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Micro finance credit use and its impact on farm productivity of rural households: the case of Machakel woreda of Amhara region, Ethiopia.

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Abstract

BThe main objective of this paper is to analyze access to microfinance credit and its impact on the farm productivity of rural households in Machakel woreda east Gojjam zone, Ethiopia. Using a cross-sectional data related to the fiscal year 2021/22, standard Tobit model was utilized to analyze the determinants of credit use and endogenous switching regression model was employed to evaluate the impact of credit on farm productivity. The result in the Tobit model shows that the amount of credit is positively and significantly affected by enterprise ownership, bank account, age of the household head, educational status, output per hectare, and the value of house while family size found to affect it negatively and significantly. The result from endogenous switching regression analysis shows that, the treatment is endogenous to the outcome variable. Taking into account this endogeneity problem, the study estimates the treatment effect of credit on farm productivity. The estimated treatment effect result shows that output per-hectare of credit user households is 38.05 percent more than their non-user counterparts. This implies that keeping other things remain constant credit can improve the productivity of households by 38.05percent in the study area. Finally, since credit is crucial for farm productivity, the study recommends the concerned bodies to arrange the way to access formal agricultural credit for rural households.

Keywords: Credit use, Tobit model, Endogenous switching regression, Productivity, Treatment Effect.

Introduction

Agricultural productivity, which is one of the basic elements of economic growth, depends on targeted investments, implementing technological innovations and continuous production with increased efficiency (Terin et al., 2014). Formal agricultural credit is crucial for farmers to purchase farm inputs, such as seeds, fertilizer, pesticides, animal feed and animal health protections etc.(Rehman et al., 2019). Sometimes farmers face a time lag between expenditure on crops cultivation and/or rising of livestock, and realization of revenues from sale of their agricultural products. Access to agricultural credit is particularly important for farmers during this time lag(FAO, 2018).In the absence of formal agricultural credit and personal savings, borrowing from informal sources like moneylenders, relatives and friends may involve unduly high interest rates and unfavorable conditions, which may make many agricultural operations uneconomical(FAO, 2018).

In Africa, roughly two-thirds of the population live in rural areas and are dependent on agriculture for their livelihoods; nearly half live-in extreme poverty, earning less than $1/day; and one-third are undernourished. Therefore, the low performance of agriculture in Africa is critically at the heart of its food insecurity and slow economic growth (MFWA, 2012).

It was reported that, in 2018 the share of agriculture in Ethiopia's gross domestic product was 31.2 percent, industry contributed 27.31 percent and the services sector contributed 36.41 percent (UNDP, 2018). The Agricultural sector generates over 70 percent export values and employs 85% of the total labor force. As the Ethiopian agricultural sector continues to be the main source of livelihood of the people, in the foreseeable future, a strong, productive and efficient agricultural sector has a potential multiplier effect on nation's socio-economic development(World Bank, 2020).

The outstanding credit to the Ethiopian economy reached 618.6 billion birr by the end of 2017 showing 25 percent annual growth from 2016 to 2017 (UNDP, 2018). Most of the credit financed mines, power and water resources (financed mostly by bonds), followed by industry, hotels and tourism, and international trade. Despite in 2018 agriculture constitutes 31.2percent of GDP, generated more than 75 percent of export values, and employed more than 70 percent of the total labor force and the major source of subsistence for most Ethiopian people, Banks' disburse the majority of credit to industry sector, which constitutes around 24.77 percent of the total GDP(World Bank, 2020).

Some studies have been conducted on the effect of credit constraints on farm productivity and the credit repayment perfor-

mance of rural households in Ethiopia. Tilahun (2015),Deininger (2012), and Komicha (2007), investigated the effect of credit constraints on the livelihood of households. Their result revealed that credit constraints have a negative impact on households' livelihood. Wisely before talking about repayment and constraints it is essential to analyze whether credit improves farm productivity or not. Ayelech (2010) and Gizachew (2017) tried to assess the role of micro finance institution in urban poverty alleviation, on smallholder farmers' income, expenditure and asset holding.

However, they fail to assess the impact of credit on farm productivity rather their intension was on urban poverty alleviation, farmer's income, expenditure and asset holding but none of these criteria can measure farm productivity. Moreover, none of these studies did apply the Tobit model and the widely accepted impact assessment methodology (Endogenous Switching Regression Method). Therefore, they are subject to serious problems arising from selection bias and unobserved heterogeneity.

Objectives of the Study

General objective of the study

The main objective of this study is to analyze the usage of formal agricultural credit and its impact on farm productivity of rural households in Machakel woreda.

Specific Objectives of the Study

- To examine factors affecting credit usage in rural area of Machakel woreda.
- To analyze the difference in access and productivity of farm inputs between credit user and non-user rural households in Machakel woreda.
- To evaluate the impact of formal agricultural credit on farm productivity of rural households in Machakel woreda.

Materials and methods

Description of the Study Area

Machakel Woreda is found in East Gojjam Administrative Zone of Amhara National Regional State of Ethiopia. Geographically the Woreda is located at 10º 19‟ 75” to 10º 41‟ 00” N latitude and 37º 16‟ 46” to 37º 45‟ 42” E longitude. Agriculture is the most important economic activity in the woreda. More than 92% of the total population livelihood is directly depends on agricultural activities.

According to the office of Machakel woreda finance (2021), in the woreda there are three formal sources of credit for rural households (ACSI, Harbu microfinance institution, and Cooperatives). From the total population of 20,615 only 7,453 have the access to formal agricultural credit. Most of these households use the credit obtained from these microfinance for agricultural purpose only. According to the office of microfinances, sometimes they deliver a purposive credit.

Sampling techniques, data and methods of analysis

The determination of sample size of this study is based on the formula of Cochran, (1977); which is given by:

$$n = \frac{z^2 pqN}{e^2(N-1) + z^2 pq}$$

$$n = \frac{(1.96)^2 0.5(0.5)20615}{(0.05)^2 20614 + (1.96)^2 0.5(0.5)} = 376$$

A total of 376 respondents were taken as a sample. Using stratified sampling technique households from each sample kebeles were grouped into credit user and non-user (treated and non-treated) groups. Since the list of credit user and non-user sample respondents is obtained, systematic random sampling technique was implemented to select 376 households (151 credit user and 225 credit non-user respondent).

Data Analysis

The econometric analysis of this study employs two regression models. First to analyze the credit usage of households Tobit model was utilized. Second an Endogenous Switching Regression analysis is employed to analyze the impact of access to credit on household's farm productivity.

The Tobit Model

The Tobit model assesses not only the probability of access to credit, but also the intensity or degree of access to credit measured by the total amount of credit obtained by the households for the production season under study in relation to the household's socioeconomic and demographic variables. This study assumes that household decision to borrow is subject to the utility obtained from borrowing and not borrowing. Households are borrowers if the expected utility obtained from borrowing is greater than the expected utility of not borrowing. Household's expected utility of access and non-access to credit can be expressed as follows:

$$U_{ij} = \beta_i Z_j + \tau_{ij} \quad \text{and} \quad EU_{mj} = \beta_m Z_j + \tau_{mj} \ldots\ldots\ldots\ldots\ldots\ldots 3.1$$

Where EU_{ij} and EU_{mj} denotes the expected utility with access and not-access to credit, respectively, and Z represents a set of households socioeconomic and demographic variables.τis a random disturbance and assumed to be independently and identically distributed with mean zero. Then the difference in expected utility may be written as:

$$y_i^* = EU_{ij} - EU_{mj} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.2$$

The Tobit model supposes that there is a latent unobserved variabley_i^*that depends linearly on x_i through a parameter vector β. It can be specified as follows:

$$y_i^* = x_i\beta + u_i \text{with } u_i \,|\, x_i \sim N(0;\sigma^2), \dots\dots\dots\dots\dots\dots 3.3$$

A household will decide to borrow if this difference between the expected utility of borrowing less not borrowing is positive. If the decision to borrow is denoted by I_i:

$$I_i = \begin{cases} y_i^* & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases} \dots\dots\dots\dots\dots\dots\dots\dots\dots. 3.4$$

The conditional expectation of credit use will be given by:

$$E(y \mid y^* > 0, X) = X'\beta + \frac{\sigma\phi\left(\frac{X'\beta}{\sigma}\right)}{\Phi\left(\frac{X'\beta}{\sigma}\right)}$$

Estimation of the Tobit model is usually done through maximum likelihood estimator and the log likelihood function can thus be written as;

$$\ln(\beta, \sigma^2/x_i) = \sum_{y_i>0} -\frac{1}{2}[\log(2\pi) + \ln\sigma^2 + (y_i - x_i\beta)^2/\sigma^2] + \sum_{y_i=0} \ln(1 - \Phi(\frac{x_i\beta}{\sigma}))$$

The above Tobit equations were adopted from Odahet al. (2017) and Awotideet al.(2015), while these authors based their derivation on Greene (2003),Maddala (1983),and Tobin (1958).

Impact Evaluation Methods

This study employed Endogenous Switching Regression to evaluate the impact of credit on farm productivity.

Endogenous Switching Regression (ESR)

this approach considers the existence of the problem of unobserved heterogeneity. Due to potential self-selection bias, credit users and non-users are not directly comparable, which implies an estimation method needs to correct this selection bias to obtain unbiased estimates of the impact of discussion groups.

In this study, 'movestay' command, implements the full information maximum likelihood method (FIML) to simultaneously estimate binary and continuous parts of the model in order to yield consistent standard errors (Lokshin & Sajaia, 2004).

$$y_{1i} = \beta_1 x_{1i} + \varepsilon_{1i} \text{ And} y_{2i} = \beta_2 x_{2i} + \varepsilon_{2i} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(3.9)}$$

Here, y_{1i} is the outcome variable (output per-hectare) of credit user households and y_{2i} is the outcome variable (output per-hectare) of credit non-user households.x_{1i} and x_{2i} are vectors of exogenous variables that affects the output per hectare of credit user and non-user households respectively, andβ_1,andβ_2, are vectors of parameters. Assume that u_i,ε_{1i} and ε_{2i} have a tri-variant normal distribution, with mean vector zero and covariance matrix:

$$\mathbf{\Omega} = \begin{vmatrix} \delta_u^2 & . & . \\ \delta_{21} & \delta_1^2 & . \\ \delta_{31} & . & \delta_2^2 \end{vmatrix}$$

Where,δ_u^2 is a variance of the error term in the selection equation, and δ_1^2 and δ_2^2 are the variances of the error terms in the continuous equations.δ_{21} is a covariance of u_i and ε_{1i} and δ_{31} is a covariance of u_i and ε_{2i}. The covariance between ε_{1i} and ε_{2i} is not defined as y1i and y2i are never observed simultaneously. We can assume that $\delta_u^2 = 1$ (γ is estimable only up to a scalar factor). The model is identified by construction through non-linearity. Based on our argument on the distribution of disturbance terms, the logarithmic likelihood function can be formulated following the procedure by(Lokshin & Sajaia, 2004)

$$\ln L = \sum_{i=1} \left\{ I_i w_i \left[\ln(F(\eta_{1i}) + \ln\left(\frac{f\left(\frac{\varepsilon_{1i}}{\sigma_1}\right)}{\sigma_1}\right) \right] + (1 - I_i) w_i \left[\ln\big(1 - F(\eta_{2i})\big) + \ln\left(\frac{f\left(\frac{\varepsilon_{2i}}{\sigma_2}\right)}{\sigma_2}\right) \right] \right\} \dots \text{(3.10)}$$

Where, F is a cumulative normal distribution function, f is a normal density distribution function, w_iis an optional weight for observation i and

$$\eta_{ji} = \frac{\gamma Z_i + \frac{\rho_j \varepsilon_{ji}}{\sigma_j}}{\sqrt{1 - \rho_j^2}} \quad j = 1, 2 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(3.1)}$$

$\rho_1 = \frac{\sigma_{21}^2}{\sigma_u \sigma_1}$ Is the coefficient of correlation between ε_{1i} and u_i and $\rho_2 = \frac{\sigma_{31}^2}{\sigma_u \sigma_2}$ is the coefficients of correlation between ε_{2i} and u_i.To make sure that estimated ρ_1,ρ_2 are bounded between –1 and 1 and estimated σ_1, $\sigma_2$are always positive, the maximum likelihood directly estimates $\ln\sigma_1$, $\ln\sigma_2$ and atanhρ:

$$\text{atanh}\,\rho_j = \frac{1}{2}\ln\left(\frac{1+\rho_j}{1-\rho_j}\right) \ldots\ldots (3.12)$$

After estimating the model's parameters, the following conditional and unconditional expectations could be calculated:
Unconditional expectations:

$$E\left(y_{1i} \,|x_{1i}\right) = x_{1i}\beta_1 \ldots\ldots (3.13)$$

$$E(y_{2i} \,|x_{2i} = x_{2i}\beta_2 \ldots\ldots (3.14)$$

Conditional expectations:

$$E\left(y_{1i} \,|I_i = 1, x_{1i}\right) = x_{1i}\beta_1 + \sigma_1\rho_1 f(\gamma Z_i)/F(\gamma Z_i) \ldots\ldots (3.15)$$

$$E\left(y_{1i} \,|I_i = 0, x_{1i}\right) = x_{1i}\beta_2 - \sigma_1\rho_1 f(\gamma Z_i)/(1 - F(\gamma Z_i)) \ldots\ldots (3.16)$$

$$E\left(Y_{2i} \,|I_i = 1, x_{2i}\right) = x_{2i}\beta_1 + \sigma_2\rho_2 f(\gamma Z_i)/F(\gamma Z_i) \ldots\ldots (3.17)$$

$$E\left(y_{2i} \,|I_i = 0, x_{2i}\right) = x_{2i}\beta_2 - \sigma_2\rho_2 f(\gamma Z_i)/(1 - F(\gamma Z_i)) \ldots\ldots (3.18)$$

Treatment Effects

In estimating treatment effect two treatment effect measures are most frequently estimated (Average Treatment Effect and Average Treatment on the Treated) in empirical studies. Average treatment effect (ATE) can be specified as follows:

$$ATE = E(y_{1i} \,|\, I_i = 1) - E(y_{2i} \,|\, I_i = 0) \ldots \ldots (3.19)$$

Where,y_{1i} and y_{2i} represent the output per hectare of credit user and non-user households respectively. The most important measure of treatment effect is Average Treatment Effect on the Treated (ATET). It can be specified as follows:

$$ATET = E(y_{1i}|I_i = 1) - E(y_{2i}|I_i = 1) \ldots \ldots (3.20)$$

Average treatment effect on the treated measures the average gain in outcomes of credit users in relative to non-users, as if non-user households were also treated.

Results and discussions

Dummy Variables and Credit use

Credit use may be affected by different socio-economic and demographic factors. Among these socio-economic factors the main determinants include: gender of the household head, enterprise ownership status of the household, risk behavior of the household, and bank account of the household. Table 1 presents the relationship between these dummy variables with the credit access of households in the study area.

Table 1: Descriptive Statistics of Dummy Variables by Credit Use

Variable	Type	Credit non-user		Credit user		Total		Chi^2
		Frequency	%	Frequency	%	frequency	%	
Gender	Female	92	40.7	70	46.7	162	43.1	0.8647
	Male	134	59.3	80	53.3	214	56.9	
	Total	225	100	151	100	376	100	
Enterprise ownership	Not own	127	56.2	75	50	202	53.7	0.573
	Own	99	43.8	75	50	174	46.3	
	Total	225	100	151	100	376	100	
Bank account	No account	204	90	24	16	228	60.6	5.291***

	Has account	22	10	126	84	148	39.4	
	Total	225	100	151	100	376	100	
Risk behavior	Not risk averse	151	67	95	63	246	64.4	1.684
	Risk averse	75	33	55	37	130	36.6	
	Total	225	100	151	100	376	100	
Source: own survey, 2022								

Gender

As it is shown in table 1, sample respondents are comprised of 151 credit user and 225 credit non-user households. 53.3 percent of credit user respondents are male headed households while the remaining 46.7 percent of the credit users are female headed households.

Enterprise ownership

A study by Aliet al., (2012) in Rwanda and Tilahun, (2015) in Ethiopia were using enterprise ownership as one of the determinants of credit use. Their result reveals a contradicting argument about the relationship between credit use and enterprise ownership status of households. As it is indicated in table 4.1, from the total credit user households, about 50 percent of them have their own enterprise. But from their non-user counter parts only 43 percent of the respondents have their own enterprise. This indicates that there is a positive relationship between credit use and enterprise ownership of households. This argument is in support with the study result of Aliet al., (2012) in Rwanda. This positive relationship between access to credit and enterprise ownership maybe due to; first households who have their own enterprise need money to run their business which results in high demand for credit. Second, households with enterprise are considered as productive and have better repayment ability.

Bank Account of Households

The survey result indicates that out of the total 225 credit non-user respondents only 10 percent of them have bank accounts. In contrast out of the total 151 credit users 84 percent of the respondents have bank account. This indicates that there is a positive relationship between credit access and having a bank account. The chi-square test is statistically significant at one percent level of significance. This means bank account significantly and positively affects credit use in the study area. This implies that households with bank account are more likely to use credit than household with no bank account. This result is in support with the finding of Lemessa and Gemechu, (2016). This may be due to the fact that households with bank account are more familiar with saving and borrowing and also they may have awareness about the advantages of borrowing and saving.

Continuous Variables and Access to Credit

A number of demographic and socio-economic variables may affect the access to credit of rural households. Table 2 presents the relationship between access to credit and the socio-economic and demographic factors.

Table 2: Descriptive Statistics of Continuous Variables by Credit Use

Variable	Credit non-user		Credit user		Min	Max	T-test
	Mean	Std. D	Mean	Std. D			
Age	47.5	11.017	50.9	10.430	23	76	t= -2.467**
Family size	5.167212	2.960797	5.471467	2.847086	1.2	15.4	t = -0.99
Livestock	6.2656	3.349	9.001	3.81	0	23.92	t=-7.35***
Education	2.9159	3.0993	3.9533	3.4100	0	10	t=-3.053**
Land size	1.4388	0.602	1.6056	0.6602	0.25	4	t=-2.44**
Value of house	38.6371	16.8169	48.2133	15.1580	10	125	t= -5.62***

Source: own survey 2022

Age of the Household Head

The average age of the household head who are taking credit is approximately 51 years old while the average age of credit non-user households is approximately 48 years old. This indicates that on average the taken sample respondents are still in their productive age. It is evidenced that the age of the household head affects the credit use of households positively. This result is in support with Ali et al., (2012). This indicates that as the age of the household head increase the probability of accessing a credit will also increase. This may be because as households get old they retire from own labor production and they need a credit to employ labor for their farm production.

Family Size

As presented in table 2, the average household size in the study area is 5 members, whereas the average household size of credit user and non-user respondents is 6 and 5 respectively. This means on average the household size of credit user respondents is greater than the household size of non-user respondents.

Livestock ownership

as indicated in table 2, the average number of livestock (TLU)

for credit user and non-user households is 9.0007 and 6.2656 respectively. This indicates that on average the number of livestock of credit user households is greater than that of non-user household. This means households with large number of livestock are more likely to use credit than households with less number of livestock. This result is contradicted with Ali et al., (2012) and in support with Tilahun, (2015). The t-test reveals that livestock ownership is statistically significant at one percent level of significance. This may be because livestock is one of productive inputs of production for farming. Therefore, a complementary capital is needed to work with the available livestock which leads to a high demand for a credit.

Educational Status of Households

literatures (e.g. Reyes et al., (2012) and Tilahun, (2015)) used education as one of the determinants of credit access. The result also shows that the average educational achievement of credit user households is approximately 4 years while the average grade of credit non-user households is approximately 3 years. This indicates that on average households with high educational level are more likely to access credit than those households with low level of education. This result is in support with Reyes et al., (2012) and Tilahun, (2015). This may be because educated households may have better knowledge about the advantages of credit and how to apply for a credit than their non-user counter parts. The t-statistics is statistically significant at five percent level of significance. This implies that there is a significant difference of credit use between households with high level of educational achievement and households with low level of educational achievement.

Land size of Households

The above result shows that the average land size of households is 1.5 hectares, whereas the mean land size of credit user and non-user households is 1.6 and 1.44 hectares respectively. This indicates that there is a difference in credit access between households based on their land size. Households with high land size are more likely to obtain credit than household with low land size in the study area. This result is in support with the results of Lemessa and Gemechu, (2016). It may be due to the fact that as households get the access to a credit their demand to land (rent a land) will increase. This results that households with high access to credit will have better land size than their low access counter parts.

Value of House

The result of the study reveals that the mean value of the house for credit user and non-user respondents is 48.2133 and 38.6371 in thousands of birr respectively. This indicates that there is a difference in credit use between respondents who owns high valued house and low valued house. Households with high valued house are more likely to use credit than those respondents who own low valued house. The t-statistics is significant at 1 percent level of significance. Ali et al., (2012) and Tilahun (2015) founds a negative relationship between the value of house and the access to formal credit. However, the result founded here is in contradicted with their findings. This may be due to the fact that on the lenders side households with high valued house are considered as wealthy households who can repay his/her loan on time. In the borrowers side households with high valued house may need money to construct their house. This need for money will lead to application for a credit and a high credit usage.

Econometrics Analysis

In this part of the study the empirical approach to estimate determinants of access to credit and the impact of credit on farm productivity is presented. To estimate these two equations, two econometric models were estimated. First, to identify the determinants of credit access in the study area a standard Tobit model was employed. Second, by using the binary outcome of access to credit as a selection equation, the impact of credit on farm productivity has been estimated using endogenous switching regression.

Estimation Result of the Tobit Model on Access to Credit of Households

In this study to assess the factors that influence the amount of credit that a household obtains the Tobit model was adopted. STATA 14.0 Software was used to run the maximum likelihood estimates of the Tobit model. The result that obtained from the regression is presented in table 4.5.

Table 3: Estimation Result of the Tobit

Variables	Coefficients	dy/dx	Std. err
Enterprise	.602	.2456**	.1214
Bank account	1.88	.7677***	.1308
Livestock	.0216	.00884	.0156
Age	.0246	.0101*	.0055
Gender	-.4638	-.1892	.1196
Education	.1285	.0524***	.0167
Risk behavior	.0401	.01637	.1199
Land size	.231	.0943	.0910
Family size-	.1065	-.0434*	.0240
Output	.025	.0103**	.0043

Value of house	.0536	.0218***	.0042

Source: own survey 2022

*, **, and *** indicates significant variables at 10 percent, 5 percent, and 1 percent level of significance respectively.

Enterprise ownership

The sign for the coefficient of enterprise ownership (Enterprise) is found to be positive, and significant at five percent level of significance. Keeping other things remain constant, on average the amount of credit obtained by households who own enterprise is 0.246 birr more than the amount of credit obtained by households without enterprise. This result is in support with Ali etal., (2012). This may be because of those enterprise owner households may have high demand for credit to run their enterprise business and lenders may consider enterprise ownership as repayment measure so that lenders will be confidential about repayment.

Bank account

this variable founds to affect the amount of credit obtained by households in the study area positively and significantly at one percent level of significance. Keeping other things remain constant, the amount of credit obtained by households who have bank account is 0.768 birr more than households without bank account. This result is in support with Lemessa and Gemechu, (2016) and Tilahun, (2015). This may be due to the fact that households with bank account have better knowledge about credit than those who have no account.

Age of the household head

he age of the household head is found to affect the amount of credit obtained by households positively and significantly at 10 percent level of significance. Keeping other things remain constant, as the age of the household head increase by one year, then the amount of credit will increase by 0.001 birr. This result is in support with Ali et al., (2014). This may be because as households get old they retire from own labor production and they need a credit to employ labor for their farm production. In the lenders side since old households are considered as wealthy households, it is assumed that older households can repay their credit

Education

the educational level of households head is also one of the significant variables obtained in the study result. This variable founds to affect the access to credit of households positively and significantly at one percent level of significance. Keeping other things remain constant, a one year increment in schooling will increase the amount of credit by 0.0522 birr. This result is in support with Tilahun, (2015). He argued that households with higher level of education have high access to credit than those less educated. This might arise from better investment behavior and the role of higher education to develop the trust of lenders by making them believe that these farmers may have a good financial literacy and level them as credit worthy. In addition this may be because in the borrower's side, educated households may have better knowledge about the advantages of credit and how to apply for a credit than their non-user counter parts.

Family size

the number of members in a household (measured in adult equivalent) was found to affect the amount of credit obtained by households negatively and significantly at five percent level of significance. Keeping other things remain constant, as the number of members in a household (measured in adult equivalent) increase by one unit then the amount of credit will decrease by 0.0434 birr. This result is contradicted with the result of Tilahun, (2015). Since households with large family size have enough labor force for production, they may hire less labor. Therefore, the amount of credit needed to hire labor will reduce in some extent.

Output per-hectare (y)

this variable has a positive and significant effect on the amount of credit at five percent level of significance. Keeping other things remains constant, as the output per-hectare of a household increase by one kilogram then the amount of credit will increase by 0.1045 birr. This result is in support with Reyes et al., (2012). The positive sign is due to the fact that more productive household needs high credit to run their agricultural production and lenders also has a confidence of repayment on more productive households than less productive households.

Value of house

The last explanatory variable included in this study is the value of house. It has a positive and significant effect at one percent level of significance. Keeping other things remain constant, as the value of the household's house increase by one thousands of birr, then the amount of credit will increase by 0.0217birr. This result is contradicted with Ali et al., (2012) and Tilahun (2015). This may be due to the fact that on the lenders side households with high valued house are considered as wealthy households who can repay his/her loan on time. In the borrowers side households with high valued house may need money to construct their house. This need for money will lead to application for a credit and a high access to credit.

The Impact of Credit use on farm Productivity

One of the main objectives of this study is, to assess if there is a considerable impact of access to credit on farm productivity of households and quantify how much is the agricultural productivity difference between credit user households and non-user households. The result for determinants of log of agricultural yield for the two groups of households is presented in table 4.6.

Table 4: Estimation Result of Endogenous Switching Regression Model

Variables	lny0	lny1
Age	-.0059*	-.0030
Gender	-.0469	-.078
Education	.0241**	.0184**
Risk behavior	-.0891	.0067
Slope	-.0963	-.0561
Land Size	.3266***	.211***
Hired Labor	.0489	-.0275
No. of oxen	.1030***	.0244
Experience	.0096***	.0085***
Family Size	.0221**	.0203**
Fertilizer	.0018***	.00166***
_cons	2.296	3.017
/lns1-1.19***		
/lns2-.785***		
/r1-.515**		
/r2.140		
sigma1.3038		
sigma2.455		
rho1-.474		
rho2.139		
LR test of independence:	chi2(1) = 5.71	Prob> chi2 = 0.0168

Source: own survey 2020

*, **, and *** indicates significant variables at ten percent, five percent, and one percent level of significance respectively.

From the correlation coefficients (rho_1 and rho_2) of the error terms of the selection equation and each regime outcome equations, the correlation coefficient between the error terms of the outcome equation of credit non-user households and the selection equation (rho_1) is significant at 5 percent level. This indicates there is a correlation between the error term of the selection equation and the error term of the outcome equation of credit non-user households. In other words unobserved variable that affects the outputs of credit non-user households also affects the selection equation. Since rho_1 is negative and statistically significantly different from zero, the model suggests that households who choose to obtain credit have higher productivity than a random farmer from the sample would have obtained. Those farmers without access to credit are not better or worse than a random farmer.

The likelihood ratio test of independence is significant at 5 percent level of significance. This indicates the violation of conditional independence assumption (CIA). This means there is inter-dependence between the three equations which imply that estimating each equation separately leads to a biased estimator. This further proves the appropriateness of our model (Endogenous Switching Regression).

The endogenous switching regression result indicates that there is a significant difference between credit user and non-user households based on some characteristics. The first (lny0) and the second(lny1) columns in table 4.6 are the coefficient estimates of the second stage switching regression model for the productivity (output per hectare) of credit non-user and user households respectively while the third (credit) column is the coefficient estimate of the selection (probit) equation.

From the total 11explanatory variables included in the productivity equation 7 variables found to affect the productivity of credit non-user households significantly. Variable education, land size, number of oxen, experience, family size, and fertilizer used have a significant positive effect on the productivity of credit non-user households while the variable age, has a significant negative effect. For credit user households, education, land size, experience, family size and fertilizer used found to affect the productivity equation positively and significantly. However, the effect of the variable age on the productivity of credit user households is insignificant unlike its effect on the productivity of credit non-user households. This indicates that unlike the case of credit non-user households even if the age of credit user households is above the productivity age, there productivity may not be affected because they can hire labor for their farm production. Therefore, age may not matter there production.

Educational level of households head is positively and significantly affecting the productivity of credit non-user household and user households at 5 percent level of significance. This result is in consistent with Reyes et al., (2012).Keeping other things

remain constant, as educational level increase by one year then the log of output per-hectare of credit non-user households and user households will increase by 2.4 percent and 1.8 percent respectively. It implies that education is more important for credit non-user households than credit user households. This may be due to the advantage of education on creating awareness about the importance of credit on farm productivity. Credit non-user households need an additional educational (training) level to know about credit and to produce more.

Land size affects the productivity of households positively and significantly for both credit user and non-user households at 1 percent level of significance. This result is in support with the findings of Urgessa, (2015),Tilahun, (2015), and Reyes et al., (2012). Keeping other things remain constant, as the size of the land cultivated increase by one unit then output per-hectare of credit non-user households and user households will increase by 32.66 percent and 21.1 percent respectively. This implies that still there is a room for production for both credit user and non-user households. In other words they are producing below the efficient level and it indicates that those sample households were belonging in first stage of production. The theory of production tells us in the first stage of production, an increase in the input of production will increase the output of a firm more that the increment in input and here similar conclusion was found. The difference in coefficient between credit user and non-user households indicates that additional land is more productive for credit non-user than user households. This may be because of the less utilization of land by credit non-user household due to inability to afford the optimal land size.

Number of oxen owned by the household significantly improved the farm productivity of credit non-user households, but insignificant for their user counter parts. Keeping other things remain constant, it is evident that an extra ox acquired by a typical credit non-user household improves the log of output per hectare of credit non-user households by 10.3percent. This result is consistent with the findings of Ali et al., (2012) and Tilahun, (2015). They argued that this is an indication of the existence of positive shadow price for oxen. Given that households are credit non-user, it is difficult for them to acquire the extra ox/en they may want. This shows the existence of unmet productivity potential for credit non-user households due to failure to get the optimal number of oxen.

Farm experience of the household improves the productivity of both credit non-user and user households significantly at 1percent level of significance. Keeping other things remain constant, a one year increment in household's farm experience will increase the log of the output per hectare of the household by 0.85 percent and 0.96 percent for credit non-user and user households respectively. It implies that credit user households are more advantageous than non-users in experiencing. An extra farming experience makes credit user households more productive than non-user households. This is because since credit user households are employers, they may get different skills of production from their employees. In addition to this credit user households may use variety of seeds and an additional farming experience may result in an additional technology and improved seeds.

Family size of the household is affecting the farm productivity of households positively and significantly at 5 percent level of significance for both credit non-user and user households. This result is in support with the result of Rahmanet al. (2014) and Urgessa (2015). They argued that family size is regarded as the source of labor for agricultural production and it improves the productivity of land. Keeping other things remain constant, a one unit increment in adult-equivalent of a household will increase the log of the output per-hectare of the household by 2.21 and 2.0 percent for credit non-user and user households respectively. Here family size is more important for credit non-users households than credit user households. This may be due to since credit non-users households do not have enough capital to hire labor, family labor is the alternative. Therefore, family size may be the only source of labor force for farm production. But for credit user households incase their family labor is not enough for production they can hire additional non-family labor. Therefore, family labor is more advantageous for credit non-user households than credit user households.

Fertilizer per hectare of land is positive and significant at 1 percent level of significances for both credit non-user and user households. The effect is approximately similar between credit user and non- user households. Keeping other things remain constant, if a typical household increases fertilizer by 1 kilogram per hectare the log of output per-hectare will grow by 0.2 percent both for credit user and non-user households. This implies that there is a room for better agricultural productivity through intensive use of fertilizer both for credit user and non-user households.

Quantifying the Productivity Impact of Credit use

Table 5: Estimation Result of Treatment Effect

Lny	Coefficient
ATET	
Credit (1 vs 0)	.3805***
POmean	
Credit (0)	3.19***

The result in table 5 shows that keeping other things remain constant, the average log of output per-hectare of credit user households is 38.05percent greater than their credit non-user counter parts in the study area. This indicates us how much this credit non-user households are worsened due to lack of credit. In addition it is evidenced that when no household is credit user, the mean potential log of output per-hectare of a household is 3.19.

Conclusion

The study concludes that low usage of formal agricultural credit is the main factor that hinders the farm productivity of rural households in the study area. The productivity of each endowment variables is not independent of access to formal agricultural credit. To afford farm endowment factors households need formal agricultural credit. Households with better access to formal agricultural credit have better access to farm inputs and pro-

ductivity than those who have no access to formal agricultural credit. It is evident that credit non user households are utilizing resources below their capacity.

Recommendations

Based on the above conclusion the following policy implications emanate from this study:-

- The evidence obtained from the study tells us credit access can improve the productivity of households by 38.05 percent. Therefore, encouraging the delivery of credit to the rural household and improving the capacity of microfinance institutions are recommended as the rural finance policy.
- To improve the capacity of microfinance institutions and incorporate banks and other financial institutions into rural financing, the government is recommended to create a linkage between microfinances and other financial institutions (like banks). This may create opportunities to share the experiences of microfinance institutions on how to deliver financial services in rural areas and the financial resources of banks.
- It is evident that the role of education on productivity is higher for credit non-user households than credit users. This implies that training is more important for credit non-users than credit users. This is because credit user households are more educated than their non-user counters parts. Implying that education is crucial for credit non-user households than users. Therefore, delivering a training service for rural is recommended.
- Fertilizer per hectare found to affect the productivity of both credit user and non-user households positively and significantly. Therefore, increasing the accessibility of fertilizes for rural households and delivering it in affordable price is recommended.

Declarations

I the undersigned declare that there is no other person who published this paper fully or partially. It is my original work.

Competing Interests

the author concludes that there is no competing interest.

Consent to Participate

Prior to data collection, the research obtained a full consent of respondents. The primary data obtained from each respondent was kept confidential and agreed with the respondents to use for academic propose only. Finally, all participants including survey enumerators, supervisors, and key informants were provided adequate training for survey administration.

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Acronyms

ACSI- Amhara Credit and Saving Institution
AGRA- Alliance for Green Revolution in Africa
DBE- Development Bank of Ethiopia
DD- Double Difference
ESR- Endogenous Switching Regression
GDP- Gross Domestic Product
IFAD- international Fund for Agricultural Development
IFC- International Finance Corporation
IFIML- Full Information Maximum Likelihood
IT- Information Technology
IV- Instrumental Variable
MDG-Millennium Development goal
MFIs- Micro Finance Institutions
MFWA -Making Finance Work for Africa
NBE- National Bank of Ethiopia
PASDEP- Plan for Accelerated and Sustained Development to End Poverty
PSM- Propensity Score Matching
SDPRP- Sustainable Development and Poverty Reduction Program
SSA-Sub-Saharan Countries
UNDP-United Nations Development Program

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