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ESTIMATION OF DEMAND FOR CREDIT ON MARGINAL FARMS—A PROFIT FUNCTION APPROACH

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The unfavourable factor proportions in the form of too much labour and too little capital and a consideration for equity and social justice have called for special attention to be paid to the credit problems of marginal farmers. Augmenting capital on these farms through increased provision of credit at reasonable rates of interest is one of the programmes adopted to improve their productivity and make them economically viable. The knowledge of optimum credit requirements of these farmers for production purposes under varying crop situations and the interest rates that such loans can bear, is important for successful implementation of this programme. This paper presents the results of an analysis using profit function for estimation of demand for crop loans by the marginal farmers. The elasticities of demand for crop loans with respect to interest rate, price of output and prices of input are estimated and their implications for credit policies are examined.

THE DATA

The data used in this study pertain to a sample of 50 marginal farmers from Amroha block of Moradabad district in Western Uttar Pradesh selected through multi-stage random sampling. This area is characterized by a predominance of marginal farms with very high intensity of cropping. The average cultivated area of the sample farmers is about half hectare and invariably they take three crops on their land in a year. The majority of these farmers borrow from moneylenders at very high rates of interest to meet their cultivation expenses. The details on some of the relevant information for the sample farmers are given in Table I. The data relate to the period January 1977 to April 1978. For purposes of analysis, the agricultural year is divided into three seasons based on the sowing and harvesting period of crops, namely, season I (May-August), season II (September-December) and season III (January-April).

TABLE I—CREDIT OPERATIONS OF SAMPLE FARMERS

Item	Season		
	I	II	III
1. Per farm cultivated land (hectare)	0·53	0·45	0·55
2. Annual rate of interest (per cent)	34·74	33·95	32·63
3. Coefficient of variation in interest (per cent)	15·00	17·00	20·00
4. Percentage of borrowers taking loan from ..			
(*i*) Co-operative society	14·00	11·00	5·00
(*ii*) Moneylender	86·00	89·00	95·00
5. Percentage of total farmers taking loan ..	73·00	78·00	45·00

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THEORETICAL FRAMEWORK

All production processes take time before the inputs are converted into outputs. In crop production, this time lag is more than in manufacturing industries. This implies that expenditures on inputs have to be incurred much in advance of the income from resulting outputs. Producers meet these expenditures out of their past savings and whenever these savings fall short of the requirements, they borrow. Hence crop loans are borrowings made to supplement the farmers' own cash savings in order to meet the expenses of growing crop to be repaid in the next period out of the income from these crops. Thus they are purely seasonal or short duration loans. The amount of crop loan required can be taken as the difference between the working capital requirements during a crop season and the available owned funds in the same period. The requirement of working capital depends on the levels of use of variable inputs and their prices. The level of use of any input is determined by its profitability under given conditions of production. Productivity and prices of inputs as well as prices of output determine profitability. Since the income flows of the farmers are seasonal, the owned part of working capital will depend on the net income from the previous crop season. Hence the demand for credit in any one season will depend on the productivity and prices of inputs, prices of output and the net income from crops in the previous season.

To start with, let the crop production function be written as:

(1) $Y=F\ (X, Z)$

where Y is physical output, X and Z are vectors representing the variable inputs $(X_1, X_2, \ldots\ldots X_m)$ and fixed inputs $(Z_1, Z_2, \ldots\ldots Z_n)$ of production, respectively.

The unit-output-price (UOP) profit function[1] corresponding to the production function (1) is:

(2) $\pi' = G\ (q_1, q_2, \ldots\ldots, q_m, Z_1, Z_2, \ldots\ldots Z_n)$

where $\pi' = (P\,Y - \sum_{i=1}^{m} p_i X_i)/P$; $q_i = p_i/P$, P is price of output, p_i is the price of ith variable input, X_i is the quantity of ith variable input, π' is the UOP profit and q_i is normalized price of ith variable input.

The usefulness of UOP profit function arises out of Shephard's Lemma[2] which states that the negative of the first derivative of the UOP profit with respect to the normalized prices is the optimal variable input quantity or the factor demand curve. Instead of having to solve a system of simultaneous equations as in the case of production function approach, one can get the derived demand function for variable inputs simply as the negative of the first derivative of the UOP profit function that is:

1. For a more detailed discussion of these derivations, see Lawrence J. Lau and Pan A. Yotopoulos, "Profit, Supply, and Factor Demand Functions", *American Journal of Agricultural Economics*, Vol. 54, No. 1, February 1972, pp. 11-18.
2. See R. W. Shephard: Cost and Production Functions, Princeton University Press, Princeton, New Jersey, 1953.

$$(3) \qquad -\frac{\partial \pi'}{\partial q_j} = X_j^* \quad (j = 1, 2, \ldots\ldots. m)$$

where X_j^* is the demand for jth variable input.

The Cobb-Douglas Case

Let the agricultural production function (1) be written in Cobb-Douglas form with decreasing returns[3] to the variable input as:

$$(4) \qquad Y = A X^{\alpha} L^{\beta_1} N^{\beta_2} N_b^{\beta_3}$$

where $\alpha < 1$, X is total variable input in rupees per farm (it includes all farm inputs except family human and bullock labour), L is cultivated land in hectares per farm, N_f is family human labour per farm in days, N_b is family bullock labour per farm in days and Y is the production of all crops per farm in quintals.[4]

Following Lau and Yotopoulos, UOP profit function can be written as:

$$(5) \quad \pi' = A^{(1-\alpha)^{-1}} (1-\alpha) \left(\frac{q}{\alpha}\right)^{-\alpha(1-\alpha)^{-1}} L^{\beta_1 (1-\alpha)^{-1}} N_f^{\beta_2 (1-\alpha)^{-1}} N_b^{\beta_3 (1-\alpha)^{-1}}$$

which can be written in natural logarithmic of the variables as:

$$(6) \quad \ln \pi' = \ln A^* + \alpha^* \ln q + \beta_1^* \ln L + \beta_2^* \ln N_f + \beta_3^* \ln N_b$$

$$\text{where } A^* \equiv A^{(1-\alpha)^{-1}} (1-\alpha)\, \alpha^{\alpha(1-\alpha)^{-1}}; \ \alpha^* \equiv -\alpha (1-\alpha)^{-1} < 0$$

$$\beta_1^* \equiv \beta_1 (1-\alpha)^{-1}; \ \beta_2^* \equiv \beta_2 (1-\alpha)^{-1}; \ \beta_3^* \equiv \beta_3 (1-\alpha)^{-1}$$

$$\pi' = \pi/P; \ \pi = PY - pX, \ q = p/P, \ p = \left(1 + \frac{i.t}{1200}\right), \ \pi'$$

is the UOP profit, π is variable profit (or returns to land and family labour), p is the price of a unit of variable input cost, which is equivalent to the unit of variable cost plus its interest. Since the unit of variable cost is a rupee and

3. Decreasing returns in the variable input are necessary to insure the existence of a unique, optimal solution to the profit-maximizing problem since constant or increasing returns in the variable inputs are inconsistent with profit maximization.

4. The production of all the crops in jth farm is worked out as follows:

$$Y_j = \sum_{i=1}^{K} P_{ij} Y_{ij} / P_j$$

$$\text{where} \quad P_j = \sum_{i=1}^{K} r_i P_{ij} / \sum_{i=1}^{K} r_i \ ; \quad r_i = \sum_{j=1}^{N} Y_{ij} \Big/ \sum_{j=1}^{N} \sum_{i=1}^{K} Y_{ij},$$

K is number of crops, N is the number of farms, Y_{ij} and P_{ij} are the production and price of ith crop and in jth farm respectively, r_i is the share of ith crop in total production of all crops in the sample households, P_j is the price of all crops for jth farmer and Y_j is the production of all crops for jth farmer.

its interest is (i.t)/1200. Therefore, p=(1+i.t/1200) where i is annual rate of interest in per cent and t is length of the crop in months.

The total variable input demand function (3) on the given quantities of cultivable land and supply of family labour may be written as:

$$(7) \qquad -\frac{qX^*}{\pi'} = \alpha^*$$

where X* is the demand for variable input (X).

The own capital available to the farmers for the purchase of variable inputs depends on profit received by the farmer in the past season. Therefore, the own capital (X^o) used for variable input may be estimated with the help of following model:

$$(8) \qquad \ln X^o = a + b \ln \pi_*$$

where X^o is own variable input in rupees and π_* is the profit in the previous crop season. Using (7) and (8), the estimates of demand for credit is obtained with the help of the following identity:

$$(9) \qquad X^{*B} = X^* - X^o$$

where X^{*B} is the demand for credit.

Substituting (6), (7) and (8) into (9) we obtain the credit demand function (10):

$$(10) \qquad X^{*B} = \ln A' + (\alpha^* - 1) \ln q + \beta_1^* \ln L + \beta_2^* \ln N_f + \beta_3^* \ln N_b - \ln a - b \ln \pi_*$$

since q = p/P, the equation (10) can be written as:

$$(11) \quad X^{*B} = \ln A' + (\alpha^* - 1) \ln p + \beta_1^* \ln L + \beta_2^* \ln N_f + \beta_3^* \ln N_b + (1 - \alpha^*) \ln P - \ln a - b \ln \pi_*$$

where $A' = A^*. \alpha^*$.

This is the credit demand model and will give the estimates of demand for credit in the current period at varying rates of interest for given level of land, family human and bullock labour and prices of agricultural commodities at the current period and profit in the preceding period.

Estimation Procedure

Equations (6), (7) and (8) are the basic ones for estimating the credit demand model (11). Since α^* appears in both the UOP profit function (6) and the variable input function (7), the two equations are estimated jointly by restricted least squares method and the α_s^* in the two equations are constrained to be equal. Equation (8) is estimated by least squares method

RESULTS AND DISCUSSION

Borrowing and Utilization of Credit

The cost of production of crops grown by the sample farmers, the average amounts borrowed for the cultivation of various crops and the profitability of growing different crops seasonwise are given in Table II.

TABLE II—AVERAGE COST OF PRODUCTION, AMOUNT BORROWED AND PROFITABILITY OF CROPS

Season	Major crop	Percentage area of the net cultivated area	Per hectare: Cost C (Rs.)	Per hectare: Purchased inputs (Rs.)	Per hectare: Borrowing (Rs.)	Share of purchased inputs to total purchased inputs (per cent)	Crop share of borrowing in total borrowing (per cent)	Returns-cost ratio
I.	Bitter-gourd	29·43	6,592	3,972	1,986	54	64	1·05
	Maize	25·27	2,817	773	262	9	7	0·66
	Paddy	16·63	3,290	1,251	243	10	4	0·79
	All crops	100·00	4,428	2,163	911	100	100	1·05
II.	Potato	93·42	6,445	3,329	2,367	94	100	1·33
	All crops	100·00	6,282	3,320	2,239	100	100	1·35
III.	Wheat	86·43	2,955	1,312	157	83	71	1·58
	All crops	100·00	3,124	1,365	193	100	100	1·49

The table shows that the amount borrowed is positively related to the expenditure on purchased inputs and the profitability of the crop grown. In all the seasons, the bulk of borrowing has been for meeting the cultivation expenses of the most profitable crop of the season.

Table III gives the distribution of credit utilization among inputs within and between seasons. Seed and fertilizers are the two major items of credit use. The share of borrowed funds in the total borrowings in the season on these two items varies depending on the input requirements of crops.

Demand Estimates for Credit

The estimation results of profit function (6) and variable input demand function (7) using restricted least squares method for each crop season for the year 1977-78 are presented in Table IV. The parameters of own variable input model (8) are estimated by least squares method and are also given in Table IV.

TABLE III—CREDIT UTILIZATION FOR CROP INPUTS SEASONWISE

Input	Season I	Season II	Season III
Seed			
Cost (Rs./ha.)	379	2,575	223
Borrowing (Rs./ha.)	47	1,299	36
Share of borrowing in total borrowing (per cent)	5	59	19
Chemical fertilizers			
Cost (Rs./ha.)	599	839	447
Borrowing (Rs./ha.)	365	557	108
Share of borrowing in total borrowing (per cent)	40	25	56
Farmyard manure			
Cost (Rs./ha.)	650	298	158
Borrowing (Rs./ha.)	348	146	0
Share of borrowing in total borrowing (per cent)	38	7	0
Irrigation			
Cost (Rs./ha.)	258	258	284
Borrowing (Rs./ha.)	66	127	46
Share of borrowing in total borrowing (per cent)	7	6	24
Plant protection measures			
Cost (Rs./ha.)	37	17	3
Borrowing (Rs./ha.)	0	0	0
Share of borrowing in total borrowing (per cent)	0	0	0
Labour			
Cost (Rs./ha.)	1,014	1,060	806
Borrowing (Rs./ha.)	64	96	2
Share of borrowing in total borrowing (per cent)	7	4	1
Machine			
Cost (Rs./ha.)	46	85	212
Borrowing (Rs./ha.)	0	0	0
Share of borrowing in total borrowing (per cent)	0	0	0
Miscellaneous			
Cost (Rs./ha.)	395	—	—
Borrowing (Rs./ha.)	21	—	—
Share of borrowing in total borrowing (per cent)	2	—	—

TABLE IV—JOINT ESTIMATION OF COBB-DOUGLAS PROFIT FUNCTION AND VARIABLE INPUT DEMAND FUNCTION AND ESTIMATES OF OWN VARIABLE INPUT FUNCTION

Function	Parameters	Estimated coefficients: Season I	Season II	Season III
UOP profit funtion				
	In A*	—5·0452	—1·9619	—1·8240
	α^*	—1·6634	—1·5065	—1·2325
		(0·7357)	(0·5485)	(0·2592)
	β_1^*	0·6205	0·7859	1·3792
		(0·2440)	(0·1424)	(0·1694)
	β_2^*	0·2695	0·0536	0·0249
		(0·2009)	(0·1170)	(0·1740)
	β_3^*	0·1715	0·0422	0·0072
		(0·1016)	(0·0690)	(0·0957)
Variable input demand function	α^*	—1·6634	—1·5065	—1·2325
		(0·7357)	(0·7357)	(0·2592)
Own variable input function	In a	4·0460	5·5656	5·3666
	b	0·3193	0·1150	0·0533
		(0·0827)	(0·0259)	(0·0044)

Figures in parentheses are the standard errors of the estimates.

As expected, the profit function is decreasing and convex in price of variable input and increasing in land and family labour. From the estimated parameters of profit function, variable input demand function and own variable input function, the credit demand function (11) can be estimated. The estimated credit demand function is given in Table V for all the three crop seasons.

TABLE V—ESTIMATES OF CREDIT DEMAND FUNCTIONS FOR DIFFERENT SEASONS

Season	Credit demand function
I	$X^{*}_{B} = 0{\cdot}0107\ p^{-2{\cdot}6634}\ L^{0{\cdot}6204}\ N_f^{0{\cdot}2695}\ N_b^{0{\cdot}1715}\ P^{2{\cdot}6634} - 57{\cdot}17\ \pi_*^{0{\cdot}3193}$
II	$X^{*}_{B} = 0{\cdot}2118\ p^{-2{\cdot}5065}\ L^{0{\cdot}7859}\ N_f^{0{\cdot}0536}\ N_b^{0{\cdot}0422}\ P^{2{\cdot}5065} - 261{\cdot}28\ \pi_*^{0{\cdot}1150}$
III	$X^{*}_{B} = 0{\cdot}1989\ p^{-2{\cdot}2325}\ L^{1{\cdot}3792}\ N_f^{0{\cdot}0249}\ N_b^{0{\cdot}0072}\ P^{2{\cdot}2325} - 214{\cdot}15\ \pi_*^{0{\cdot}0533}$

The results indicate that the demand elasticities for credit with respect to input and output prices are highly elastic for all the seasons. The magnitude of elasticity is maximum for the first season and minimum for the third season. The demand for credit is estimated for varying rate of interest at geometric mean levels of land, family human and bullock labour, price of output and previous season's variable profit. The average duration of crop loan as estimated from the survey data is about three months in each crop season. Therefore, the calculations of demand for credit is based on a duration of three months for each season. The results are presented in Table VI.

TABLE VI—ESTIMATED DEMAND FOR CREDIT AND ELASTICITY OF DEMAND FOR CREDIT

Annual rate of interest (per cent)	Season I		Season II		Season III	
	Credit (Rs.)	Elasticity	Credit (Rs.)	Elasticity	Credit (Rs.)	Elasticity
10	1,799		2,926		1,585	
		—0·1300		—0·1090		—0·0973
20	1,650		2,721		1,486	
		—0·2166		—0·1797		—0·1602
30	1,513		2,532		1,393	
		—0·3037		—0·2492		—0·2217
40	1,387		2,358		1,308	
		—0·3920		—0·3176		—0·2821
50	1,271		2,197		1,228	
		—0·4820		—0·4237		—0·3416
60	1,164		2,048		1,154	
		—0·5744		—0·4523		—0·4003
70	1,066		1,911		1,085	

As expected, the demand for credit declines with the increase in the rate of interest. The average elasticity of demand for credit with respect to interest rate indicates that the demand is inelastic. The magnitude of elasticity increases with the increase in the rate of interest. The reason for high optimal credit requirement in season II is the high input expenditure on potato, the major crop grown in this season. The seasonal differences in the optimal credit requirements are positively related to differences in expenditures on purchased inputs.

POLICY IMPLICATIONS

The findings of this study show that the demand for credit by the marginal farmers is inelastic with respect to the rate of interest and highly elastic with respect to prices of both inputs and output. For policy purposes it is important to know the magnitudes of likely changes in the demand for credit for given changes in levels of rate of interest, prices of input and prices of output. Estimates of changes in credit demand for changes in these factors are worked out using the demand function and are given in Table VII.

TABLE VII—ESTIMATES OF CHANGES IN INPUT AND CREDIT DEMAND UNDER DIFFERENT POLICIES

Policy situation	Season I	Season II	Season III
	Percentage increase in variable input level		
1. 10 per cent decrease in price of variable input ..	32·39	30·22	25·66
2. 10 per cent decrease in rate of interest	2·15	1·98	1·06
3. 10 per cent increase in price of output	28·89	26·98	25·62
	Percentage increase in credit demand		
1. 10 per cent decrease in price of variable input ..	45·91	37·30	31·60
2. 10 per cent decrease in rate of interest	3·06	2·45	1·31
3. 10 per cent increase in price of output	40·96	30·30	31·53

Table VII shows that the rate of interest is not likely to affect the quantum of credit demanded significantly as compared to prices. Both input and output prices have tremendous influence on the quantity of inputs used and on credit requirements. Input prices are more important than output prices.

Considering the fact that the existing levels of use of variable inputs are far below the optimal levels in all the seasons,[5] there is scope for absorbing

5. The existing average levels of variable inputs per farm are Rs. 1,360, Rs. 2,086 and Rs. 876 against the optimum levels of Rs. 2,057, Rs. 3,038 and Rs. 1,637 in seasons I, II and III respectively. The corresponding credit demands are Rs. 483, Rs. 1,007 and Rs. 106 at the present levels and Rs. 1,452, Rs. 2,468 and Rs. 1,369 at the optimum levels.

more credit even at the existing high rates of interest paid by these marginal farmers. The fact that these farmers are paying and can pay high rates of interest on loans if they can be made available clearly indicates the constraints on the supply side of credit. Given favourable input and output prices, their demand potential for credit is likely to be very much higher. If these demands are to be met, there is a strong case for strengthening the infrastructure for the supply of credit. Even if this will mean an increase in the supply price of credit from the present levels of lending institutions, still it will be worthwhile for the farmers to borrow. The results of this study clearly indicate that steps to bring down interest rates on loans to the marginal farmers cannot be of much help. What is far more important is increasing the available supply of credit.

NON-FARM BUSINESS OF CULTIVATORS AND INSTITUTIONAL FINANCE

V. A. Avadhani*

The object of this paper is to examine the extent of involvement of cultivators in non-farm activity and the availability of institutional finance for this. Section I offers a brief introduction. In section II, the overall picture of non-farm activity of cultivators is presented, followed by an analysis of non-farm business by category of cultivator households in section III. Section IV sets out the factors influencing non-farm activity and section V examines the availability of institutional finance for non-farm activity. Summary and conclusions are presented in section VI.

I

INTRODUCTION

Non-farm business is defined by the All-India Debt and Investment Survey (AIDIS) as to comprise all economic activities covering manufacturing and repairing services, mining and quarrying, trade, transport, professions and services. The survey data of non-farm business were collected under the following heads: industries, transport, trade, profession and services.[1] Industry includes all manufacturing activities in relation to food-stuff, agricultural produce and others performed either manually or by machines. Repair work by service workshops, eating establishments, tea shops, etc., was also classified as industry. Mining, quarrying, generation of electricity and allied activities are included under this head. Transport is defined as to include all

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1. The data for this paper are drawn heavily from the AIDIS and All-India Rural Debt and Investment Survey (AIRDIS).