

The Demand and Supply of Credit for Households

Bali Swain, Ranjula

Postprint / Postprint

Zeitschriftenartikel / journal article

Zur Verfügung gestellt in Kooperation mit / provided in cooperation with:

www.peerproject.eu

Empfohlene Zitierung / Suggested Citation:

Bali Swain, R. (2008). The Demand and Supply of Credit for Households. *Applied Economics*, 39(21), 2681-2692.
<https://doi.org/10.1080/00036840600749516>

Nutzungsbedingungen:

Dieser Text wird unter dem "PEER Licence Agreement zur Verfügung" gestellt. Nähere Auskünfte zum PEER-Projekt finden Sie hier: <http://www.peerproject.eu> Gewährt wird ein nicht exklusives, nicht übertragbares, persönliches und beschränktes Recht auf Nutzung dieses Dokuments. Dieses Dokument ist ausschließlich für den persönlichen, nicht-kommerziellen Gebrauch bestimmt. Auf sämtlichen Kopien dieses Dokuments müssen alle Urheberrechtshinweise und sonstigen Hinweise auf gesetzlichen Schutz beibehalten werden. Sie dürfen dieses Dokument nicht in irgendeiner Weise abändern, noch dürfen Sie dieses Dokument für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, aufführen, vertreiben oder anderweitig nutzen.

Mit der Verwendung dieses Dokuments erkennen Sie die Nutzungsbedingungen an.

gesis
Leibniz-Institut
für Sozialwissenschaften

Terms of use:

This document is made available under the "PEER Licence Agreement". For more information regarding the PEER-project see: <http://www.peerproject.eu> This document is solely intended for your personal, non-commercial use. All of the copies of this documents must retain all copyright information and other information regarding legal protection. You are not allowed to alter this document in any way, to copy it for public or commercial purposes, to exhibit the document in public, to perform, distribute or otherwise use the document in public.

By using this particular document, you accept the above-stated conditions of use.

Mitglied der

Leibniz-Gemeinschaft



The Demand and Supply of Credit for Households

Journal:	<i>Applied Economics</i>
Manuscript ID:	APE-05-0506
Journal Selection:	Applied Economics
Date Submitted by the Author:	15-Sep-2005
JEL Code:	Q14 - Agricultural Finance < Q1 - Agriculture < Q - Agricultural and Natural Resource Economics, O17 - Formal, Informal Sectors; Shadow Economy, etc. < O1 - Economic Development < O - Economic Development, Technological Change, and Growth, C51 - Model Construction and Estimation < C5 - Econometric Modeling < C - Mathematical and Quantitative Methods, G20 - General < G2 - Financial Institutions and Services < G - Financial Economics
Keywords:	Credit, Demand, Supply, Rural Finance

powered by ScholarOne
Manuscript Central™

THE DEMAND AND SUPPLY OF CREDIT FOR HOUSEHOLDS

Ranjula Bali Swain
Assistant Professor
Department of Economics
Uppsala University
Box 513, 75120
Sweden
Email: Ranjula.Bali@nek.uu.se

Abstract

The demand and supply of credit in the rural credit markets is investigated in this paper using household data from India. The aim is to study the effects of household, farm productive characteristics and the policy variables on the demand and supply of credit. A type 3 Tobit model is estimated which corrects for sample selection and endogeneity bias. In addition, a generalised Double Hurdle model is estimated where the information on the household's access to credit is included to estimate the demand and supply of credit. The results suggest that the size of the operational holdings, net-wealth, dependency ratio, educational level of the household and the wages and output prices are important determinants of the demand and supply of credit for farm households. The Double Hurdle model confirms that the 'size of land owned' plays a crucial role in whether the household has access to a loan or not.

1. Introduction

Financial planning plays a crucial role in agricultural development in the developing economies. This leads to the need for a proper understanding of the working of the rural finance markets and the investigation into the factors affecting the demand for credit. There is a further need to study policy relevant issues like the relationship of ownership of land with the demand and supply of credit and the impact of government policies in other factor markets (for instance minimum wage policies) on the demand for credit. Using household level data from the Puri district, in India, this paper investigates the demand for and supply of credit for investment and consumption.

The quantitative research on the factors influencing rural loan demand is quite limited.¹ Many studies that try to estimate loan demand suffer from bias due to data truncation, resulting from the omission of the non-borrowers (Hesser and Schuh, 1962; Pani, 1966; Long 1968; Ghatak, 1976) and simultaneity bias arising from the endogeneity of interest rate. Moreover, the demand for credit of a household is often calculated from data that reports only a single loan transaction per household with the exception of a few studies (for instance, Nagarajan, Meyer and Hushak, 1995). Such estimates would be misleading in the presence of credit supply constraints and multiple loans. Furthermore, a majority of these studies are based on data that was collected over a decade ago.

This paper accounts for most of these problems. Using recently collected data from Orissa, India, the demand and supply of credit for farm households is estimated using a type 3 Tobit

¹ Desai and Mellor (1993) state that, ' There are only seven studies that examine this issue quantitatively (Pani 1966; Long 1968; Araujo 1967; Paulson 1984; Nyanin 1969; Hesser and Schuh 1962; and Lins 1972). These studies provide 14 cases -- 4 in India, 3 in Kenya, 5 in United States, and 1 each in Brazil and Republic of Korea.' Apart from this they mention about the studies of Iqbal (1982) but do not use it for their analysis.

1
2
3 model, which deals with the problem of sample selectivity bias and the endogeneity of the
4 interest rate and loan size. The estimates show that interest rate, net-wealth, area of
5 operational holdings, primary activity of the head of the household and output price are
6 factors that determine demand for credit. In addition, factors like family size and dependency
7 ratio also influence the household's demand. Loan size, net wealth, operational holdings,
8 distance from the bank and dependency ratio are the factors that are significant in determining
9 the interest rate.
10
11
12
13
14
15
16
17
18
19
20
21

22 The Generalized Double Hurdle Model on the other hand does more than just estimate the
23 demand and supply for credit. It goes a step further by taking the "access to loans" into
24 account while estimating the demand and supply for the households. The econometric model
25 is adapted to include the additional information on the household's access to loan, collected in
26 the data. The empirical results in this paper are especially relevant for the current financial
27 planning as the study uses recently collected data. The results from the Double Hurdle model
28 indicate that the effective lending policies in the rural credit markets of Puri are asset based.
29 Size of land owned is an important determinant of households' access to loans. The interest
30 rate and the wage of the household determine the demand for loans. Net wealth, land quality
31 and education are important determinants on the supply side.
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

The paper is written in five compact parts with the following section reviewing some of the
important features of the data. The theoretical framework is introduced in Section 3. The
following section presents the econometric specification and the estimation issues of the type
3 Tobit and the Double Hurdle model. It also contains a description of the variables and the
identification issues. A discussion on the results of the estimated models and the concluding
remarks are presented in the final section of this paper.

2. Data

The data used for the analysis in this paper is collected by the author in the 'Rural Credit Market Survey of the Puri district in India' for the reference period 1996. The survey has information on 1052 households that were selected by a two stage stratified sample, from 66 villages, spread in the 11 administrative blocks of the Puri district, which is the coastal district of Orissa, in east India. After deleting the households with missing values we are left with information on 989 households. About 500 of these 989 households did not take any loan. Of the 489 households that borrowed, 430 had only single loans whereas 59 households took two loans during the reference period.

The majority of households are farm households, as 78% of the sample households, own land. 39% of the total sample households are marginal farmers whereas 21% are small farmers². The farms still use traditional forms of agriculture, though there is a slow change towards modern technology. Table 1, presents the sample means and standard deviations for some of the selected variables for different household category. Large landowners borrow about three times as much as the small landowners and about five times as much as the landless. On the average they pay a much lower interest rate as compared to the landless and small landowners.

3. Theoretical Framework

3.1 Theoretical Model

The theoretical framework for this paper is based on Iqbal (1981, 1983). The model is modified such that, the rate of interest is endogenously determined as a function of both the

² Marginal farmers own less than 1 hectare while small farmers own between 1 and 2 hectares. This is a standard definition used in government and census reports.

1
2
3 amount of loan and the quality of the borrower. This is in lieu with the semi-commercialised
4 and highly personal atmosphere of the credit markets in developing economies, where the
5 capital markets do not function smoothly.
6
7
8
9

10
11
12 It takes the household as a basic unit of analysis and assumes that the household behaves as a
13 single individual and maximises its utility over a time span of two periods. The utility
14 function is well behaved, monotonic, twice continuously differentiable and strictly concave.
15
16
17 The household maximises its utility subject to the budget and time constraints. The model
18 includes the labour-leisure choice with the consumption in the two periods. The two periods
19 ‘current’ (period 1) and ‘future’ (period 2) capture the borrowing-investment-repayment
20 cycle. The household has a given initial endowment of productive farm assets and socio-
21 economic household characteristics.
22
23
24
25
26
27
28
29
30
31
32
33

34 In the ‘current’ period the household produces some output using its household labour, initial
35 endowment of productive farm assets and fixed farm characteristics. It also earns some
36 income by supplying its labour to the market. The price of output and labour are exogenously
37 given. The household borrows for both production and consumption purposes.³ The loan has
38 to be repaid in the ‘future’ period. In addition, no voluntary default by the household is
39 assumed. Since there are no future periods, after period 2, it is assumed that the productive
40 assets are consumed in the second period and the household does not leave any bequests for
41 the subsequent period.
42
43
44
45
46
47
48
49
50
51
52
53
54

55 If the markets for products and factors were perfect, with exogenous prices and no transaction
56 cost, there would be separability between the consumption and production decisions of the
57
58

59
60

³ Though the formal credit institutions lend primarily for the productive purposes, the informal credit institutions
lend for both the consumption and production purposes.

1
2
3 households. This implies that the household would first solve its production problem and
4
5
6 decide what profit level it should obtain. Given this profit level, the household would solve
7
8 for its consumption and work problem. In the developing countries as also in Puri district, all
9
10 markets do not work perfectly and the households are semi-commercialised. Thus, the
11
12 separability between the production and consumption decisions does not necessarily work.
13
14
15
16

17
18 If the capital markets were functioning smoothly the rate of interest would have been given
19
20 exogenously. However, in the credit markets of Puri, it is not unrealistic to assume that the
21
22 rate of interest is household specific. The model assumes that the interest rate depends not just
23
24 on the amount borrowed but also on the capability of the household to repay the loan and the
25
26 fixed farm and household characteristics. We assume that the rate of interest charged on the
27
28 loan is a function of both the amount of loan and initial endowment of productive farm
29
30 assets.⁴
31
32
33
34
35

36 The formal model is explained in an earlier publication of the author⁵. The model implies an
37
38 implicit demand function for borrowing, given as,
39
40
41
42

$$B^* = B^*(K_1, z^h, z^q, p_1, p_2, p_K, w_1, w_2, r^*) \quad (\text{A})$$

43
44
45
46
47
48 Where B^* is the amount borrowed, K_1 is the initial endowment of productive farm assets, z^h
49
50 are household characteristics, z^q are fixed farm characteristics, p_1 and p_2 is the price of output
51
52 in the period 1 and period 2 respectively. The depreciation function is denoted by p_K , while w_1
53
54 and w_2 represent the market wage rates for period 1 and period 2. Therefore, the amount of
55
56
57
58
59
60

⁴ The interest rate function is subject of the discussion in section 3.2.

⁵ Reference to author's earlier publication removed for the double anonymous peer review process.

credit demanded is a function of both the exogenous variables in the model and the endogenous rate of interest, r^* .

3.2 The Interest Rate Function

The supply side is represented by the interest rate function. The rate of interest is the price of credit and is therefore a function of the cost of lending the loan. Three kinds of costs are taken into consideration; the opportunity cost of funds (r_O), the administrative costs of servicing the loan (r_A) and the risk premium to be charged to the borrower (r_R). Therefore, the rate of interest function may be written as:

$$r^* = f(r_O, r_A, r_R) \quad (B)$$

Where r^* is the total rate of interest charged. The opportunity cost component of the rate of interest is the lender's unit cost in using the funds for lending rather than putting those funds to alternative use. Furthermore, the administrative cost would be the costs involved in 'servicing' the loan. The 'risk of default' on the loan, is reflected by a combination of the individual characteristics of the household and the nature of project for which the loan is taken. In the data, loans are broadly borrowed for two purposes: production and consumption purposes⁶. For obvious reasons, the risk associated with these two types of loans is different. A part of the risk premium component of the interest rate function might also be influenced by the amount borrowed as the risk increases with bigger loan amounts.

The formal institutions like commercial banks, co-operatives and government programmes, give credit mostly for productive purposes. Their operating goal is a combination of profit maximisation and developmental assistance. For instance, profit maximisation is the driving

⁶ Loans taken for investment in land, business or house etc. and for meeting the operating expenses in agriculture are considered productive loans. Consumption loans are loans taken for meeting contingencies, consumption and other needs.

1
2
3 force for a commercial bank, though they do have to meet a certain percentage of borrowing
4 to the rural areas⁷ at administered⁸ interest rates. Loans under the government programmes are
5 heavily subsidised and are lent primarily as development assistance to poor households. A
6 common characteristic for the formal lending institutions is the lack of information on the
7 borrowers that they are lending to.
8
9

10
11
12
13
14
15
16
17
18 Loans from friends and relatives are lent with some social or altruistic benefits in mind. On
19 the other hand traders-merchants, landlords and employers lend to the people that they have
20 interacted with in the labour or goods market. These kinds of loans are generally interlinked
21 with the transaction in the other market and the gains and losses in one, can be adjusted in the
22 other. Professional moneylenders are not much different from the banks in terms of their
23 profit maximisation aims, but they have additional information about their clients due to
24 former interactions, social relations or geographical proximity arising from staying in the
25 same village. This is also true for almost all the informal lending institutions. Therefore, they
26 could be characterised by competition between the lenders with relatively good information
27 about the repayment probabilities. Although, all the three cost components of the interest rate
28 function are active, the risk component will be taken as the one driving the interest rate
29 function.
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49

3.3 Multiple Loans

50
51 Some sample households in the data reported multiple loans. In the presence of supply
52 constraints from a particular lender, the household tries to satisfy its demand from other
53
54

55
56
57 ⁷ The RBI report of 'A Review of the Agricultural Credit System in India', 1990.

58
59 ⁸ The current interest rate regulations are: For loans below Rs. 25,000 the rate of interest charged is 12% and for
60 loans between Rs. 25,000 and 200,000, the interest rate is 13.5%. For loans over Rs. 200,000, the banks are free to fix their own rates. (Information from the RBI).

sources. As a result multiple loans are observed which may be indicative of the households that were loan size rationed by one lender and forced to fulfil their demand by borrowing from another lender. On the other hand households that borrow just one loan satisfy their entire loan demand from one lender. The treatment of multiple loans in this paper is similar to Nagarajan, Meyer and Hushak (1995). The amount borrowed by the household is the sum of all the loans taken by the household in the reference period. For households with more than one loan, the contract with the highest interest rate is chosen as the marginal contract, and is considered the interest rate charged to the household.

4. Econometric Framework

4.1 Estimating Demand and Supply with a Type 3 Tobit

The econometric framework is based on the theoretical model described in the previous section. In order to deal with the problems of sample selectivity bias and the endogeneity of the rate of interest and the size of the loan, the type 3 Tobit model is used to estimate the demand and supply of credit. The model is specified as follows:

$$B^* = X_1\beta_1 + r^*\beta_2 + u_1 \quad (a)$$

$$r^* = X_2\beta_3 + B^*\beta_4 + u_2 \quad (b)$$

$$B = \begin{cases} B^* & \text{if } B^* > 0 \\ 0 & \text{if } B^* \leq 0 \end{cases} \quad (c) \quad (1)$$

$$r = \begin{cases} r^* & \text{if } B^* > 0 \\ 0 & \text{if } B^* \leq 0 \end{cases} \quad (d)$$

Where $\{u_1, u_2\}$ are the i.i.d drawings from a bivariate normal distribution with zero mean, variances σ_1^2 and σ_2^2 , and covariance σ_{12} . B^* is the amount of loan demanded and r^* is the rate of interest related to the loan demand. B and r are the observed loan amount and the

1
2
3 observed interest rate; X_1 is the vector of the exogenous variables affecting the demand for
4
5 loans and X_2 is the vector of exogenous variables affecting the rate of interest.
6
7
8
9

10 The econometric analysis starts by estimating the reduced form of the model by Heckman's
11 two-step procedure and then predicting the endogenous explanatory variables using the
12 estimated reduced form. Finally, the structural form is estimated with *observed endogenous*
13 *explanatory* variables being replaced by the *predicted endogenous explanatory* variables and
14
15 with Heckman's lambda added to each equation. These estimates are consistent but not
16
17 efficient.
18
19
20
21
22
23
24
25
26

27 **4.2 Description of the variables**

28 The theoretical framework suggests that the demand for credit is affected by the interest rate,
29 farm production characteristics, socio-economic characteristics of the households, current and
30 expected output prices and wages. The *dependent variable* is taken as the total amount
31 borrowed by the household in the reference period. In the case of the multiple loan
32 households, the sum of all the loans is used to indicate the amount of loan demanded by the
33 household.
34
35
36
37
38
39
40
41
42
43
44
45

46 Net wealth is the proxy for the initial endowment of the household and is calculated as the total
47 wealth less the standing sum of all the loans that have to be repaid by the household in the
48 reference period. 'Wealth' is calculated as the sum of the value of land¹⁰, house, tractor, water
49
50
51
52
53
54
55
56
57

58 ⁹ Loan size rationing occurs when the loan amount received by the borrower is smaller than the one they
59 demanded.

60 ¹⁰ This is calculated by using the village specific prices on irrigated and unirrigated land. The information on
prices prevailing in the village was collected simultaneously during the survey.

1
2
3 pumps and other farm equipment.¹¹ In addition, the value of livestock, coconut and fruit trees
4
5 and brass utensils was also added.¹² The size of the operational holdings and the proportion of
6
7 irrigated land describe the farm production characteristics. The age of the head of the
8
9 household, family size, dependency ratio and the primary activity of the household head are the
10
11 variables used to describe the household's characteristics. The dummy takes the value one if
12
13 the household's head is engaged in agriculture as a primary activity, and zero otherwise.
14
15 Output prices and wages are important variables suggested by the model. In the absence of data
16
17 on expected output price and wage rate, the future price might be considered as a multiple of
18
19 the current price. The 'average price of paddy'¹³, which was collected in the village level round
20
21 of the survey¹⁴ is used as a proxy for the output price. The data on the 'average daily male
22
23 agricultural wage rate' is used for the wage variable. This would result in interpreting the sum
24
25 of the coefficient of the current wage as the sum of the effects of both current and expected
26
27 wages.
28
29
30
31
32
33
34
35

36 The interest rate function has three components, the opportunity costs of the funds, the
37
38 administrative cost of the loan and the risk premium attached to each loan. Since these are not
39
40 directly observed in the data, suitable proxies are identified and used. The administration cost
41
42 might not be that important in this model because we do not distinguish between different
43
44 lenders here. In addition, it is assumed that the opportunity cost, is the same through Puri for
45
46 different lenders, due to similar and limited opportunity available in the regional economy for
47
48
49
50

51 ¹¹ Financial assets, which were mainly in the form of savings for the surveyed households, were not included due
52 to under-reporting resulting in a lot of missing values.
53

54 ¹² In the pilot study the respondents were also asked to report on the value of gold and jewellery that they have.
55 This question was later dropped, as the respondents were reluctant to answer it and became suspicious of the
56 surveyors. This was considered necessary in order to preserve the quality of the data and the trust between the
57 surveyor and the respondent. This trade off resulted in an under-estimation of the value of assets.
58

59 ¹³ Paddy is the main crop and a majority of the households engaged in agricultural production produce it.
60

¹⁴ While conducting the household survey, questionnaires were filled simultaneously for village level variables,
for each of the sixty-six sample villages

1
2
3 using these funds in alternative ways. Therefore, it is the risk premium component that is
4 driving the interest rate function. The cost components of the interest rate function are proxied
5 by the net-wealth, the amount borrowed, the distance from the bank and co-operative society,
6 the size of operational holdings, household characteristics (like family size, the age of
7 household's head and the dependency ratio) and education¹⁵. The *dependent variable* is the
8 interest rate recorded for the positive borrowings observed in the data. In the presence of
9 multiple loans and heterogeneity in the terms and conditions of the loan contracts, the
10 selection of the 'marginal contract' in this¹⁶ paper is done on the basis of the highest interest
11 rate.
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

27 The 'loan demand' is identified by the proportion of irrigated area, agriculture as the primary
28 activity of the head of household, wages and the price of output. Agricultural activity in Puri
29 is substantially dependent on weather, due to the use of traditional methods of cultivation and
30 lack of proper irrigation facilities in the region. The proportion of irrigated land holding¹⁷ that
31 a household affects its production capacity. However, this detailed information is not
32 available to the lenders. Similarly, if the head of household has agriculture as his primary
33 activity, the household has a higher production capacity given his experience. The output
34 prices and the wages are factors that influence the household's level of demand for credit
35 through the amount of consumption and leisure that it chooses.
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50

51 The supply side is identified by distance from the bank, distance from the cooperative and the
52 number of matriculates (level of education) in the households. Proximity to the formal
53
54
55
56

57 ¹⁵ Education is proxied by the 'number of matriculates' in the household. Matriculates are individuals who have
58 completed at least 10 years of education but need two or more years to complete their senior school.

59 ¹⁶ The interest rate function shows spikes that are present around 13% rate of interest for loans taken from formal
60 institution.

¹⁷ The proportion of the irrigated land is over the total amount of operational holding (includes the amount of
land owned plus (minus) the amount of land leased-in (leased-out).

1
2
3 institutions like banks and co-operatives decreases the administrative and transaction costs for
4
5 the lenders. The number of matriculates indicates the household members with over 10 to 11
6
7 years of formal education. Households that have a high component of human capital
8
9 constitute relatively lower risk.
10
11

12 13 14 15 **4.3 Integrating Access Using a Double Hurdle Model**

16
17 For a loan to be observed as a market outcome, the borrowing household has to pass two
18
19 hurdles. It should have a positive demand for credit and access to it. The household's access
20
21 to the loan and hence its ability to participate in the credit market depends on factors
22
23 determining how credible the borrowing household is in the eyes of the lender. This decision
24
25 is distinct from the 'decision of the household on the amount that it decides to borrow', which
26
27 follows from the utility maximisation exercise of the household. In the Double Hurdle model
28
29 the lender provides credit to only those households that he finds 'creditworthy' as he is
30
31 concerned with maximising his profit and minimising his risk of default. The access to a loan
32
33 is therefore defined as a function of the creditworthiness of the household in the eyes of the
34
35 lender. However, at a given interest rate there may still be credit rationing because the
36
37 adjustment of the interest rate to equate the ex ante supply is not the sense in which the rate is
38
39 endogenous. In estimating the model the information collected in the survey about the
40
41 respondents having access to the loan has been used. Adding an access function to the
42
43 reduced form of 1(a) and 1(b) model becomes
44
45
46
47
48
49
50
51
52

$$\begin{aligned}
 y^* &= \beta' X_y + \varepsilon_y \\
 r^* &= \gamma' X_r + \varepsilon_r \\
 D^* &= \delta' Z + \varepsilon_D
 \end{aligned}
 \tag{2}$$

Where y^* is the latent variable for loan, r^* is the latent interest rate and D^* is the latent access variable which reflects whether the household has access to the loan or not. The random variables ε 's are distributed as:

$$\begin{pmatrix} \varepsilon_y \\ \varepsilon_r \\ \varepsilon_D \end{pmatrix} \sim IN \left(\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}; \begin{pmatrix} \sigma_1^2 & & \\ \rho_{12}\sigma_1\sigma_2 & \sigma_2^2 & \\ \rho_{1D}\sigma_1 & \rho_{2D}\sigma_2 & 1 \end{pmatrix} \right)$$

The standard Cragg (1971) Double Hurdle model uses no information, which identifies those who are rationed from those who have no demand. In our survey there are responses to a question, which contribute useful information. The respondents were asked the question, 'did you try to take a loan in the reference period but did not get it?'¹⁸ The households answering 'yes' constitute nearly 47.4 percent of the sample households. Using this information jointly with the data on the loans actually taken, three subgroups of households are identified and defined by the following events and the corresponding probabilities:

$$\Pr(\text{household demands and has access to credit}) = \Pr[y^* > 0 \text{ and } D^* > 0]$$

$$\Pr(\text{household demands but has no access to credit}) = \Pr[y^* > 0 \text{ and } D^* \leq 0] \quad (3)$$

$$\Pr(\text{household did not ask for a loan}) = \Pr[y^* \leq 0]$$

The households with positive demand and access are empirically identified as the households, who have taken a loan independently of their response to the supplementary survey question (group 1). The group of households with a positive demand and no access to credit consists of

¹⁸ Additional information is needed on: whether the household did not borrow because it expected that it would be turned down. In addition, one should also have information on whether the household was loan size rationed. Nevertheless, in this model we progress with the restricted amount of information available in the data.

those who have answered yes to the survey questions and have not taken any loan (group 2). Finally, the group of households that did not ask for the loan was empirically identified as those households, which took no loans and responded negative to the survey question (group 3). The log likelihood of the model is therefore given by,

$$\begin{aligned} \ln L = & \sum y_1 \ln \left(\frac{1}{\sigma_1 \sigma_2} \phi \left(\frac{y - \beta' X_y}{\sigma_1}, \frac{r - \gamma' X_r}{\sigma_2}, \rho_{12} \right) \right) + \sum y_1 \ln \Phi(\delta' z) \\ & + \sum y_2 \ln \Phi \left(\frac{\beta' X_y}{\sigma_1} \right) \Phi(-\delta' z) + \sum y_3 \ln \Phi \left(-\frac{\beta' X_y}{\sigma_1} \right) \end{aligned} \quad (4)$$

Where ϕ is the normal bivariate pdf, Φ is the cdf and y_1 , y_2 and y_3 are dummy variables taking the value one when an observation belongs to groups 1, 2 or 3 respectively. Following Cragg (1971) to improve identification, ρ_{1D} and ρ_{2D} were assumed to equal zero. The third term of the likelihood expression (equation 4) then becomes the product of the two marginal distributions. Subject to the conventional identifying restrictions there is a corresponding likelihood expression for the structural model. The structural parameters were estimated by maximising this function. A potential weakness of this model is that the implicit assumption that all households with non-zero demand tried to get a loan. Some of those might have responded “no” to the survey question might have anticipated that they would have got no for an answer even if they tried for a loan and thus never attempted to get one.

The factors effecting access of households to credit are the amount of land owned, the non-land wealth of the household, the quality of land, the proportion of irrigated area as a percentage of the operational holding and the number of males working and earning. The credit worthiness of the household depends on the lender’s perception about the household’s capacity to repay. The factors that affect the capability of the household to repay and are

1
2
3 easily observable by the lender are therefore considered to effect access to credit for a
4
5 household.
6
7
8
9

10 Land is the most preferred form of collateral by all lenders. Therefore households with larger
11 land ownership would be expected to have a greater access to credit. Similar relationship is
12 expected for the quality of land and the proportion of irrigated area, as they enhance the
13 productive capacity of the farm. The increase in the number of working or earning male
14 members of the household is perceived as favourable and should increase the accessibility of
15 loan for the household. The non-land wealth of the household would also be expected to
16 increase the chances for the household to get a loan.
17
18
19
20
21
22
23
24
25
26
27
28

29 The access function is identified by the size of land owned, the amount of net non-land wealth
30 and the proportion of the irrigated area. The size of land owned and the amount of net non-
31 land wealth signal the credit worthiness of the household. Whereas the amount of loan
32 demanded and supplied to the household are based on the size of the operational holding. The
33 supply function is identified by the distance from the banks and the education variable. While
34 the demand equation is identified by the wages and the output price. The demand is identified
35 from the supply through the number of male members working or earning in the household.
36 The banks are officially required to evaluate the loan on the basis of the incremental income
37 expected from the project that is financed. Evaluation studies of some banks show that family
38 labour was not included while making these calculations¹⁹ and therefore this variable should
39 not affect the supply to the formal sector.
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58

59 ¹⁹ For instance, refer to UCO Bank (1999), Manager's Handbook, fourth edition.
60

²⁰ 11.26% of the household's lease-in half or less than half of their operational holdings. Whereas 15.32% of the households lease in more than half or all of their operational holdings from others.

5. Results and Concluding Remarks

5.1 Type 3 Tobit Results

The results from the estimation of type 3 Tobit are presented in two tables. Table 2, shows the results from the probit and the reduced form interest rate and loan demand equations. Table 3, gives the results for the structural form of the interest rate and the loan demand equation.

We begin by inspecting the sample selection bias in the data (see Table 3). For the structural form of the interest rate equation the inverse of the Mill's ratio (λ) is significant, thereby indicating the existence of a sample selection bias. The results for the structural form of the loan demand equation however do not show any significant sample selection bias.

Analysing the results from the structural form of the loan demand equation (Table 3), it is observed that the coefficients of interest rate and net wealth are significant. As expected, the demand for loan increases as the rate of interest decreases. Similarly, the increase in the net wealth of the household implies a decrease in the loan demanded, because a household with a higher initial endowment of productive farm assets has the capability to satisfy its needs without borrowing. The amount of loan demanded increases significantly with the size of the operational holding. This is probably due to the increase in the need for working capital for agricultural purposes. The coefficient of the dependency ratio is both positive and significant. As one would expect, a higher ratio of non-earning members to the earning members implies more expenditure and less income. However, it has been difficult to reconcile this with the result that the increase in the family size actually decreases the demand for loans. One possible explanation could be that increased family size might actually reflect increased number of earning members in the family.

1
2
3 The coefficient for the output price is negative and significant, which implies an increase in
4 the income with the increase in the output price, resulting in a decline for the need to borrow.
5
6 The primary activity of the household's head is also significant. The variables proportion of
7 irrigated area, as a percentage of the operational holdings, the age of the household's head and
8 the wage rate are insignificant in the structural form of the loan demand equation.
9
10
11
12
13
14
15
16

17 The estimates of structural form of the interest rate equation (Table 3) show that the amount
18 borrowed and the net wealth, both have negative and significant coefficients. A higher level
19 of net wealth of the household implies both a better capacity to repay the loan and/or ability of
20 the household to offer better collateral for the loan. These imply a lower risk to the lender, a
21 lower risk premium charged to the borrower and hence a lower interest rate. The loan amount
22 has a negative coefficient probably because 60.5% of the loans by value come from the
23 formal sector, which lends bigger average size loans (as compared to the informal sector), at a
24 subsidised interest rate.
25
26
27
28
29
30
31
32
33
34
35
36
37
38

39 The coefficient of the operational holding is positive and significant. This might initially seem
40 surprising but if we investigate the share of the leased-in land to the operational holding for
41 each household, it is observed that 25% of the households do actually lease in land.²¹
42 Similarly, 10% of the households actually lease out their land, whereas 5% of the households
43 lease out more than half or all of the land that they own to others. This implies, that the size of
44 operational holdings reflect a substantial number of households that are engaged in
45 cultivation, but do not own a substantial amount of land that they are cultivating. We may
46 recollect here that land is the most acceptable form of collateral. Therefore, the increase in the
47
48
49
50
51
52
53
54
55
56
57
58

59
60

²¹ 11.26% of the household's lease-in half or less than half of their operational holdings. Whereas 15.32% of the households lease in more than half or all of their operational holdings from others.

1
2
3 interest rate with an increase in the size of the operational holdings is probably due to such
4
5 households that are charged a higher risk premium by the lender.
6
7
8
9

10 The dependency ratio has a positive and significant coefficient. This is expected due to the
11
12 higher number of dependants implying a higher consumption need of the household and a
13
14 lower per capita availability of income. The negative coefficient of the distance of the
15
16 household from the co-operative is also as expected. However, variables like the distance
17
18 from the bank, education, family size, the age of the head of the household are not significant.
19
20
21

22
23
24 The usefulness of these results depends on the model's ability to replicate observed data. A
25
26 Chi-square goodness of fit reveals that the simulated distribution and the observed distribution
27
28 are dissimilar. The type 3 Tobit predicts rather well the loan amount distribution, but less well
29
30 the interest rate distribution (see Figure 1 and 2). It is not able to replicate the spike at around
31
32 13 percent but puts it much close to zero.
33
34
35
36
37
38

39 **5.2 The Double Hurdle Results**

40
41 The amount of land owned is an important factor for accessibility to a loan (see Table 4). This
42
43 confirms the widely held view in literature that ownership of land is an important factor in
44
45 deciding whether a household gets a loan or not. However, the effect of nonland wealth²³ of
46
47 the household is not as expected. One reason for this anomaly could be the treatment of the
48
49 lenders as a homogenous category. As stated before in the paper, the lenders are a diverse mix
50
51
52

53
54 ²² This definition does not completely capture rationing. Additional information is needed on: whether the
55
56 household did not borrow because it expected that it would be turned down. In addition, one should also have
57
58 information on whether the household was loan size rationed. Nevertheless, in this model we progress with the
59
60 restricted amount of information available in the data.

²³ Major components of non-land wealth include farming equipment, houses or buildings, livestock, fruits or coconut trees, brass utensils.

1
2
3 with co-operative societies, development and commercial banks on one hand and professional
4 moneylenders, employers, landowners and friends and relatives on the other. Furthermore,
5 some constituents of the non-land wealth can be very difficult to liquidate for the lender in
6 case of default or by the borrower for repayment of a loan in case of imminent default.²⁴
7
8
9
10
11
12
13
14

15 The factors affecting the access function are the determinants of the credit worthiness of the
16 household. Whereas those determining the supply are the ones affecting the cost of loan. The
17 creditworthiness of the household in the eyes of the lender is not effected by how far or near
18 he stays though it does affect the transaction cost of the borrower or the lender. Land quality
19 and the size of the operational area are factors that affect the productive capacity of the farm
20 and imply an increase in the income generated. Although it seems that these factors affect
21 credit worthiness positively, many formal and some informal lenders make their judgement of
22 the creditworthiness of households primarily on the basis of the amount of land that they own.
23 This is supported by the fact that the quality of land and the proportion of irrigated area are
24 statistically insignificant.
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40

41 The supply side results show that the interest rate is not significantly affected by the amount
42 of loan.²⁵ The net-wealth of the household, the quality of land and education are the factors
43 that significantly affect the interest rate. As expected the net-wealth of the household is
44 inversely related to the interest rate. A richer household implies a lower risk and hence a
45 lower interest rate. Higher quality of land increases the productive capacity of land and its
46
47
48
49
50
51
52
53

54 ²⁴ For example, banks and co-operatives have no use for small houses or huts. It is also difficult to sell these
55 houses as the rural areas have close personal bonding and most of the people in the area know each other. People
56 will generally not buy the house because it might be uncomfortable to live there when you know that the
57 acquaintances that you displace might not have any other place to stay.

58 ²⁵ This is not surprising since the interest rates are administered by the commercial and the development banks.
59 In addition, a large number of loans (more than 17 per cent in the sample) are taken from friends and relatives.
60

1
2
3 expected income. Similarly, a higher education level of the household signifies higher human
4 capital content and increases the ability of the household to generate income. Both education
5 and quality of land are inversely related to the interest rate.
6
7
8
9

10
11
12 The demand side estimates clearly reflect the results of the separation of the 'access' to credit,
13 from the decision of the household on how much to borrow. According to this model the
14 interest rate and the wage rate significantly determine the amount of loan demanded. The
15 signs of these variables are in accordance to theoretical expectations. The increase in wage
16 rate would imply substitution of the household's farm labour by the market labour and would
17 therefore imply a decrease in the household's factor of production and hence a decrease in the
18 amount of credit demanded.
19
20
21
22
23
24
25
26
27
28
29
30

31
32 In order to test the importance of the extension of the Type 3 Tobit model to the Double
33 Hurdle, a check was made to test if the two models are nested. Testing for the nesting of the
34 models will therefore require that the $\delta = \beta / \sigma_1$ in equation 2, which would require that the
35 explanatory variables going into the demand and the access equations are the same. However,
36 this is not possible in our case, since the access equation captures the creditworthiness of the
37 borrower in the eyes of the lender and is very different from the decision of the household to
38 take a loan. The models cannot be tested for nesting and are therefore not the same. There
39 remains a need for further research where a clear distinction is made between the formal and
40 informal lender in the credit market.
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

5.3 Concluding Remarks

The estimations from the type 3 Tobit model.²⁶ and the Double Hurdle model provide a comprehensive view of the demand and supply situation of the credit market. The type 3 Tobit results show that apart from the interest rate the household characteristics like the net wealth owned, family size, dependency ratio and the primary activity of the household's head were important determinants of demand. In addition, the price of output and the area of operational holdings were also significant determinants on the demand side. Furthermore, in the Tobit model net wealth, loan size, operational holding and the dependency ratio were important determinants of the interest rate function. The Double Hurdle model, uses the additional data information on access to confirm the continuing importance of the role played by the amount of land owned, in determining whether the borrower gets the loan or not. If this is true then the landless, the agricultural labourers and the marginal and small farmers may continue to face difficulty to get a loan because of the lack of access to credit. It is precisely this group that the government wants to target, with its subsidised credit programs through the formal institutions. The futility of the current lending policies (for instance, provision of cheap credit) in benefiting the disadvantaged rural households has been well recorded in literature not just for India but also for other countries in Asia, Africa and Latin America. Recognising that the lending approach, especially by the formal lending institutions is not suitable to the needs of the rural poor, some steps have been taken by the National Bank for Agriculture and Rural Development (NABARD). This involves the promotion of Self Help Groups (SHGs), which is a type of group lending schemes. However, this is only one step in this direction and lending in the rural credit markets need to be made more accessible to the landless and poor households.

²⁶ The diagnostics of the Double Hurdle model does not necessarily reveal better results than the type 3 Tobit model, which is probably a result of the rather strong assumptions of the model.

Tables

Table 1. Sample mean and standard deviations of some variables¹.

Variables & units	All households	Large land-owners ²⁷	Small land-owners	Landless	Borrowers
Amount borrowed in ref. period per household (Rs.)	3,496 (12,802)	9,596 (35,018)	3,440 (10,686)	1,914 (3,680)	6,663 (17,074)
Interest rate (%)	22.2 (19.0)	15.0 (11.6)	22.6 (19.0)	23.0 (21.3)	22.2 (19.0)
Value of security (Rs.)	6,396 (22,276)	19,023 (56,376)	6,997 (19,729)	743 (3,088)	12,189 (29,593)
wage rate (Rs. per day)*	31 (8)	33 (11)	31 (8)	32 (7)	30 (7)
distance from nearest main road (Kms.)*	3.0 (3.5)	4.3 (4.6)	3.1 (3.4)	2.7 (3)	3.1 (3.6)
distance from bank (Kms.)*	5.6 (6.6)	9.0 (10.0)	5.4 (6.3)	5.0 (6.4)	5.3 (6.4)
distance from credit-co-op society (Kms.)*	4.0 (5.0)	7.0 (9.0)	3.7 (4.6)	3.5 (4.7)	3.4 (4)
household's net wealth (Rs.)	137,261 (156,067)	487,423 (227,681)	144,605 (116,909)	11,484 (25,072)	128,528 (150,915)
household's non farm income (Rs.)	8,521 (16,471)	17,418 (20,720)	9,195 (16,746)	3,704 (12,256)	6,909 (13,909)
household's size	8.0 (4.5)	13.4 (6.7)	8.0 (4.3)	6.5 (3.3)	8.2 (4.9)
Age of household's head (yrs.)	47 (13)	49 (13)	48 (13)	46 (13.4)	48 (13)
Land owned (hectares per household)	1.0 (1.0)	4.2 (1.3)	1.1 (0.7)	0.0	1.0 (1.2)
household's working members	5.0 (3.3)	8.4 (5.3)	5.0 (3.1)	3.8 (2.1)	5.0 (3.5)
proportion of irrigated land as a % of gross operational holding	0.3 (0.5)	0.4 (0.5)	0.4 (0.6)	0.2 ² (0.3)	0.4 (0.6)

¹ Standard deviations are in the parenthesis. Figures for the following variables; village bank, fertiliser, seed and pesticide shop and Notified area council have a few missing values.

² Some landless households might have leased in land and a part of their operational holding might consist of irrigated land.

* Village level data was collected for these variables.

²⁷ Households owning more than 3 hectares of land are defined as large landowners.

Table 2. The Borrowing decision (Probit) and the reduced form rate of interest and loan demand equations.²⁸

	Borrowing decision (Probit) ²⁹ 1	Reduced form Interest rate equation ³⁰ 2	Reduced form Loan demand equation ³¹ 3
Constant	.106 (.622)	56.588 ^b (23.269)	-125718.1 ^c (64983.61)
Net wealth (Rupees)	-1.3e-6 ^a (4.08 e-7)	.00001 (.00003)	-.14 ^b (.07)
Distance from co-operative (kms.)	-.065 ^a (.016)	1.722 (1.252)	-7061.05 ^c (3944.7)
Distance from bank (kms)	.028 ^b (.012)	-.817 (.555)	3219.79 ^c (1662.33)
Operational Holding (in hectares)	.014 (.065)	1.218 (1.064)	3788.56 ^b (1660.15)
Proportion of irrigated area as a percentage of the operational holding	.099 (.094)	-4.933 ^b (2.111)	20677.56 ^b (8861.03)
Education (no. of matriculates in the household)	.060 ^b (.029)	-2.910 ^b (1.180)	8224.03 ^b (3626.14)
Family size	.014 (.011)	-.546 ^a (.329)	1264.80 ^c (724.62)
Age of the household's head (yrs.)	.002 (.003)	-0.058 (.083)	388.12 ^c (180.05)
Dependency ratio	.408 (.332)	-1.449 (8.916)	44224.39 ^c (26401.01)
Primary activity of the ³² household's head is agriculture.	.367 ^a (.095)	-13.103 ^c (6.827)	34476.44 ^c (19399.36)
Wages ³³ (Rs.)	-.059 ^a (.011)	2.177 ^c (1.149)	-6775.64 ^c (3872.55)
Output price ³⁴ (Rs. per kg)	.282 ^a (.087)	-10.348 ^c (5.352)	30001.90 ^c (16049.08)
Lambda hat		-49.988 ^c (29.269)	183333.7 ^c (99603.87)
Log likelihood	-618.21		
Chi –square	131.67		
Adjusted R-Square		0.10	0.29
Root Mean Square Error		18.4	16601
Observation	987	487 ³⁵	487

²⁸ The asymptotic standard errors are reported in the parentheses; ^a, ^b and ^c represent the significance level at 1, 5 and 10% respectively.

²⁹ Dependent variable takes value 'one' for borrowers and 'zero' for non-borrowers; the probit is estimated using all the exogenous variables affecting the loan demand and supply.

³⁰ The reduced form interest rate and loan demand equations are estimated by the exogenous variables affecting both the demand for and supply of loans.

³¹ The dependent variable is the aggregate loan size of the household. The estimation is done using the variables that affect the loan demand.

³² The primary activity of the head of household takes value 'one' if the head of the household works as a 'self employed farmer'; it takes value zero otherwise.

³³ These are the Daily Male Agricultural Wages, reported village-wise, in the data.

³⁴ Average price of paddy, reported village wise in the data.

Table 3. Structural form of the rate of interest and loan demand equations, with and without the rate of interest and the loan amount as exogenous variables.³⁶

	Structural form of the loan demand equation 'r' is endogenous ³⁷	Structural form of the interest rate equation 'B' is endogenous ³⁸
Constant	45449.16 ^b (18464.54)	12.22 ^b (6.59)
Interest rate	-2187.739 ^a (770.94)	-
Amount of loan	-	-.0002 ^b (.0001)
Net wealth (Rupees)	-.056 ^b (.027)	-.00004 ^a (7.7 e-6)
Distance from co-operative (kms.)	-	-.610 ^c (.356)
Distance from bank (kms)	-	.205 (.214)
Operational holding (in hectares)	5337.39 ^a (1737.32)	2.21 ^b (.985)
Proportion of irrigated area ³⁹	6572.971 (4909.91)	-
Education (no. of matriculates in the household)	-	-.425 (.530)
Family size	-542.97 ^c (283.532)	-.111 (.218)
Age of the household's head (yrs.)	133.282 (67.46)	.067 (.066)
Dependency ratio	23316.69 ^b (11481.76)	13.22 ^b (5.78)
Primary activity of the household's head is agriculture.	-9881.665 ^b (3994.947)	-
Wages (Rs.)	691.63 (439.79)	-
Output price (Rs. per kg)	-4633.947 ^b (2084.5)	-
Lambda hat	3996.605 (8982.324)	9.82 ^a (3.64)
Adjusted R-Square	0.27	0.10
Root Mean Square Error	16738	18.33

³⁵ There are 500 non-borrowers.³⁶ The asymptotic standard errors are reported in the parentheses; ^a, ^b and ^c represent the significance level at 1, 5 and 10% respectively. The Huber-White standard errors have been used.³⁷ The structural form of the loan demand equation, when the rate of interest is taken as an endogenous variable. The predicted values of the interest rate, \hat{r} , are used in this regression.³⁸ The structural form of the interest rate equation, when the loan amount is an endogenous variable, which is predicted by the reduced form rate of interest equation as \hat{B} .³⁹ The proportion of the irrigated area as a percentage of the operational holding.

Table 4. Estimated Coefficients for the Double Hurdle Model.⁴⁰

Access function		
Intercept	0.8396 ^a (0.1352)	
Size of land owned (in hectares)	0.1219 ^b (0.0727)	
Non land wealth (Rupees)	-0.0252 ^c (0.0156)	
Quality of land	-0.0069 (0.1564)	
Proportion of irrigated area ⁴¹	0.1679 (0.1482)	
No. of male members working or earning in the household	0.0041 (0.0328)	
Structural equation	Structural form of the loan demand equation	Structural form of the interest rate equation
Intercept	1.2953 (1.3921)	0.6336 ^c (0.3351)
interest rate	-1.9230 ^c (1.4241)	-
amount of loan	-	0.0018 (0.2851)
Wages (Rs.)	-0.2373 ^c (0.1778)	-
Output price (Rs. per kg)	-0.0284 (0.1521)	-
No. of male members working or earning in the household	0.0141 (0.0359)	-
Operational holding (in hectares)	0.0225 (0.2141)	0.0343 (0.0756)
Net wealth (Rupees)	-0.2848 (0.3198)	-0.1663 ^b (0.0619)
Land Quality	-0.2034 (0.4508)	-0.2100 ^c (0.1402)
Dependency ratio	0.1856 (1.3902)	0.4669 (0.4678)
Education (no. of matriculates in the household)	-	-0.0638 ^c (0.0467)
Distance from banks (kms.)	-	-0.0027 (0.0047)
Sigma	2.8427 ^b (1.3418)	1.0331 ^a (0.1385)
Rho	0.8744 ^a (0.2756)	
Log L	-8.3995	

⁴⁰ The asymptotic standard errors are reported in the parentheses; ^a, ^b and ^c represent the significance level at 1, 5 and 10% respectively. The Huber-White standard errors have been used. 21 observations were not used because the information was not available to decide whether the household was rationed or not. The above estimation is done using information on 966 households.

⁴¹ The proportion of irrigated area as a percentage of the operational holdings.

References

- Cragg, J. G. (1971) Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods, *Econometrica*, Vol.39, No. 5.
- Desai and Mellor. (1993) *Institutional Finance for Agricultural Development, An Analytical Survey of Critical Issues*, Food Policy Review 1, International Food Policy Research Institute, Washington, D.C.
- Ghatak, S. (1976) *Rural Money Markets in India*, New Delhi: Macmillan of India.
- Hesser, L.F., and G.E. Schuh. (1962) The demand for agricultural mortgage credit, *Journal of farm economics* Vol. 44, No. 5, pp. 1583-1588.
- Iqbal, F. (1983) The Demands for Funds by Agricultural Households: Evidence from Rural India, *Journal of Development Studies*, Vol. 20, No1.
- Iqbal, F. (1986) in *Agricultural household models: application and policy*, editors Singh, Squire and Strauss, World Bank publication, John Hopkins University Press, Baltimore and London.
- Long, M.G. (1968) Why peasant's farmers borrow?, *American Journal of Agricultural Economics*, Vol. 50, No. 4.
- Nagaranjan G., Meyer, R. L. and L.J. Hushak. (1995) *Demand for Agricultural Loans: A theoretical and econometric analysis of the Philippine credit market*, Economics and Sociology Occasional Paper number 2233, Ohio State University.
- Pani, P.K. (1966) Cultivator's demand for credit: A cross section analysis, *International Economic Review*, Vol. 7, No. 2.