesh Bank, Dacca, 1979.

Von Pischke, J.D. and D.W. Adams. "Yangibility and Design and Evaluation of Agricultural Credit Projects", American Journal of Agricultural Economics, 62(1980):719-726.

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- Wiens, T.B. "Peasant Risk-Aversion and Allocative Behaviour: A Quadratic Programming Experiment." American Journal of Agricultural Economics, 55(1976):629-635.
- Wolgin, J.M. "Resource Allocation and Risk: A Case Study of Smallholder Agriculture in Kenya", American Journal of Agricultural Economics, 57(1975):622-630.