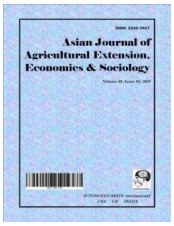

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Determinants of Demand for Formal Agricultural Credit in Rural India

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Authors' contributions

This work was carried out in collaboration between all authors. Author MU designed the study and performed the statistical analysis. Authors MU and RP wrote the protocol and the first draft of the manuscript. Author VK managed the analyses of the study. Author TT managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The present study aimed to analyze the impact of major determinants of participating in formal credit market and amount of credit borrowed at household level in rural India. National Sample Survey Organization's household level data on debt and investment (70th round, 2012-13) was used for analysis. Heckman sample selection model was employed to analyze the functional relationship between amount of credit availed and household level characters. Larger farm size, Kissan Credit Card and bank account holding were the major factors determining the accessibility of more amount of formal agricultural credit in rural regions.

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1. INTRODUCTION

Growth in agriculture sector is attributed to the development of the financial and credit system. Majority of rural farmers are adhere with weak financial stability such as low saving and low investments. Lack of capital formation in agriculture is a major setback to the rural farming to follow modern and sustainable production system. In India, Gross Capital Formation (GCF) as per cent of agricultural GDP was only 20.11% in 2009-10, 18.5% in 2010-11, 20.8% in 2011-12 and 21.3% in 2012-13. Of the total GCF, more than 15% is considered as the private investment. Government investment has been less than 4% in agriculture over the years. In this situation, agricultural activities at farm level are in demand of more capital formation from government through availing credit for investment in irrigation systems, development of storage and processing facilities.

Access to capital is a pre requisite for market-lead agricultural production activities against conventional farming system. To accelerate productivity of crops, sufficient cash are needed; to adopt high yielding varieties and other modern farm inputs such as fertilizers and pesticides; to invest in improved irrigation technologies and land reclamation; to purchase or rent vehicles for easy market access. This can possibly produces profitable farm business, adequate food, much employment opportunities and diversified supply of agricultural raw materials to the other sectors. Credit reduces the risk against weather failure and increase the resource use efficiency to maximize farm output [1]. Thus, capital endowments in farming sector not only nexus growth of agriculture and allied sectors but also develop inter sector activities.

Access to credit by various formal and informal lending institutions in India has been deliberately supported the farming sector to overwhelm scarcity of capital-investment in agricultural sector. Credit is considered as an effective mechanism to enhance production and consumption activity of majority of the households [2,3,4,5,6]. Armendariz and Morduch [4] argued that microfinance institutions can promote rural consumption pattern by bridge the gap between demand and supply of credit. In 1977-78, co-operative bank was the prime lending institution for rural agricultural and allied activities with the supply of credit amount of Rs.10.58 billion followed by commercial banks with Rs.2.88 billion and Regional Rural Banks (RRB) with Rs.0.44 billion in India. Due to branch expansion and effective credit policies, credit supply from commercial banks has been increased to Rs.2178 billion while co-operatives and RRB accounted only Rs.818 and Rs.470 billion in 2011-12.

Although Government has regulated the supply of credit by adopting various credit policies in the nation, still there are some lacunas in availing the formal credit at the farmer or household level in rural areas. It is assumed that household characters may influence the farmers' participation in credit market and amount of credit demand. Some of the literature observed that type of asset, marital status, distance to the market center and location of households, age of farmers, membership of a social group, education, nature of the credit market and owning of lands [7] have positive influence over access to credit. It is noted that repaying capacity of loan by farmers is based on years of farming, credit experience and level of formal education [8]. Therefore, it is necessary to know the level of influence of major determinants on the decision to participate and borrow credit from the formal credit agency for agricultural purposes.

2. DATA AND METHODOLOGY

2.1 DATA

The household data on debt and investment pattern collected by the National Sample Survey Organization (NSSO), Government of India at national level, particularly pertaining to the period 2012-13 were used for this study. These comprehensive National Sample Survey (NSS) data from rural regions of India with a sample size of over 50,000 households has a high acceptance in research and policy. The detailed sampling procedure is given in the reports on Key indicators of debt and investment in India, 2013, released by the planning commission, Government of India.

2.2 MODEL SPECIFICATION: HECKMAN'S SAMPLE SELECTION (MAXIMUM LIKELIHOOD) MODEL

It is a common problem in the survey data that large number of respondents may report non-

participation in accessing credit due to socioeconomic limits confronted by the respondents. In case of such a censored data, the use of ordinary least squares regression analysis yields biased, inconsistency and inefficient regression parameters since limiting the range of the dependent variable leads to a non-zero mean on the error term [9]. While the single equation censored Tobit [10] model has been proposed to deal with such censored data, it should be stressed that the model is unduly restrictive as it implicitly assumes that the independent variables have the same impact on the probability of accessing (participating in credit market) and amount of demand for formal agricultural credit. In our study, Heckman sample selection function was employed to accommodate such kind of zero participation problem encountered in large sized survey data on availing institutional credit for agriculture. Following the notations from [11]. The Heckman sample selection model can be written as follows:

$$\begin{aligned} \log y &= x'\beta + v \quad if \quad z'\alpha + u > 0 \ , \\ y &= 0 \qquad\quad if \quad z'\alpha + u \le 0 \ , \end{aligned} \tag{1}$$

where *y* denotes the dependent variable of the model; *x* and *z* represent the vectors of independent variables which explain the dependent variable; β and α denote conformable vectors of parameters; *u* and *v* are the error terms which are distributed as bivariate normal with zero means and a finite covariance matrix:

$$\begin{bmatrix} u \\ v \end{bmatrix} \sim N\left\{ \begin{matrix} 0 \\ 0 \end{matrix} \right\}, \begin{bmatrix} 1 & \sigma\rho \\ \sigma\rho & \sigma^2 \end{bmatrix} \tag{2}$$

where, σ denotes the standard deviation of *v*, and the correlation between *u* and *v* is represented by ρ. The standard deviation of *u* is not known, thus it is set at unity, given that the selection outcomes are observed as binary, which means that the value is either 1 or 0.The sample likelihood function is:

$$L = \prod_{y=0} [1 - \Phi\ (\ z'\alpha\ )] \prod_{y>0} \Phi \left[\frac{z'\alpha + \rho\ (\log y - x'\beta / \sigma}{(\ 1 - \rho^2\ )^{1/2}} \right] y^{-1}\ \frac{1}{\sigma} \phi \left(\frac{\log\ - x'\beta}{\sigma} \right) \tag{3}$$

where y^{-1} is the Jacobian of the transformation from log *y* to *y*, and ϕ (·) and Φ(·) are the standard normal probability density function (pdf) and cumulative distribution function (cdf), respectively. When the errors are independent ($\rho = 0$), (3) reduces to that of the two-part model, in the case where the log-likelihood function is separable in parameters α and $[\beta\ , \sigma]'$, and therefore estimation can be broken down to a probit model (to estimate α) using the whole sample and a linear regression of log *y* on *x* (to estimate β and σ) using only the non-limit observations.

There is continued interest in the marginal effect calculation in the sample selection model. Based on the procedure given by[11], the conditional mean of the dependent variable *y* is:

$$E\ (\ y \mid y > 0\ ) = \exp(\ x'\beta + \sigma^2\ /2\ )\ \Phi\ (\ z'\alpha + \sigma\rho\ ) / \Phi\ (\ z'\alpha\ ) \tag{4}$$

Since the marginal probability of a positive observation is:

$$\Pr(\ y > 0\ ) = \Phi\ (\ z'\alpha\ ) \tag{5}$$

the unconditional mean of y is:

$$E\ (\ y\ ) = \exp(\ x'\beta + \sigma^2\ /2\ )\ \Phi\ (\ z'\alpha + \sigma\rho\ ) \tag{6}$$

Differentiating Equations (4), (5) and (6) gives the marginal effects on probability, conditional mean and unconditional mean of a common element of *x* and *z* (say $x_j = z_j$):

$$\partial \Pr(\ y>0\ )/\partial x_j\ =\phi\ (\ z'\alpha\ )\ \alpha_j \tag{7}$$

$$\partial E\ (\ y\,|\,y>0\ )/\partial x_j\ =[\ \Phi\ (\ z'\alpha\ )]^{-2}\ \exp(\ x'\beta+\sigma^2\ /2\ )\{[\ \Phi\ (\ z'\alpha\ )\ \phi\ (\ z'\alpha+\sigma\rho\ ) -\phi\ (\ z'\alpha\ )\ \Phi\ (\ z'\alpha+\sigma\rho\ )]\ \alpha_j\ +\Phi\ (\ z'\alpha+\sigma\rho\ )\ \beta_j\ \} \tag{8}$$

$$\partial E\ (\ y\ )/\partial x_j\ =\exp(\ x'\beta+\sigma^2\ /2\ )[\ \phi\ (\ z'\alpha+\sigma\rho\ )\ \alpha_j\ +\Phi\ (\ z'\alpha+\sigma\rho\ )\ \beta_j \tag{9}$$

These marginal effects can be evaluated at data points of interest, such as the sample means of explanatory variables.

2.3 VARIABLES SELECTION

Heckman sample selection (ML) model was estimated for availing credit for various farm operations. Amount of credit availed from the government institution (in rupees) was taken as the dependent variable. Based on the equation (1), the dependent variable refers to the natural logarithm of the amount of credit availed by a household in a year. Independent variables are as follows: household size (in numbers), age and age square of household head (in years), farm size (hectare), education level, gender of household head (1 for man headed households and 0 for woman headed households), having bank account (1 for bank account holders and 0 for others), dummy for Kissan Credit Card holders (1 for card holders and 0 for others), dummy variables for different social groups[1] and dummy variables for different types of households based on occupation. Choosing independent variables is one of the empirical issues in the estimation of Heckman regression model. As in the other sample selection model, we used exclusion conditions to identify the model parameters. Although there is no *a priory* exclusion conditions for the current samples, we excluded the age and age square variables in the credit demand equation which was used in the selection equation. Use of such different sets of variables in the two equations ensures that the model is identified. Stata version 13.0 was used to estimate the log likelihood function of the Heckman sample selection model.

3. RESULTS AND DISCUSSION

In this section, we estimated the functional relationship between the amounts of credit availed from government institutions for agricultural purpose and some major household level characters. For this, we employed Heckman sample selection model because the data set used for the analysis consisted of zero credit demand by many households. The results of ML estimation (Table 1) show that the estimated error correlation coefficient (ρ) between selection and credit demand equations and its corresponding covariance term (λ) are significant. Besides, Likelihood Ratio (LR) test rejected independence of the error terms of the selection and consumption equations. All these suggest the importance of selectivity correction in the present analysis. All the estimated coefficients with respect of both the selection and credit demand equations are found statistically significant, except education in selection equation and sex, Kissan Credit Card holders (KCC), other occupation type, presence of livestock and presence of non-agricultural equipment in credit demand equation.

With the separate equations to accommodate sample selection and level, and with the logarithmic transformation in the dependent variable, the effects of explanatory variables on the probability and the amount of credit demand are non-trivial. Further, as discussed in the methodology section, marginal effects on probability, conditional and unconditional levels (Equations 7, 8 and 9) were worked out to explore the impacts of household characters on the probability of participation in credit market and the amount of credit demand. The conditional marginal effect measures how the credit demand changes due to a specific independent variable for current beneficiaries. The marginal effects of probability measure how those beneficiaries who are at zero credit start borrowing credit due to the influence of independent variables. The effects of unconditional level provide an overall assessment of what contributes for availing credit level by increasing (or decreasing) either the probability or conditional level.

[1]*Social groups refers schedule tribes, schedule caste, other backward class and general category.*

Table 1. Results of maximum likelihoods estimates of Heckman sample selection model

Variables	Participation equation	Credit demand equation
Age	0.015**	-
	(0.003)	
Age square	0.000**	-
	(0.000)	
Farm size	0.171**	0.015**
	(0.005)	(0.003)
Household size	-0.007*	0.000**
	(0.003)	(0.000)
Education	-0.002 ns	0.147**
	(0.002)	(0.005)
Sex	0.316**	0.034 ns
	(0.025)	(0.004)
Bank account holder	0.484**	0.026**
	(0.018)	(0.003)
Scheduled caste	0.250**	-0.013**
	(0.023)	(0.042)
Other backward class	0.309**	0.336**
	(0.019)	(0.036)
General category	0.294**	0.150**
	(0.021)	(0.034)
Kissan Credit Card holder	1.237**	0.366 ns
	(0.019)	(0.029)
Self-employed in non-agriculture	-0.541**	0.469 ns
	(0.029)	(0.031)
Regular wage earners	-0.698**	0.012**
	(0.026)	(0.042)
Casual labor in agriculture	-0.411**	0.018**
	(0.023)	(0.051)
Casual labor in non-agriculture	-0.615**	0.222**
	(0.025)	(0.052)
Earners from other sectors	-0.587**	-0.303 ns
	(0.047)	(0.043)
Presence of Livestock	0.124**	-0.234 ns
	(0.016)	(0.05)
Presence of agricultural machinery and implements	0.430**	0.146**
	(0.017)	(0.092)
Presence of non-agricultural equipment	-0.048*	0.008 ns
	(0.022)	(0.023)
Constant	-2.442**	-0.135**
	(0.082)	(0.033)
Rho (ρ)	-0.252**	
	(0.047)	
Sigma(σ)	1.058**	
	(0.01)	
Lambda (λ)	-0.266**	
	(0.051)	
Wald test of independent of equations (rho=0) chi^2	22.17**	

*Note: Figures in the parentheses are standard errors; ** and * indicate significant at P=0.01 and P=0.05, respectively; ns - non-significant*

The estimated marginal effects on probability, conditional and unconditional levels are presented in Table 2. Most of the estimated marginal effects on probability, conditional and unconditional levels are statistically significant. The probability of participating in credit market by the Indian rural household was positive when there was an increase in age of household head, increased farm size, holder of KCC and bank account, being a male household head, households having livestock and agricultural machineries. For example, one hectare increased in farm size increased the probability of availing credit by 4.40 per cent, *ceteris paribus*. Similarly, the likelihood of availing credit by the KCC holders was higher by 10.67 per cent compared to non-KCC holders. Contrastingly, the probability of availing credit was lower among the households of increased family size, households engaged in occupations other than agriculture and households having non-farm equipment. For example, self-employed in non-agricultural occupations, regular salary wage earners, casual labour in agriculture, casual labour in non-agriculture and other earners are found less likely to avail formal agricultural credit by 0.59, 0.65, 0.51, 0.62 and 0.61 per cent, respectively.

It is also suggested that improvement in the level of most of the household characters increased the demand for more amount of agricultural credit. Specifically, increase in the farm size of the current farmer (conditional) by one hectare increased the demand for formal agricultural credit by Rs.6905.116, while the average farmer (unconditional) is expected to access credit by Rs.2855.306, *ceteris paribus*. Similarly, institutional characters such as having bank account and KCC are expected to have positive impact and more borrowing of agricultural credit. Bank account and KCC holders at a conditional level are expected to access Rs.6822.212 and Rs.4199.446 as formal agricultural credit, respectively, whereas our results show that it was Rs.383.686 and Rs.1751.805 at the unconditional level for respective bank account and KCC holders. When compared to the scheduled tribes, households under scheduled caste, other backward classes and general category are expected to avail credit by Rs.2800.991, Rs.6607.464 and Rs.8535.396 at conditional level and Rs.121.622, Rs.217.678 and Rs.237.522 at unconditional level, respectively. If the households are self-employed, casual labour in agriculture and non-agriculture sector, the amount of credit borrowing

Table 2. Marginal effects of explanatory variables

Variables	Probability (x 100) in %	Conditional level	Unconditional level
Age	0.40**	125.025**	171.268**
	(0.001)	(34.495)	(34.268)
Age square	0.00**	-1.227**	-1.681**
	(0.000)	(0.334)	(0.333)
Farm size	4.40**	6905.116**	2855.306**
	(0.001)	(249.39)	(86.506)
Household size	-0.19*	1213.7**	142.373**
	(0.001)	(132.359)	(37.086)
Education	-0.05 ns	938.99**	143.31**
	(0.001)	(105.212)	(28.457)
Sex	0.95**	781.268 ns	125.911**
	(0.002)	(481.104)	(27.32)
Bank account holder	1.78**	6822.212**	383.686**
	(0.003)	(596.062)	(82.474)
Scheduled caste	0.69**	2800.991**	121.622**
	(0.001)	(476.965)	(28.735)
Other backward class	0.91**	6607.464**	217.678**
	(0.002)	(555.51)	(48.713)
General category	0.86**	8535.396**	237.522**
	(0.002)	(705.73)	(54.566)
Kissan Credit Card holder	10.67**	4199.446**	1751.805**
	(0.015)	(439.674)	(294.796)
Self-employed in non-agriculture	-0.59**	-1296.963*	-71.854**
	(0.001)	(504.403)	(17.807)
Regular wage earners	-0.65**	609.357 ns	-76.457**
	(0.001)	(558.107)	(18.943)
Casual labor in agriculture	-0.51**	-3966.393**	-69.825**
	(0.001)	(432.053)	(17.441)
Casual labor in non-agriculture	-0.62**	-3815.597**	-77.967**
	(0.001)	(450.281)	(19.505)
Earners from other sectors	-0.61**	17.394 ns	-72.395**
	(0.001)	(1045.014)	(18.315)
Presence of Livestock	0.29**	461.526 ns	39.622**
	(0.001)	(273.999)	(10.555)
Presence of agricultural machinery and implements	1.48**	-370.811 ns	168.004**
	(0.003)	(336.086)	(35.145)
Presence of non-agricultural equipment	-0.09*	574.507 ns	-7.344 ns
	(0.000)	(403.288)	(5.95)

*Note: Figures in the parentheses are standard errors; ** and * indicate significant at P=0.01 and P=0.05, respectively; ns - non-significant*

decreased by Rs.1296.963, Rs.3966.393 and Rs.3815.597, respectively at the conditional level, whereas it was less than Rs.70 in each occupation category at the unconditional level.

4. CONCLUSION

It is concluded that, among the different household characters, increase in farm size, having Kissan Credit Card and bank account were identified as the major factors of determining both the probability of participation in formal credit market and accessing more amount of credit for agricultural purpose in rural India. Specifically, Kisan Credit Card scheme may improve the accessibility of credit. Therefore, it is suggested that improvement in institutional characters like KCC and bank account may help to increase the probability of participating and accessing formal agricultural credit. Further, Schedule Caste and Schedule Tribes had less accessibility to the formal credit than the other category households. This can be concluded that SC/ST farmers may not well aware about the formal agricultural credit.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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