

## The Demand and Supply of Credit for Households

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### The Demand and Supply of Credit for Households

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## THE DEMAND AND SUPPLY OF CREDIT FOR HOUSEHOLDS

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### *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.<sup>1</sup> 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

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<sup>1</sup> 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.

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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.  
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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.  
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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 farmers<sup>2</sup>. 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

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<sup>2</sup> 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.

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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.  
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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 The household maximises its utility subject to the budget and time constraints. The model  
17 includes the labour-leisure choice with the consumption in the two periods. The two periods  
18 ‘current’ (period 1) and ‘future’ (period 2) capture the borrowing-investment-repayment  
19 cycle. The household has a given initial endowment of productive farm assets and socio-  
20 economic household characteristics.  
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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.<sup>3</sup> 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.  
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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  
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60 <sup>3</sup> Though the formal credit institutions lend primarily for the productive purposes, the informal credit institutions  
lend for both the consumption and production purposes.

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3 households. This implies that the household would first solve its production problem and  
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6 decide what profit level it should obtain. Given this profit level, the household would solve  
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8 for its consumption and work problem. In the developing countries as also in Puri district, all  
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10 markets do not work perfectly and the households are semi-commercialised. Thus, the  
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12 separability between the production and consumption decisions does not necessarily work.  
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18 If the capital markets were functioning smoothly the rate of interest would have been given  
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20 exogenously. However, in the credit markets of Puri, it is not unrealistic to assume that the  
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22 rate of interest is household specific. The model assumes that the interest rate depends not just  
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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  
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28 loan is a function of both the amount of loan and initial endowment of productive farm  
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30 assets.<sup>4</sup>  
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36 The formal model is explained in an earlier publication of the author<sup>5</sup>. The model implies an  
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38 implicit demand function for borrowing, given as,  
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$$B^* = B^*(K_1, z^h, z^q, p_1, p_2, p_K, w_1, w_2, r^*) \quad (\text{A})$$

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48 Where  $B^*$  is the amount borrowed,  $K_1$  is the initial endowment of productive farm assets,  $z^h$   
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50 are household characteristics,  $z^q$  are fixed farm characteristics,  $p_1$  and  $p_2$  is the price of output  
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52 in the period 1 and period 2 respectively. The depreciation function is denoted by  $p_K$ , while  $w_1$   
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54 and  $w_2$  represent the market wage rates for period 1 and period 2. Therefore, the amount of  
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<sup>4</sup> The interest rate function is subject of the discussion in section 3.2.

<sup>5</sup> 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 purposes<sup>6</sup>. 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

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<sup>6</sup> 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.

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3 force for a commercial bank, though they do have to meet a certain percentage of borrowing  
4 to the rural areas<sup>7</sup> at administered<sup>8</sup> 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.  
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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.  
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### 3.3 Multiple Loans

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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  
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57 <sup>7</sup> The RBI report of 'A Review of the Agricultural Credit System in India', 1990.

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59 <sup>8</sup> 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  $\sigma_1^2$  and  $\sigma_2^2$ , and covariance  $\sigma_{12}$ .  $B^*$  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

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3 observed interest rate;  $X_1$  is the vector of the exogenous variables affecting the demand for  
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5 loans and  $X_2$  is the vector of exogenous variables affecting the rate of interest.  
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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  
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15 with Heckman's lambda added to each equation. These estimates are consistent but not  
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17 efficient.  
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#### 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.  
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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 land<sup>10</sup>, house, tractor, water  
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58 <sup>9</sup> Loan size rationing occurs when the loan amount received by the borrower is smaller than the one they  
59 demanded.

60 <sup>10</sup> 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.

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3 pumps and other farm equipment.<sup>11</sup> In addition, the value of livestock, coconut and fruit trees  
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5 and brass utensils was also added.<sup>12</sup> 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  
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9 household, family size, dependency ratio and the primary activity of the household head are the  
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11 variables used to describe the household's characteristics. The dummy takes the value one if  
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13 the household's head is engaged in agriculture as a primary activity, and zero otherwise.  
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15 Output prices and wages are important variables suggested by the model. In the absence of data  
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17 on expected output price and wage rate, the future price might be considered as a multiple of  
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19 the current price. The 'average price of paddy'<sup>13</sup>, which was collected in the village level round  
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21 of the survey<sup>14</sup> 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  
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25 of the coefficient of the current wage as the sum of the effects of both current and expected  
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27 wages.  
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36 The interest rate function has three components, the opportunity costs of the funds, the  
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38 administrative cost of the loan and the risk premium attached to each loan. Since these are not  
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40 directly observed in the data, suitable proxies are identified and used. The administration cost  
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42 might not be that important in this model because we do not distinguish between different  
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44 lenders here. In addition, it is assumed that the opportunity cost, is the same through Puri for  
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46 different lenders, due to similar and limited opportunity available in the regional economy for  
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51 <sup>11</sup> 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.  
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54 <sup>12</sup> 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 <sup>13</sup> Paddy is the main crop and a majority of the households engaged in agricultural production produce it.  
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<sup>14</sup> While conducting the household survey, questionnaires were filled simultaneously for village level variables,  
for each of the sixty-six sample villages

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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 education<sup>15</sup>. 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 this<sup>16</sup> paper is done on the basis of the highest interest  
11 rate.  
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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 holding<sup>17</sup> 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.  
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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  
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57 <sup>15</sup> 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 <sup>16</sup> The interest rate function shows spikes that are present around 13% rate of interest for loans taken from formal  
60 institution.

<sup>17</sup> 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).

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

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17 For a loan to be observed as a market outcome, the borrowing household has to pass two  
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19 hurdles. It should have a positive demand for credit and access to it. The household's access  
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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  
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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  
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33 is therefore defined as a function of the creditworthiness of the household in the eyes of the  
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35 lender. However, at a given interest rate there may still be credit rationing because the  
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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  
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41 respondents having access to the loan has been used. Adding an access function to the  
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43 reduced form of 1(a) and 1(b) model becomes  
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$$\begin{aligned}
 y^* &= \beta' X_y + \varepsilon_y \\
 r^* &= \gamma' X_r + \varepsilon_r \\
 D^* &= \delta' Z + \varepsilon_D
 \end{aligned}
 \tag{2}$$

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  $\varepsilon$ '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?'<sup>18</sup> 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

<sup>18</sup> 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  $\phi$  is the normal bivariate pdf,  $\Phi$  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,  $\rho_{1D}$  and  $\rho_{2D}$  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

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3 easily observable by the lender are therefore considered to effect access to credit for a  
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5 household.  
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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.  
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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 calculations<sup>19</sup> and therefore this variable should  
39 not affect the supply to the formal sector.  
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59 <sup>19</sup> For instance, refer to UCO Bank (1999), Manager's Handbook, fourth edition.  
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<sup>20</sup> 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 ( $\lambda$ ) 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.

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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.  
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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.  
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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.  
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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.<sup>21</sup>  
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  
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60 <sup>21</sup> 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.

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3 interest rate with an increase in the size of the operational holdings is probably due to such  
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5 households that are charged a higher risk premium by the lender.  
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10 The dependency ratio has a positive and significant coefficient. This is expected due to the  
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12 higher number of dependants implying a higher consumption need of the household and a  
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14 lower per capita availability of income. The negative coefficient of the distance of the  
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16 household from the co-operative is also as expected. However, variables like the distance  
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18 from the bank, education, family size, the age of the head of the household are not significant.  
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24 The usefulness of these results depends on the model's ability to replicate observed data. A  
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26 Chi-square goodness of fit reveals that the simulated distribution and the observed distribution  
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28 are dissimilar. The type 3 Tobit predicts rather well the loan amount distribution, but less well  
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30 the interest rate distribution (see Figure 1 and 2). It is not able to replicate the spike at around  
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32 13 percent but puts it much close to zero.  
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## 39 **5.2 The Double Hurdle Results**

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41 The amount of land owned is an important factor for accessibility to a loan (see Table 4). This  
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43 confirms the widely held view in literature that ownership of land is an important factor in  
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45 deciding whether a household gets a loan or not. However, the effect of nonland wealth<sup>23</sup> of  
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47 the household is not as expected. One reason for this anomaly could be the treatment of the  
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49 lenders as a homogenous category. As stated before in the paper, the lenders are a diverse mix  
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54 <sup>22</sup> This definition does not completely capture rationing. Additional information is needed on: whether the  
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56 household did not borrow because it expected that it would be turned down. In addition, one should also have  
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58 information on whether the household was loan size rationed. Nevertheless, in this model we progress with the  
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60 restricted amount of information available in the data.

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

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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.<sup>24</sup>  
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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.  
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41 The supply side results show that the interest rate is not significantly affected by the amount  
42 of loan.<sup>25</sup> 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  
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54 <sup>24</sup> 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.  
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59 <sup>25</sup> This is not surprising since the interest rates are administered by the commercial and the development banks.  
60 In addition, a large number of loans (more than 17 per cent in the sample) are taken from friends and relatives.

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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.  
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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.  
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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.  
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### 5.3 Concluding Remarks

The estimations from the type 3 Tobit model.<sup>26</sup> 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.

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<sup>26</sup> 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 variables<sup>1</sup>.**

Variables & units	All households	Large land-owners <sup>27</sup>	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 <sup>2</sup> (0.3)	0.4 (0.6)

<sup>1</sup> 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.

<sup>2</sup> 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.

<sup>27</sup> 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.<sup>28</sup>**

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

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

<sup>29</sup> 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.

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

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

<sup>32</sup> 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.

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

<sup>34</sup> 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.<sup>36</sup>**

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

<sup>35</sup> There are 500 non-borrowers.<sup>36</sup> The asymptotic standard errors are reported in the parentheses; <sup>a</sup>, <sup>b</sup> and <sup>c</sup> represent the significance level at 1, 5 and 10% respectively. The Huber-White standard errors have been used.<sup>37</sup> 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.<sup>38</sup> 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  $\hat{B}$ .<sup>39</sup> The proportion of the irrigated area as a percentage of the operational holding.

**Table 4. Estimated Coefficients for the Double Hurdle Model.<sup>40</sup>**

Access function		
Intercept	0.8396 <sup>a</sup> (0.1352)	
Size of land owned (in hectares)	0.1219 <sup>b</sup> (0.0727)	
Non land wealth (Rupees)	-0.0252 <sup>c</sup> (0.0156)	
Quality of land	-0.0069 (0.1564)	
Proportion of irrigated area <sup>41</sup>	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 <sup>c</sup> (0.3351)
interest rate	-1.9230 <sup>c</sup> (1.4241)	-
amount of loan	-	0.0018 (0.2851)
Wages (Rs.)	-0.2373 <sup>c</sup> (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 <sup>b</sup> (0.0619)
Land Quality	-0.2034 (0.4508)	-0.2100 <sup>c</sup> (0.1402)
Dependency ratio	0.1856 (1.3902)	0.4669 (0.4678)
Education (no. of matriculates in the household)	-	-0.0638 <sup>c</sup> (0.0467)
Distance from banks (kms.)	-	-0.0027 (0.0047)
Sigma	2.8427 <sup>b</sup> (1.3418)	1.0331 <sup>a</sup> (0.1385)
Rho	0.8744 <sup>a</sup> (0.2756)	
Log L	-8.3995	

<sup>40</sup> The asymptotic standard errors are reported in the parentheses; <sup>a</sup>, <sup>b</sup> and <sup>c</sup> 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.

<sup>41</sup> The proportion of irrigated area as a percentage of the operational holdings.

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