Access to Micro Finance Credit and its Impact on Farm Productivity of Rural Households: The Case of Machakel Woreda, Amhara Region, Ethiopia

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Research Article

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ACCESS TO MICROFINANCE CREDIT AND ITS IMPACT ON FARM PRODUCTIVITY OF RURAL HOUSEHOLDS: THE CASE OF MACHAKEL WOREDA OF AMHARA REGION, ETHIOPIA.

By

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Abstract
Agriculture is the main livelihood of Ethiopians and it is characterized by its low productivity and traditional backward way of production. The 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. Multistage sampling technique was employed to select sample respondents from the total population. Quantitative type of data was collected from primary and secondary sources available. A structured questionnaire was used as the main instrument of primary data collection. Using a cross-sectional data related to the fiscal year 2019/20, standard Tobit model was utilized to analyze the determinants of credit access 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 which implies that keeping other things remain constant credit can improve the productivity of households by 38.05 percent 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 Access, Tobit model, Endogenous switching regression, Productivity, Treatment Effect.
1.1. 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 31.2 percent 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 performance 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.

1.2. Objectives of the Study
1.2.1. General objective of the study
The main objective of this study is to analyze the access to formal agricultural credit and its impact on farm productivity of rural households in Machakel woreda.

1.2.2. Specific Objectives of the Study
- To examine factors affecting access to formal agricultural credit 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.
2. 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 $10^\circ 19' 75''$ to $10^\circ 41' 00''$ N latitude and $37^\circ 16' 46''$ to $37^\circ 45' 42''$ 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 (2019), 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.

2.1. 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:

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

Where, $n$= sample size, $N=$ the total target population, $\epsilon =$ level of significance (precision), $p=$ population reliability, and $z=$ normal reduced variable at 0.05 level of significance $z$ is 1.96

As stated above there are 20615 rural households in Machakel woreda who are engaging in farm production in the fiscal year 2019/20. Therefore, in our case the total population $N$ is equal to 20615. As stated by Cochran (1977), to get the reliable sample size one should take the value of “$p$” 0.5. Therefore, population reliability $P$ is 50 percent and $q$ is equal to 50 percent (or $q=0.5$).

Thus, the number of households to be taken as a sample is given as follows.

$$n = \frac{(1.96)^20.5(0.5)20615}{(0.05)^220614 + (1.96)^20.5(0.5)} = 376$$

To select sample respondents Multi-stage sampling technique was utilized. First, Machakel woreda, where the author identified the problem, was selected purposively. Since these kebeles are homogenous, 4 kebeles were selected using simple random sampling technique.
In the third stage, using stratified sampling technique households from each sample kebeles were grouped into credit user and non-user (treated and non-treated groups). Finally, 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).

2.2. Data Analysis
To analyze the data obtained from the sample household, both descriptive and econometric analyses were used.

2.2.1 The Econometric Model
The econometric analysis of this study employs two regression models. First to analyze the access to credit of households a standardized Tobit model is utilized. Second an Endogenous Switching Regression analysis is employed to analyze the impact of access to credit on household’s farm productivity.

2.2.2 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:

\[ EU_{ij} = \beta_i Z_j + \tau_{ij} \quad \text{and} \quad EU_{mj} = \beta_m Z_j + \tau_{mj} \]

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. \( \tau \) is a random disturbance and assumed to be independently and identically distributed with mean zero. Then the difference in expected utility may be written as:

\[ y_i^* = EU_{ij} - EU_{mj} \]

A household will decide to borrow if this difference between the expected utility of borrowing less not borrowing is positive.
The Tobit model supposes that there is a latent unobserved variable $y^*_i$ that depends linearly on $x_i$ through a parameter vector $\beta$. There is a normally distribute error term $u_i$ to capture the random influence on this relationship. It can be specified as follows:

$$y^*_i = x_i \beta + u_i \mid x_i \sim N(0; \sigma^2), \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldot
The above Tobit equations were adopted from Odah et al. (2017) and Awotide et al. (2015), while these authors based their derivation on Greene (2003), Maddala (1983), and Tobin (1958).

**Cobb-Douglas Production Function**

By taking food crops and vegetable production as the representative production of the whole farm activity, the Cobb-Douglas form of agricultural production function was estimated to assess the impact of formal agricultural credit on farm productivity. Formally, the production function can be written as:

\[ y = AX_1^{\beta_1} e^u \]  

Where, \( y \) = Yield of food crops and vegetables (in kg. per hectare), \( A \) = the technological factor, \( x_1 \) = vectors of factors affecting agricultural output, \( \beta_1 \) = parameters to be estimated, \( e \) = the base of logarithm, \( u \) = stochastic random error term. Transforming to the appropriate functional form, (Log-linearizing the production function) the equation can be rewritten as:

\[ \ln y = \ln A + \ln \beta_1 x_1 + u \]  

(3.10)

**3.7.3. 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. This model takes into account both observed and unobserved factors when estimating the impact of discussion groups (Heckman et al., 1997; Dehejia and Wahba, 2002). 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. This approach relies on joint normality of the error terms in the binary and continuous equations (Lokshin & Sajaia, 2004).
In our case we have two regimes that are credit user and non-user. A household will borrow if his/her expected utility of borrowing is greater than the expected utility of not borrowing. The difference between expected utility of borrowing and not-borrowing can be specified as follows.

\[ y_i^* = EU_{ij} - EU_{mj} = \gamma Z_i + u_i \] ................................. 3.11

Where \( y_i^* \) denotes the latent variable which is the difference between the expected utility of borrowing and not borrowing, \( Z_i \) denotes the vector of exogenous variables that affect the latent variable, \( \gamma \) denotes a parameter coefficient, and \( u_i \) denotes the error term. Expecting binary outcome, the access to credit equation can also be specified as follows.

\[ I_i = \begin{cases} 
1 & \text{if } \gamma Z_i + u_i > 0 \ldots \ldots \ldots \ldots \ldots \ldots (3.12) \\
0 & \text{if } \gamma Z_i + u_i \leq 0 \ldots \ldots \ldots \ldots \ldots (3.13) 
\end{cases} \]

Where \( I_i \) denotes the access to credit of a household. In endogenous switching regression the outcome variable is estimated for each regime individually. The outcome equation for the credit user and non-user households can be specified as follows.

\[ y_{1i} = \beta_1 x_{1i} + \varepsilon_{1i} \quad \text{And} \quad y_{2i} = \beta_2 x_{2i} + \varepsilon_{2i} \] ................................. 3.14

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, and \( \beta_1 \) and \( \beta_2 \), are vectors of parameters. Assume that \( u_i, \varepsilon_{1i} \) and \( \varepsilon_{2i} \) have a tri-variant normal distribution, with mean vector zero and covariance matrix:

\[ \Omega = \begin{bmatrix} 
\delta_u^2 & \cdot & \cdot \\
\delta_{21} & \delta_1^2 & \cdot \\
\delta_{31} & \cdot & \delta_2^2 
\end{bmatrix} \]

Where, \( \delta_u^2 \) is a variance of the error term in the selection equation, and \( \delta_1^2 \) and \( \delta_2^2 \) are the variances of the error terms in the continuous equations.\( \delta_{21} \) is a covariance of \( u_i \) and \( \varepsilon_{1i} \) and \( \delta_{31} \) is a covariance of \( u_i \) and \( \varepsilon_{2i} \). The covariance between \( \varepsilon_{1i} \) and \( \varepsilon_{2i} \) is not defined as \( y_{1i} \) and \( y_{2i} \) are never observed simultaneously. We can assume that \( \delta_u^2 = 1 \) (\( \gamma \) 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).
\( \ln L = \sum_{i=1}^{n} \left[ l_i w_i \left[ \ln(F(\eta_{1i}) + \ln \left( \frac{f(\varepsilon_{1i})}{\sigma_1} \right) \right] + (1 - l_i) w_i \left[ \ln(1 - F(\eta_{2i})) + \ln \left( \frac{f(\varepsilon_{2i})}{\sigma_2} \right) \right] \right] \) … (3.15)

Where, \( F \) is a cumulative normal distribution function, \( f \) is a normal density distribution function, \( w_i \) is an optional weight for observation \( i \) and

\[
\eta_{ji} = \frac{\gamma Z_i + \rho_j \varepsilon_{ji}}{\sqrt{1 - \rho_j^2}}, \quad j = 1, 2 \quad \text{…………………………………. (3.16)}
\]

\[
\rho_1 = \frac{\sigma_2^2}{\sigma_u \sigma_1}, \quad \text{the coefficient of correlation between } \varepsilon_{1i} \text{ and } \varepsilon_{2i}, \quad \text{and } \rho_2 = \frac{\sigma_2^2}{\sigma_u \sigma_2}, \quad \text{is the coefficients of correlation between } \varepsilon_{2i} \text{ and } \varepsilon_{1i} \text{. To make sure that estimated } \rho_1, \rho_2 \text{ are bounded between } -1 \text{ and } 1, \text{ and estimated } \sigma_1, \sigma_2 \text{ are always positive, the maximum likelihood directly estimates } \ln \sigma_1, \ln \sigma_2 \text{ and } \text{atanh } \rho:
\]

\[
\text{atanh } \rho_j = \frac{1}{2} \ln \frac{1 + \rho_j}{1 - \rho_j} \quad \text{…………………………………………………………… (3.17)}
\]

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

Unconditional expectations:

\[
E(y_{1i} \mid x_{1i}) = x_{1i} \beta_1 \quad \text{…………………………………………………………… (3.18)}
\]

\[
E(y_{2i} \mid x_{2i}) = x_{2i} \beta_2 \quad \text{…………………………………………………………… (3.19)}
\]

Conditional expectations:

\[
E(y_{1i} \mid I_i = 1, x_{1i}) = x_{1i} \beta_1 + \sigma_1 \rho_1 f(yZ_i)/F(yZ_i) \quad \text{…………………………………………………………… (3.20)}
\]

\[
E(y_{1i} \mid I_i = 0, x_{1i}) = x_{1i} \beta_2 - \sigma_1 \rho_1 f(yZ_i)/(1 - F(yZ_i)) \quad \text{…………………………………………………………… (3.21)}
\]

\[
E(y_{2i} \mid I_i = 1, x_{2i}) = x_{2i} \beta_1 + \sigma_2 \rho_2 f(yZ_i)/F(yZ_i) \quad \text{…………………………………………………………… (3.22)}
\]

\[
E(y_{2i} \mid I_i = 0, x_{2i}) = x_{2i} \beta_2 - \sigma_2 \rho_2 f(yZ_i)/(1 - F(yZ_i)) \quad \text{…………………………………………………………… (3.23)}
\]
Treatment Effects: the treatment effect of a program measures how much the program intervention affects the outcome variable. 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) is the difference between the expected outcome of credit user and non-user households. It can be specified as follows:

\[
ATE = E(y_{1i} | I_i = 1) - E(y_{2i} | I_i = 0) \quad \ldots \quad (3.24)
\]

Where, \(y_{1i}\) and \(y_{2i}\) represent the output per hectare of credit user and non-user households respectively. It is applicable if households in the population are randomly assigned to the treatment. However, most of the time treatment is not randomly assigned to households and this measure of treatment effect may be misleading. Therefore, the most important measure of treatment effect is Average Treatment Effect on the Treated (ATET). It can be specified as follows:

\[
ATET = E(y_{1i} | I_i = 1) - E(y_{2i} | I_i = 1) \quad \ldots \quad (3.25)
\]

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. It is the difference between the expected outcome of credit user households and the expected outcome of credit non-user households if non-user households were users. However, the main problem here is that a household cannot be credit user and non-user at a time. In this situation one has to introduce some identifying assumptions in order to solve the selection problem.

The Reduced Form of the Equation

It is specified by a standard Tobit model as follows:

\[
y^* = x^* \beta + u, \ \text{with} \ \frac{u}{x} \sim N(0; \sigma^2), \ \text{with} \ y = y^* \text{ if } y^* > 0, \ \text{and} \ y = 0 \ \text{otherwise} \ldots \quad (3.28)
\]

Then it can be written as follow:

\[
y^* = \gamma_0 + \gamma_1 \text{enterp} + \gamma_2 \text{bankacc} + \gamma_3 \text{livstock} + \gamma_4 \text{age} + \gamma_5 \text{gender} + \gamma_6 \text{edu} + \gamma_7 \text{rskb} + \gamma_8 \text{landsize} + \gamma_9 \text{famsize} + \gamma_{10} y + \gamma_{11} \text{valhouse} + u \ldots \quad (3.29)
\]

The second equation is the output equation. In the output equation, since the dependent variable is a continuous variable it is specified as log linear form of cobb-Douglas equation as follows:

\[
\ln y = A + \beta_1 \text{age} + \beta_2 \text{gender} + \beta_3 \text{edu} + \beta_4 \text{rskb} + \beta_5 \text{slop} + \beta_6 \text{landsize} + \beta_7 \text{hrdlbor} + \beta_8 \text{nnooxen} + \beta_9 \text{experian} + \beta_{10} \text{famsize} + \beta_{11} \text{fert} + u \ldots \quad (3.30)
\]
Where, \( y \) = the dependent variable representing output per hectare of a household.

\( \beta_i \) = The vectors of parameters to be estimated and the full name of independent variables are listed below in table 3.2

\( u \) = The error terms

Table 1 Descriptions and Expected Sign of Variables


<table>
<thead>
<tr>
<th>Variable name</th>
<th>Description</th>
<th>Symbol</th>
<th>Expected sign in output equation</th>
<th>Expected sign in access to credit equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Continuous</td>
<td>Age</td>
<td>+</td>
<td>Ambiguous</td>
</tr>
<tr>
<td>Gender</td>
<td>Dummy</td>
<td>Gender</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Family size</td>
<td>Continuous</td>
<td>Famsize</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Education</td>
<td>Continuous</td>
<td>Edu</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Risk behavior</td>
<td>Dummy</td>
<td>Rskb</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Slope</td>
<td>Continuous</td>
<td>Slop</td>
<td>-</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Enterprise ownership</td>
<td>Dummy</td>
<td>Enterp</td>
<td>Not applicable</td>
<td>Ambiguous</td>
</tr>
<tr>
<td>Livestock ownership</td>
<td>Continuous</td>
<td>Livstock</td>
<td>Not applicable</td>
<td>Ambiguous</td>
</tr>
<tr>
<td>Value of house</td>
<td>Continuous</td>
<td>Valhouse</td>
<td>Not applicable</td>
<td>-</td>
</tr>
<tr>
<td>Land size</td>
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<td>Landsize</td>
<td>Ambiguous</td>
<td>+</td>
</tr>
<tr>
<td>Fertilizer used</td>
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<td>Fert</td>
<td>+</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Hired labor</td>
<td>Dummy</td>
<td>Hrdlobr</td>
<td>+</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Number of oxen used</td>
<td>Continuous</td>
<td>Nooxn</td>
<td>+</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
3. Results and discussions

3.1. Dummy Variables and Access to Credit

Access to credit 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 2 presents the relationship between these dummy variables with the credit access of households in the study area.

Table 4.1 Descriptive Statistics of Dummy Variables by Credit Use

<table>
<thead>
<tr>
<th>Variable</th>
<th>Type</th>
<th>Credit non-user</th>
<th>Credit user</th>
<th>Total</th>
<th>Chi²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Female</td>
<td>Frequency</td>
<td>92</td>
<td>40.7%</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>Frequency</td>
<td>134</td>
<td>59.3%</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Frequency</td>
<td>225</td>
<td>100%</td>
<td>151</td>
</tr>
<tr>
<td>Enterprise ownership</td>
<td>Not own</td>
<td>Frequency</td>
<td>127</td>
<td>56.2%</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Own</td>
<td>Frequency</td>
<td>99</td>
<td>43.8%</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Frequency</td>
<td>225</td>
<td>100%</td>
<td>151</td>
</tr>
<tr>
<td>Bank account</td>
<td>No account</td>
<td>Frequency</td>
<td>204</td>
<td>90%</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Has account</td>
<td>Frequency</td>
<td>22</td>
<td>10%</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Frequency</td>
<td>225</td>
<td>100%</td>
<td>151</td>
</tr>
<tr>
<td>Risk behavior</td>
<td>Not risk averse</td>
<td>Frequency</td>
<td>151</td>
<td>67%</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>Risk averse</td>
<td>Frequency</td>
<td>75</td>
<td>33%</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Frequency</td>
<td>225</td>
<td>100%</td>
<td>151</td>
</tr>
</tbody>
</table>

Source: own survey, 2020

Gender: As it is shown in table 4.1, among the selected sample respondents 162 households are female headed while the remaining 214 are male headed. As it is stated in chapter three a total of 376 sample respondents were selected for the purpose of data collection. These sample respondents are comprises of 151 credit user and 225 credit non-user households. The obtained result in table 4.1 shows that 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 access to credit. Their result
reveals a contradicting argument about the relationship between credit access and enterprise ownership status of households. As it is indicated in table 4.1 most of the households in the woreda have no enterprise while some owns it. Although the enterprise owner respondents are smaller in number the share of credit user households are greater than non-user households. 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 Ali et 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. These two reasons result in a high access to credit for enterprise owning households.

**Bank Account of Households:** Bank account is considered as one of the determinants of accessing credit in the study area. Households who have bank accounts are more likely to access a credit from financial institutions in the study area. 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 the access to credit of respondents in the study area. This implies that households with bank account are more likely to access 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 have better knowledge about credit than those who have no account. Households with bank account are more familiar with saving and borrowing and also they may have awareness about the advantages of borrowing and saving this result in a high demand for credit and better application for credit.
4.1.2 Continuous Variables and Access to Credit

A number of demographic and socio-economic variables may affect the access to credit of rural households. Table 4.2 presents the relationship between access to credit and the socio-economic and demographic factors.

Table 4.2 Descriptive Statistics of Continuous Variables by Credit Use

<table>
<thead>
<tr>
<th>Variable</th>
<th>Credit non-user</th>
<th>Credit user</th>
<th>Min</th>
<th>Max</th>
<th>T-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>47.5</td>
<td>50.9</td>
<td>23</td>
<td>76</td>
<td>t = -2.467**</td>
</tr>
<tr>
<td>Family size</td>
<td>5.167212</td>
<td>5.471467</td>
<td>1.2</td>
<td>15.4</td>
<td>t = -0.99</td>
</tr>
<tr>
<td>Livestock</td>
<td>6.2656</td>
<td>9.001</td>
<td>0</td>
<td>23.92</td>
<td>t = -7.35***</td>
</tr>
<tr>
<td>Education</td>
<td>2.9159</td>
<td>3.9533</td>
<td>0</td>
<td>10</td>
<td>t = -3.053**</td>
</tr>
<tr>
<td>Land size</td>
<td>1.4388</td>
<td>1.6056</td>
<td>0.25</td>
<td>4</td>
<td>t = -2.44**</td>
</tr>
<tr>
<td>Value of house</td>
<td>38.6371</td>
<td>48.2133</td>
<td>10</td>
<td>125</td>
<td>t = -5.62***</td>
</tr>
</tbody>
</table>

Source: own survey 2020

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 access to credit 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 4.2, 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 4.2, 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 access 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. In the supplier’s side, there is a confidentiality of repayment of credit on households with large number of livestock than those own less number of livestock.

**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 accessing credit between households with high level of educational achievement and households with low level of educational achievement.

**Land size of Households:** Land is one of the most important assets for rural households. It is used as the main input of agricultural production. Besides is usage as input land is also the means of different honors and economic activities. In empirical studies household’s access to credit is also determined by the size of household’s land. 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). The t-statistics is statistically significant at 5 percent level of significance. This implies that credit access to households with large land size is statistically different from households with low land size. Here land size indicates the total cultivated land in the fiscal year 1029/20. The significance difference in land size between credit user and non-user households 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:** House is one of the assets of rural households. Since house is used as collateral for accessing a credit, some studies are using it as the determinant factor of credit. In this study the value of house in birr is considered as one of the determinants of credit access. However, rural house is not used as collateral to get a credit. Since our case study is on the rural part of the society, we cannot consider house as collateral but we can relate it in other means. The result of the study reveals that the average value of the house of the respondent in the study area is 42.4574 in thousands of birr, whereas 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 access of credit between respondents who owns high valued house and low valued house. Households with high valued house are more likely to access credit than those respondents who own low valued house.

The t-statistics is significant at 1 percent level of significance. This implies that the value of house of households significantly affects credit access of households and the result is in contradict with the expected sign. 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 finding. 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.

**4.1.4. Test of Mean Differences in Selected Agricultural Variables between Credit Users and Non-Users.**

This section presents the test of the mean differences in some selected agricultural variables between credit user and non-user households in the study area. The results as revealed in Table 4.5 show that the households that have access to credit are not entirely similar to those that did not have access to credit. Those households that have access to credit have statistically significant higher output, land size, and number of oxen than those households that have no
access to credit. However, the results show no significant difference in fertilizer use between the two groups of households.

Table 4.3 Agricultural Variable Distributions between Credit User and Non-user Households

<table>
<thead>
<tr>
<th>Variable</th>
<th>Combined mean</th>
<th>credit=1</th>
<th>Credit=0</th>
<th>Mean difference</th>
<th>t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output per hectare (kg)</td>
<td>30.12367</td>
<td>38.16333</td>
<td>24.7876</td>
<td>13.37572</td>
<td>-10.022***</td>
</tr>
<tr>
<td>Land size (in hectare)</td>
<td>1.505386</td>
<td>1.605267</td>
<td>1.438827</td>
<td>0.1668392</td>
<td>-2.4436**</td>
</tr>
<tr>
<td>Fertilizer per hectare(kg)</td>
<td>126.2326</td>
<td>129.6256</td>
<td>123.9806</td>
<td>5.644997</td>
<td>-0.7345</td>
</tr>
<tr>
<td>Number of oxen</td>
<td>2.765957</td>
<td>2.986667</td>
<td>2.619469</td>
<td>0.3671976</td>
<td>-2.9939**</td>
</tr>
</tbody>
</table>

Source: own survey 2020

The signs *, **, and *** indicates significant variables at ten percent, five percent, and one percent level of significant respectively. The findings in table 4.4 are not an indication of the impact of access to credit on household’s productivity; neither do they indicate that those households that have access to credit are better in output or in other variables than those that did not. Basically, this result is only an indicator to the fact that there is a sample selection bias. Take for example; there is a mean significant difference in output, land size, and number of oxen between credit user and non-user households. This means there is heterogeneity between the two groups.

Any conclusion on the impact of access to credit on any outcome of interest based on the mean differences will be biased and generate erroneous policy recommendations. Thus, the observed differences in productivity between those households with access to credit and those with no access to credit have no causal interpretation. Therefore, to empirically determine the impact of access to credit on our outcome of interest, we adopted other econometric models such as endogenous Switching Regression model that conveniently eliminate observable and unobservable biases in the sample and provide a consistent estimate of the impact.

4.2 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.

4.2.1 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>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>dy/dx</th>
<th>Std. err</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise</td>
<td>.602</td>
<td>.2456**</td>
<td>.1214</td>
</tr>
<tr>
<td>Bank account</td>
<td>1.88</td>
<td>.7677***</td>
<td>.1308</td>
</tr>
<tr>
<td>Livestock</td>
<td>.0216</td>
<td>.00884</td>
<td>.0156</td>
</tr>
<tr>
<td>Age</td>
<td>.0246</td>
<td>.0101*</td>
<td>.0055</td>
</tr>
<tr>
<td>Gender</td>
<td>-.4638</td>
<td>-.1892</td>
<td>.1196</td>
</tr>
<tr>
<td>Education</td>
<td>.1285</td>
<td>.0524***</td>
<td>.0167</td>
</tr>
<tr>
<td>Risk behavior</td>
<td>.0401</td>
<td>.01637</td>
<td>.1199</td>
</tr>
<tr>
<td>Land size</td>
<td>.231</td>
<td>.0943</td>
<td>.0910</td>
</tr>
<tr>
<td>Family size</td>
<td>-.1065</td>
<td>-.0434*</td>
<td>.0240</td>
</tr>
<tr>
<td>Value of house</td>
<td>.0536</td>
<td>.0218***</td>
<td>.0042</td>
</tr>
</tbody>
</table>

Source: own survey 2020

*, **, and *** indicates significant variables at 10 percent, 5 percent, and 1 percent level of significance respectively. The sign of coefficients obtained from the regression result has some contradiction with the expected sign while some variables revealed as they were expected.

**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 et al., (2012). In the descriptive part of this study (see Table 4.1) this variable was also found to affect the access to credit of households positively and similar result is found.
here. 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. Households with bank account are more familiar with saving and borrowing and also they may have awareness about the advantages of borrowing and saving this result in a high demand for credit and better application for credit.

**Age of the household head:** the 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 Tilahun, (2015). This negative relationship between the amount of credit and family size is because; 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 measures the farm productivity of households. It 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 by0.1045birr. 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.

4.2.2. The Impact of Formal agricultural Credit 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 4.4 Estimation Result of Endogenous Switching Regression Model

<table>
<thead>
<tr>
<th>Variables</th>
<th>lny0</th>
<th>lny1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-.0059</td>
<td>-.0030</td>
</tr>
<tr>
<td>Gender</td>
<td>-.0469</td>
<td>-.078</td>
</tr>
<tr>
<td>Education</td>
<td>.0241**</td>
<td>.0184**</td>
</tr>
<tr>
<td>Risk behavior</td>
<td>-.0891</td>
<td>.0067</td>
</tr>
<tr>
<td>Slope</td>
<td>-.0963</td>
<td>-.0561</td>
</tr>
<tr>
<td>Land Size</td>
<td>.3266***</td>
<td>.211***</td>
</tr>
<tr>
<td>Hired Labor</td>
<td>.0489</td>
<td>-.0275</td>
</tr>
<tr>
<td>No. of oxen</td>
<td>.1030***</td>
<td>.0244</td>
</tr>
<tr>
<td>Experience</td>
<td>.0096***</td>
<td>.0085***</td>
</tr>
<tr>
<td>Family Size</td>
<td>.0221***</td>
<td>.0203**</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>.0018***</td>
<td>.00166***</td>
</tr>
<tr>
<td>Enterprise ownership</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bank Account</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livestock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of house</td>
<td></td>
<td></td>
</tr>
<tr>
<td>_cons</td>
<td>2.296 3.017</td>
<td></td>
</tr>
<tr>
<td>/lns1</td>
<td>1.19***</td>
<td></td>
</tr>
<tr>
<td>/lns2</td>
<td>-.785***</td>
<td></td>
</tr>
<tr>
<td>/r1</td>
<td>-.515**</td>
<td></td>
</tr>
<tr>
<td>/r2</td>
<td>1.40</td>
<td></td>
</tr>
<tr>
<td>sigm1</td>
<td>.3083</td>
<td></td>
</tr>
<tr>
<td>sigm2</td>
<td>.455</td>
<td></td>
</tr>
<tr>
<td>rho1</td>
<td>-.474</td>
<td></td>
</tr>
<tr>
<td>rho2</td>
<td>.139</td>
<td></td>
</tr>
<tr>
<td>LR test of independence: (\text{chi}^2(1) = 5.71) Prob&gt; (\text{chi}^2 = 0.0168)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 interdependence 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 11 explanatory 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 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 10.3 percent. 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 1 percent 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 Rahman et 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.

4.2.3 Quantifying the Productivity Impact of Credit Access

Table 4. Estimation Result of Treatment Effect

| InyCoef.  | Std. Err. | P>|z| |
|-----------|-----------|---|
| ATET      |           |   |
| Credit (1 vs 0) | .3805     | 003 |
| POmean    |           |   |
| Credit (0) | 3.19      | 000 |

The result in table 4 shows that keeping other things remain constant, the average log of output per-hectare of credit user households is 38.05 percent greater than their credit non-user counterparts 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.

5.2 Conclusion

The study concludes that low access to 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 an access to formal agricultural credit. Households with better access to formal agricultural credit have better access to farm inputs and productivity than those who have no access to formal agricultural credit.

5.3 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.

- According to the finding, Educational background of credit non-user households is less than credit users. This is evidence that training of rural households is crucial to improve the access to credit of rural households. In addition 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 counterparts. 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.

**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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Figures

**Figure 1**

conceptual framework

**Supplementary Files**

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