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Impact of Microfinance Credit Access on Households Income and Welfare: Evidence from Ethiopia

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ABSTRACT

Introduction: Welfare is the measure of the living standard of the society, and it is the other dimension of poverty. World has different groups of population in terms of living standards. Some of world's population has been lived in luxuries house with many rooms. Hover, seven million people have been lived under extreme poverty. Above 40% of world population could not obtain $2 per day. The other recent studies indicate that about 900 million individuals in the world live in acute poverty based on income measurement of poverty. This indicates that poverty is at its high level all over the world but its concentration is very high at Sub Saharan Africa and South Asia.

Objective of the study: The main objective of this study is investigating the impact of microfinance credit access on households' income and welfare case study in rural South Gondar.

Materials and methods: The study has used both inferential statistics and econometric model. Under the inferential section, the study has compared the socioeconomic characteristics of treatment group and controlled group in terms of mean, variance and T-test. The econometric part of the study has employed Propensity Score Matching method (PSM) of analysis. Limited dependent variable models are appropriate for PSM analysis to estimate the propensity score of treatment and control group.

Results and discussion: Sex of the respondent is one of the demographic variables that is employed by this study. Most of the respondents of the study were males (77.01%) but 22.99% were females. The mean age of females and males is 43 and 49 respectively. The mean income of females and males is 44912 and 57253 respectively. Even if the study did not test statistically, the average consumption of female headed and men headed households approximately same.

Conclusion: This study has examined the impact of credit access on households' poverty reduction in terms of income and welfare case study in ACSI, rural South Gondar zone. The grand objective of the study is analyzing the impact of ACSI credit access on households' income and welfare. The study has estimated the average treatment effect of credit access of ACSI on the borrowers (ATT) in terms of income and consumption. Since the nature of data in non-experimental, the study has used counterfactual.

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INTRODUCTION

Welfare is the measure of the living standard of the society, and it is the other dimension of poverty. World has different groups of population in terms of living standards. Some of world's population has been lived in luxuries house with many rooms. Hover, seven million people have been lived under extreme poverty. Above 40% of world population could not obtain $2 per day. The other recent studies indicate that about 900 million individuals in the world live in acute poverty based on income measurement of poverty. This indicates that poverty is at its high level all over the world but its concentration is very high at Sub Saharan Africa and South Asia. About 1.6 billion people are poor in terms of access to social services and security. Ethiopia was the highest one in the world where more than half of world's population lives below absolute poverty line in 2000. In case of Ethiopia 44% of the total population was lived below poverty line.

Among different development programs, microcredit institutions have succeeded in poverty reduction since 1970's. There are many supporters of microfinance for its positive influence among clients of microcredit. In developing economies formal financial institutions have ignored poor section of population. Formal financial institutions did not provide credit, saving and insurance for poor. Microfinance institutions have gained considerable attention for its ability to improve household's income and welfare, and it has been used as technique for poverty reduction. The impact of microfinance credit service is doubt full. This is because financial sustainability of microfinance institution is unbalanced. This means financial institutions should work for sustainable financial service provision for poor. Regardless of this approach, other organizations have used microfinance institution to develop different services continuously to overcome requirements of poor. However, there is other argument which says that microfinance has not significant effect in developing economy since microfinance support informal activities that have not enough market demand as a result its effect on households' income and welfare is negligible.

There are a few studies regarding to the impact of microfinance credit services on household's income and welfare Ethiopia like Bisrat, Hussien, Guruswaym and Birhanu. Bisrat and Paul had conducted study on the role of microfinance in alleviating urban poverty case study in Jimma town, Ethiopia. The target population was clients of three microfinance that are active Jimma. 120 clients of microfinance were randomly selected and used for their analysis. They used before-after test method of analysis while they examined the impact of microfinance in poverty reduction. Their study measured poverty in terms of income, employment creation, asset holding and saving. They found that income of clients has increase significantly after households used the services of microfinance. This means the poverty of individuals who used the services of microfinance is decreased in terms of monetary approach. Employment creation for those who join microfinance is significantly increased according to their result. Having their strength, their study has its own limitation in terms of methodology. They have attempted to examine the impact of microfinance credit access in poverty reduction by using before after approach with the help of descriptive statistics. However, impact studies need strong econometric investigation rather than weak descriptive and inferential statistics. Descriptive statistics couldn't isolate the impact of microfinance credit access on the dependent variable. There may be problem of selection bias. The other study conducted regarding to the role of microfinance on poverty reduction was in Tigray region by Guruswamy. He had conducted study on the role of microfinance on poverty alleviation case study in Tigray, Ethiopia. The main objective his study was assessing the role of microfinance in reducing poverty in Tigray. Target population for his study was the clients of DE Debit Credit and Saving Institution (DCSI) who live in Mekellle. The method of analysis employed by his study was more qualitative approach and simple descriptive statistics. His analysis was focused on households' socioeconomic situations rather than on effect of microfinance on poverty reduction. He found that microfinance has positive on the life of individuals but he found that the problems of DCSI while it provides its services are high interest rate, loan application procedure, collateral and lack of follow up. His study failed to show the role of microfinance on poverty reduction with strong method of analysis investigated the causality between micro-finance and poverty in Ethiopia case study in Dale woreda in Sidama zone. His study population was clients of Omo Microfinance Institution (OMI). Two stage sampling procedure was used to bring the representatives of the population. The total numbers of sampling units were 200 who used for his study analysis. He used both qualitative and quantitative methods that are framed evaluative research approach. His study attempted to measure poverty in terms of income of clients, health and educational expenditures of households who are clients of OMI. This means he attempted to investigate the probable effect of microfinance on clients' income, education and expenditures. He found that client's income has increased after they are user of services of microfinance. According to his result 52% of respondents had income in the range of 1000 birr-2000 birr. However, after they have the opportunity of microfinance individuals' income increases to the range 2001-3000. His study regression result failed to support the significant effect of credits from microfinance to increase income and health care of client sat 5% significance level. Again, he found that the effect of microfinance credit on access to education is insignificant. His study has its own strong side even if again he has failed to use good impact analysis model. His findings have not consistence. This means from his inferential statistics he reported that microfinance

increase income, access to education and health care of clients. However, his simple econometric regression failed to support findings from inferential statistics.

Among the mentioned studies on the above, no one had conducted study on the impact of ACSI credit access on income and welfare with the propensity score matching. All of them had investigated the role of other microfinance institutions in reducing poverty in terms of income and asset, and some of the mentioned studies have methodological limitation since they applied simple descriptive statistics. However, impact evaluation studies with descriptive and weak econometric models could not convey reliable information. The most popular method of impact evaluation is Propensity Score Matching (PSM). Having the above gaps, this study examined the impact of ACSI credit access on households' income and welfare using Propensity Score Matching method (PSM) case study in the rural part of South Gondar, Ethiopia [1-8].

Objective of the Study

The main objective of this study is investigating the impact of microfinance credit access on households' income and welfare case study in rural South Gondar.

Specific Objective

In line with the general objective, the study has addressed the following specific objectives.

- To examine the role of microfinance credit access on borrowers' income and welfare.
- To identify the main determinants of households' decision to participate in microfinance credit access.

Research Questions

The study has answered the following questions:

- What is the role of microfinance credit access on borrowers' income and welfare?
- What are the main determinants to participate in microfinance credit access?

MATERIALS AND METHODS

Description of the Study Area

The study is conducted in rural South Gondar zone where is one of zonal administration of Amhara regional administration. South Gondar is bordered with West Gojjam on the South, West Gojjam with South West and Bahir Dar, Lake Tana on the West and North Gondar on the North, Wage hemra on the North East, North Wolo on the East, and North Wolo on South East. South Gondar has different agro ecological zones. These different agro ecological zones provide good potential to agricultural activities in the study area. The dominant economic activity that captures many labor forces of the zone is agricultural sector. Based on the census projected by CSA, the total estimated population was 2,051,738.

Nature of Data and Sampling

In this study cross sectional data was employed to achieve the objective of the study. Both qualitative and quantitative data were employed. The population of the study was rural households who live permanently in rural South Gondar, Ethiopia. The study has applied multi stage sampling to draw the representative households. First, the study stratified the total population into different segment based on administrative woreda. Second, the study selects four woredas Farta woreda, Libokemkem woreda, Sidama Woreda and Fogera woreda. Third, the study categorized households into credit takers (treatment group) and noncredit takers (controlled group). Finally, the study has selected kebeles randomly in the selected woredas. According to 2013 population projection of CSA the total number household heads in the four woredas was 225631. The study used Yamane sample size determination cited in that is:

$$n = \frac{N}{1+N(e^2)}$$

Where;

n=Sample size

N=Total household

E=Level of precision

$$n = \frac{225631}{1+225631(0.05)^2} = 399$$

Then, the study determined number of sample in each selected woreda given its respective proportion:

$$n_i = \frac{N_i}{N} \times n_.$$

Where, N_i=Households in each selected woreda, i 1, 2, 3 and 4

$$n_1 = \frac{58227}{225631} * 399 = 102, n_2 = \frac{58780}{225631} * 399 = 103, n_3 = \frac{57547}{225631} * 399 = 101, \quad n_4 = \frac{51076}{225631} * 399 = 90.32.$$

Where;

n_1=Sample households in Farta woreda;

n_2=Sample households in Fogera woreda;

n_3=Sample households in Sidama woreda;

n_4=Sample households in Libokemkem woreda.

Hence, the study has statistically determined 399 households for the analysis purpose. However, the study used additional 5% of statistically determined sample size since impact model analysis requires large sample size so that 422 households were used for unit of analysis. Half of the total sample was

drawn from those individuals who had not taken credit from ACSI but the remaining half was drawn from those who have taken credit in ACSI.

This study has collected socioeconomic characteristics of the sample by using structured questionnaires. Relevant data for this study was collected from two groups that would be categorized in to individuals who had not taken credit and have taken credit in ACSI. This is because the study is aimed to examine the impact of microfinance credit access on income and welfare.

Method of Data Analysis and Model Specification

The study has used both inferential statistics and econometric model. Under the inferential section, the study has compared the socioeconomic characteristics of treatment group and controlled group in terms of mean, variance and T-test. The econometric part of the study has employed Propensity Score Matching method (PSM) of analysis. Limited dependent variable models are appropriate for PSM analysis to estimate the propensity score of treatment and control group. The most practical models of categorical outcome are binomial and multinomial models which require the maximum likelihood estimation to estimate the parameters. For Binary outcome dependent variable let say y could take one of the two possible outcomes. Logit and Probity are the most probabilistic functional form of categorical outcome. The logit regression model experience only dependent variable in which it has only two values either 1 or 0. Logistic model has assumed set of independent variables that would have an effect on the dependent variable have logistic distribution. Most econometrician and statisticians has appreciated the underlying distribution assumption of independent variables and error terms since most situations are not behave in normal distribution. This study has used logistic model to examine the determinants of the dependent variable of the study.

$$pr(y=1|X) = G(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + - - - - - + \beta_n X_n) \text{-------1}$$

Where;

y is dependent variable,

X_i is set of independent variables for more compact representation.

$$pr(y=1|X) = G(X\beta) \text{----------2}$$

Where;

X is vector of independent variable,

β is vectore of parameters.

We can write logistic function

$$G(X\beta) = e^{X\beta}/1 + e^{X\beta} \text{----------3}$$

$$ll = \ln\left(pr(y=1|X)\Big/1 - pr(y=1|X)\right) \text{----------4}$$

$$ll = \ln\left(\frac{e^{X\beta}}{1-e^{X\beta}}\right) = X\beta \text{----------5}$$

$$ll = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + - - - - + \beta_n X_n \text{----------6}$$

Propensity Score Matching

Propensity score matching is techniques that solve the problem of selection bias while we calculate the impact of a given intervention. Observational studies are vulnerable to bias when we estimate the causal inference of a certain intervention. However, propensity score matching is the panacea of such kind of problem by using counterfactual techniques. The modern economy has applied different interventions or programs to achieve a certain economic objective. The effect of this intervention must be evaluated with right technique. According to Alex et al., recent method of matching is popular to evaluate the impact of intervention. The propensity score matching method of evaluation drawn the sample based on the observable characteristics of the respondents. The propensity score matching method finds matches of the treatment unit in the control unit given the covariates. The matching process searches individual in the control group who have same characteristics in the treatment group. Propensity score matching method of evaluation of a certain intervention has depends on two basic assumptions. These assumptions are Conditional Independence (CIA)/ strong ignorability and common support. The conditional independence assumptions states that the treatment variable (D) assignment and the outcome variable (Y) are independent each other.

$$(Y^0, Y^1) \perp D|X \text{---------7}$$

The other assumption is common support. This assumption states that a unit in the treatment group and respective individual in the control have same propensity during the assignment of treatment given the covariates (X). This means that every unit in the treatment group (D=1) must have corresponding unit with same probability P(X) in the control group (D=0).

$$0 < pr(D=1|X=x) < 1 \text{---------8}$$

The common support assumption ensures that the covariates not to predictor of the potential outcome. The matching of treated unit and control unit is processed in the area where there is overlap. The central objective of evaluation of a certain intervention is estimation of the aggregate effect of the program on the treatment group. Basically, there are two types of aggregate effects of the intervention. These are average treatment effect on the treated group (ATT). Average treatment effect on the treated group (ATT) is the average

impact on those individuals who have been exposed to the program.

$$ATT = E[(y^1{}_i - y^0{}_i)|D] = E(y^1{}_i|D) - E(y^0{}_i|D) \text{----------9}$$

The average treatment effect on the treated group for the sample is calculated as follow as:

$$\widehat{ATT} = \frac{1}{N_D}\sum_{i=1}^{N_D}(y^1 - y^0)|D \text{----------10}$$

Where,

N_D sample size of control group.

Average treatment effect on the treated group (ATT) is the average advantage of the intervention to treat group who drawn randomly from the treatment group. The other aggregate effect Average Treatment Effect (ATE). Average Treatment Effect (ATE) is the average effect of the intervention on the entire population for both treated and control.

$$ATE = E[(y^1 - y^0)|D * pr(D = 1) + E[(y^1 - y^0)|D] * pr(D = 0) \text{----------11}$$

Where, Pr (D=1) and Pr (D=0) the probability of an individual to involve in the intervention to treatment and control group respectively. ATE to the sample

$$\widehat{ATE} = \frac{\sum_{i=1}^{N}(y^1 - y^0)}{N} = \frac{1}{N}[\sum_{i=1}^{N_D=1}(y^1 - y^0)|D = 1 + \sum_{i=0}^{N_D=0}(y^1 - y^0)|D = 0] \text{----------12}$$

Matching of Covariates

In case of observational studies, the matching of covariates is the best technique to isolate the effect of covariates on the outcome of the intervention between treated and control group. The central point of matching of covariates is creating comparison group to treatment group given the covariates of the model. Matching of covariates is non-experimental approach. Propensity score is used to match covariates between treatment and control group. There are different matching methods like nearest-neighbor matching, Caliper matching, Kernel and local linear matching.

Treatment and Outcome Variable

The treatment variable (D) of this study is the ACSI credit access to households. The treatment variable (D) takes the value 1 (D=1) if the individual takes credit in ACSI otherwise 0 (D=0). The outcome variable of this study is income and welfare of households in the rural part of South Gondar.

Independent Variable Identification

The covariates of the model that are employed in this study are sex of the household, marital status of the household, age of the household, age square of the household, family size, education status, agricultural land quality, agricultural land availability, agricultural land size, and livestock ownership.

Sex of the household: It is obvious that sex is qualitative variable. The studies assign value 1 if the household is male otherwise 0. The study has expected that sex has more likelihood to access the ACSI credit. However, the study found the reverse one. This means that being male has low probability to take credit in ACSI relative to female headed households.

Age of the household: Age is continuous variable in this study. It is measured in years. The study has expected that as younger households would have more likelihood to take credit in ACSI. The logistic regression shows that younger individuals have more likelihood to take credit in ACSI.

Age square of the household: The study has used the square of age of households to account the probability of aged households to access credit in ACSI. The study has expected that aged households have less likelihood to take credit in ACSI. The result supports this expectation. This means that aged individuals have less likelihood to take credit in ACSI.

Marital status: Martial status has its own influence to take credit. The nature of marital status is qualitative variable. For this reason, the study assigned value 1 if the individual has married, 0 otherwise. The study found that marital status has negative and significant effect at 5% significance level. The probability to take credit in ACSI will decrease with being married relative to married households.

Family size: Family size is the member of individuals in a given household. The study measured family size as continuous variable. The study has expected that family size would have positive and significant effect to take credit in ACSI. The result shows that family size has insignificant effect.

Education: Households' level of education is included in the model of the study. The study measured education as categorical variable. Even if the study expects positive effect of higher education to access credit the result indicates that education has not significant effect.

Agricultural land availability: Agricultural land is the major resource of farmers. Therefore, farmers have considered their land availability to decide to take credit and other economic decisions. The study has designed agricultural land availability as dummy variable to analysis purpose. The study found that agricultural land availability has insignificant effect on the dependent variable.

Agricultural land size: Agricultural land size also important variable to farmers whether they decided to take credit or not. That is the study has incorporated this variable in model. In this study agricultural land size is measured as continuous form of variable in hectare. The study has expected that households who have higher agricultural land size would have less probability to take credit relative to its counterpart. However, it has insignificant effect.

Livestock ownership: Livestock ownership is also the other variable that would have an effect on households' decision to take credit. The study has used Tropical Livestock Unit (TLU) measurement to calculate livestock ownership of households. The study has expected that as livestock ownership increases, households would have less probability to take credit. The

logistic regression indicates that livestock ownership has positive and significant effect on the dependent variable.

Nature of the survey: The survey was administered for two months between April and May in 2020. The survey was conducted through face to face interview with structured questionnaire. The survey was conducted in the rural South Gondar, Ethiopia. The survey employed enumerators for survey administers. The survey administers were trained for two hours about how to present the questionnaire and interview with respondents. Totally, survey administers were four. All enumerators were BSc students. Respondents who were employed in this study were household heads. The study was proposed to survey 422 respondents. The study was lucky in terms of response rate of the questionnaire since the response rate was 100% [9-15].

RESULTS AND DISCUSSION

Descriptive and Inferential Statistics

Characteristics of respondents over sex: Sex of the respondent is one of the demographic variables that are employed by this study. Most of the respondents of the study were males (77.01%) but 22.99% were females. The mean age of females and males is 43 and 49 respectively. The mean income of females and males is 44912 and 57253 respectively. Even if the study did not test statistically, the average consumption of female headed and men headed households approximately same. The mean consumption of female headed and men household headed households is 11078 and 11236 respectively. Among 97 females of the respondents, 64.95% have taken credit from ACSI. 46.46% of male respondents have taken credit from ACSI (**Tables 1 and 2**).

Table 1: Sex of the respondent.

Sex	Freq	Percent	Cum
Female	97	22.99	22.99
Male	325	77.01	100
Total	422	100	

Table 2: Sex of the respondent and treatment variable.

	Treatment Var		Total
Sex	Non-credit takers	Credit takers	
Female	34	63	97
Male	174	151	325
Total	208	214	422

Households' Education Status

The study has categorized background of respondent's education into illiterate, attained formal education, and attained informal education. 44.79%, 37.2% and 18.01% of respondents had attained formal education, attained informal education and had no attained any form of education respectively. Most borrowers from ACSI are households who attained formal education but the least borrowers are households who had not attained any education (**Tables 3 and 4**).

Table 3: Background of respondents' education.

Education	Freq	Percent	Cum
Illiterate	76	18.01	18.01
Formal	189	44.79	62.8
Informal	157	37.2	100
Total	422	100	

Table 4: Background of respondent's education and treatment variable.

	Treatment Var		Total
Education	Non-credit takers	Credit takers	
Illiterate	47	29	76
Formal	79	110	189
Informal	82	75	52
Total	208	214	422

Descriptive Statistics of Continuous Variable

The mean income, consumption, livestock, agricultural land size, family size, and age of respondents are 54416.55, 11199.77, 4.637796, 6.190995, 4.729858, and 48.13981 respectively (Table 5).

Table 5: Summary of statistics of continuous variable.

Variable	Obs	Mean	Std. dev	Min	Max
Income	422	54416.55	42906.37	1900	405000
Consumption	422	11199.77	7467.888	695	92970
Livestock	422	4.637796	1.644736	0	12.21
Agricultural land size	422	6.190995	3.204608	1	20
Family size	422	4.729858	2.231923	1	12
Age	422	48.13981	12.23976	20	85

Outcome and Treatment Variable

The treatment variable of the study is ACSI credit access, and the outcome variables are income and consumption (Welfare) of households. It is possible to describe the link between the treatment variable and outcome variable by using T-Test. The mean consumption to control group and treated group is 9255.1058 and 13089.902 respectively. The T-Test indicates that there is significant difference between the consumption of control group and treated group. The T-Test implies that the average consumption of treated group is significantly higher than the average consumption of the control group. This implies that households who have taken credit from ACSI have better welfare relative to households who have not taken credit. However, the t-test of mean income between treated and control group indicates that the average income of control group is significantly higher than the average income of treated group. This means that the access of credit to households have not significant importance (Table 6).

Table 6: Comparison of treatment and control group over continuous variable.

Variable	Treatment group	Control group	Std. Err		Confidence Interval	
	Mean	Mean	Treatment group	Control group	Treatment group	Control group
Age	46.61215	49.71154	0.756827	0.913744	(45.12 48.09)	(47.91 51.50)
Family size	4.443925	5.024038	0.149504	0.155633	(4.15 4.73)	(4.71 5.32)

Agricultural land size	5.957944	6.430769	0.22505	0.215054	(5.516.40)	(6.00 6.85)
Income	44043.2	65089.14	1571.67	3781.619	(40953 47132)	(57655 72522)
Consumption	13089.9	9255.106	429.1862	560.6044	(12246 13933)	(8153 10357)
Livestock	4.467196	4.813317	0.111906	0.113578	(4.24 4.68)	(4.59 5.03)

As the below tables shows, the mean average of continuous variables in the control group is higher than the mean average of continuous variable in treatment group except consumption (**Tables 7 and 8**).

Table 7: Household consumption difference over treatment variable.

Group	Freq	Mean	Std. err	Std. dev	95% CI
Control	208	9255.106	560.6044	8085.151	8149.88 10360.33
Treated	214	13089.9	429.1862	6278.453	12243.91 13935.9

Mean difference: -3834.796

H0: mean diff = 0; Ha: mean diff<0; Ha: mean diff ≠ 0; Ha: mean diff>0

PR (T<t)=0.0000; Pr (|T|>|t|)=0.0000; Pr(T>t)=1.0000

DF=420

T=-5.4507

Table 8: Household income difference over treatment variable.

Group	Freq	Mean	Std. err	Std. dev	95% CI
Control	208	65089.14	3781.619	54539.29	57633.71 72544.57
Treated	2014	44043.2	1571.67	22991.55	40945.18 47141.22

Mean difference: 21045.94

H_0: mean diff = 0; H_a: mean diff<0; H_a: mean diff ≠ 0; H_a: mean diff>0

PR (T<t)=1.0000; Pr (|T|>|t|)=0.0000; Pr(T>t) = 0.0000

DF=420

T=-5.1905

Econometric Result

Logit model result: The study has conducted logistic regression to identify factors that affect the household's likelihood to access credit in ACSI. Based on this result age, age square, marital status, agricultural land availability, and livestock ownership have significant effect on the households' chance to access credit in ACSI. Sex, age square, marital status, agricultural land availability, and livestock ownership have negative and significant effect on the households' likelihood to access credit in ACSI. The probability to take credit in ACSI will decrease with being male relative to female households.

This means that male headed households have lower chance to take credit in ACSI relative to female headed households. The other demographic variable that is included in the model is age square of households. As the age of household becomes high, the probability to take credit in ACSI will decrease by 0.0004. Marital status of the household also incorporated in the model, and it has negative and significant effect at 5% significance level on the likelihood of households to take credit in ACSI. Households who have married have lower chance to take credit in ACSI relative to their counterpart. Among economic variables that are included in the model agricultural land availability and livestock ownership have negative and significant effect at 10% and 5% significance level on the dependent variable of the study. Households who have agricultural land have lower chance to take credit in ACSI relative to its counterpart. This is because households who have agricultural land will not have demand to credit relative to individuals who have not agricultural land. With regarding to livestock, as household's livestock increases by a unit the probability to take credit in ACSI will decrease by 0.032. The background of household education has

insignificant. However, age has positive and significant effect at 1% significance level on the probability of the household to take credit in ACSI. The probability to take credit in ACSI will increase as the household is younger (Table 9).

Table 9: Logistic regression and its marginal effect.

Variable	Coefficient	P-value	dy/dx	p-value
Sex	-0.709	0.007	-0.174	0.005
	-0.263		-0.062	
Age	0.19	0.005	0.047	0.005
	-0.067		-0.016	
Age square	-0.001	0.004	-0.0004	0.004
	-0.0006		-0.00016	
Marital status	-0.859	0.034	-0.214	-0.214
	(0.405)		-0.101	-0.101
Family size	-0.074	0.378	-0.016	0.378
	-0.065		-0.018	
Education status	0.047	0.751	0.011	0.751
	-0.15		-0.037	
Agricultural land quality	(-0.177)	0.274	-0.044	0.274
	-0.162		-0.04	
Agricultural land avail	(-1.357)	0.118	(-0.301)	0.043
	-0.867		-0.149	
Agricultural land size	0.0381	0.432	0.008	0.432
	-0.032		-0.01	
Livestock	(-0.131)	0.064	(-0.032)	0.064
	-0.071		-0.017	
Constant	-1.654	0.589		
	-0.894			

No of obs: 422; Pseudo R^2: 0.0682; LR $chi^2(11)$: 39.89; log likelihood: -272.52092; Prob>chi^2: 0.000

Propensity Score Estimation and Balancing Propensity Score

The first step in impact evaluation using propensity score matching is estimation of propensity score of the treatment and control group over covariates. The dependent variable of this study is binary that is households who have taken credit in ACSI denoted by 1, otherwise 0 for households who have not taken credit in ACSI. For this reason, the study has used logistic model of regression to estimate the propensity score. According to Horst et al., propensity score measures the probability that an individual would be involved given the set of covariates of the model. We can see the value of Pseudo R^2 to say something about the balance of covariates of the model between treatment group and control group after matching the propensity score of the logistic regression. Lower Pseudo R^2 has facilitates to have good matching between groups. Hence, this study is very lucky since its Pseudo R^2 is very low that is 0.015. We can use t-test to confirm the balance of covariates between treatment group and control group. The propensity score balanced test indicates that both treatment and controlled group have same probability to access credit in ACSI given the covariates of the model. It is also possible to see the distribution of propensity score for treatment and control group before matching (Figure 1 and Table 10).

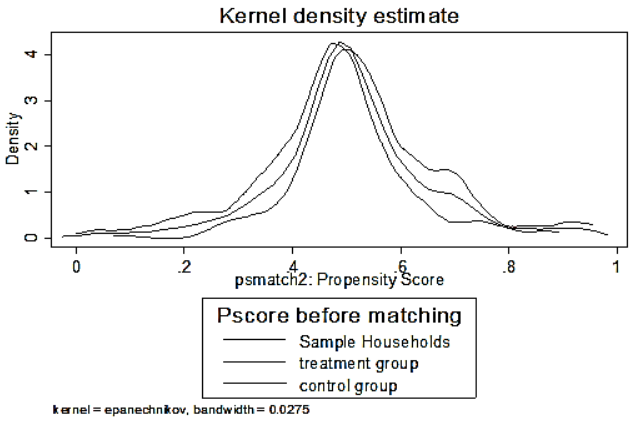

Figure 1: Distributions of propensity score.

Table 10: Test of propensity score between treatment and control group.

Variable	Mean		Bias	P-value
	Treated	Control		
Sex	0.71	0.64	13.5	0.216
Age	46.61	46.593	0.2	0.986
Age square	2294.7	2279.5	1.3	0.876
Marital status	0.83645	0.85514	-1.3	0.606
Family size	4.4439	4.4953	-2.3	0.804
Education status	1.215	1.2056	1.3	0.892
Agricultural land avail	0.93925	0.98131	-23	0.026
Agricultural land size	5.9579	6.3832	-13.3	0.163
Agricultural land quality	1.3925	1.3879	0.7	0.948
Livestock	4.4672	4.6	-8.1	0.406
Ps R^2; LR chi^2; Mean bias: 0.0159.016.5				

Matching Algorithm

Matching treatment and control group is the corner stone of propensity score matching method. There are different alternatives of matching methods that can match treated units and control units given covariates. Criterions are available to select the best matching method. According to Dehejia and Wahba, balancing test, pseudo R^2 and large matched sample size are the criterion to choose the best matching technique. In this study the best matching algorithm is Kernel matching method with band width 0.1 (**Table 11**).

Table 11: Choice of matching method.

Matching methods size	Balancing test	Pseudo R^2	Matched sample
Caliper (0.025)	10	0.019	400
Caliper (0.1)	10	0.019	412
Caliper (0.25)	10	0.019	414
Caliper (0.5)	10	0.019	414
NN (1)	10	0.019	414
NN (2)	10	0.012	414
NN (3)	10	0.015	414
NN (4)	10	0.015	414
NN (5)	10	0.014	414
Kernel (0.1)	10	0.007	412
Kernel (0.25)	7	0.018	412
Kernel (0.5)	5	0.04	414
Radius (0.1)	4	0.051	414
Radius (0.25)	4	0.051	414
Radius (0.5)	4	0.051	414

Balance of Covariates after Matching

The study has checked the balance of covariates between treated groups and control group before the choice of best matching algorithm. However, testing balance of covariates between the treatment group and control group before matching is not that much feasible. Therefore, we have to test the balance covariates between treatment and control group after the choice of best matching method. The above table shows that Kernel (0.1) is the best matching algorithm of this study. The following table shows the balance of covariates after matching. The balance of covariates after matching can be verified by Pseudo R^2, bias reduction, and probability value. The Pseudo R^2 must be low to have balanced covariates between treatment group and control group. In this study the Pseudo R^2 is very low after matching relative to unmatched Pseudo R^2. Pseudo R^2 after matching is 0.007 but before matching Pseudo R^2 is 0.067. The other test of balance of covariates is mean bias reduction. In this study the mean bias before matching is 22% but mean bias after matching is reduced to 4.2%. The other test is t-test or probability value. In this test covariates must be insignificant after matching. In this study eight covariates were not balanced between treatment and control group before matching because probability value is significant. However, after matching all covariates are balanced between treatment and control group because probability value is insignificant (**Table 12**).

Table 12: Propensity score balancing test.

Variablele	Unmatched/ matched	Mean		Bias	P-value
		Treated	Control		
Sex	Unmatched	0.70561	0.83654	-31.5	0.001
	Matched	0.72115	0.71899	0.5	0.961
Age	Unmatched	46.612	49.712	-25.5	0.009
	Matched	46.962	46.872	0.7	0.932
Age square	Unmatched	2294.7	2644.1	-29.3	0.003
	Matched	2325.8	2304.6	1.8	0.829
Marital status	Unmatched	0.83645	1.0865	-17	0.08
	Matched	0.85096	0.87105	-1.4	0.564
Family size	Unmatched	4.4439	5.024	-26.2	0.007
	Matched	4.5096	4.6811	-7.7	0.415
Education	Unmatched	1.215	1.1683	6.5	0.505
	Matched	1.2067	1.1986	1.1	0.908
Agricultural land avail	Unmatched	0.93925	0.99038	-28	0.004
	Matched	0.96635	0.98788	-11.8	57.9
Agricultural land size	Unmatched	5.9579	6.4308	-14.8	0.13
	Matched	6.1298	6.4332	-9.5	0.328
Agricultural land quality	Unmatched	1.3925	1.5337	-19.7	0.043
	Matched	1.4327	1.4181	2	0.839
Livestock	Unmatched	4.4672	4.8133	-21.1	0.031
	Matched	4.5325	4.6193	-5.3	0.566

Sample: Pseudo R^2 P; Unmatched: 0.06722.0; Matched: 0.0074.2

Estimation of Average Treatment Effect to Treated Group (ATT)

Estimation of average treatment effect on the treated group is the central point of impact studies in general and propensity score matching in particular. According to Moreno-Serra, it represents the average impact of the intervention on individuals who exposed to a given intervention. Average treatment effect to the treated group is the measure of the average effect of the intervention on individuals who are drawn randomly in the treated group. As the study mentioned on its methodology the outcome variable of this study are income and consumption. Therefore, this study has estimated average treatment effect on the income and consumption of the treated group. While the study estimated average treatment effect on the treated group, eight numbers of individuals have discarded in the treated group because these eight individuals are off support of the common support. The average treatment effect on the treated group (ATT) in terms of income on the treated group is 44390.8981 but on control group is 56884.9369. The difference of ATT in terms of income between treated and control group is negative. However, the average treatment effect (ATT) in terms of consumption on the treated group is 13323.0874, and on the control group is 8920.84951. The difference is positive. This implies that credit takers' welfare that is measured by consumption is improved. However, estimation of average treatment effect to treatment group is not that much relevant without the best matching algorithm. This is because without correct matching it is difficult to separate the effect of the intervention effect on the outcome variable. The average treatment effect on the treatment group (ATT) in terms of income is 44409.2548 which is less than ATT of control group that is 58895.7629. This may be due to the problem of households' credit allocation in productive activity after they have taken credit. Households may spend the credit in the area of unproductive investment. However, average treatment effect on the treatment group (ATT) in terms of consumption is 13198.9375 which are higher than ATT of control group that is 9989.14274. This implies that ACSI credit access has improved the welfare of households in terms of consumption. This means ACSI credit access has reduced poverty of households in terms of poverty [16-20] (**Tables 13-16**).

Table 13: Common support before choice of matching method.

Psmacth 2: Treatment assignment	Psmatch 2: Common support		Total
	Off support	On support	
Untreated	0	208	208
Treated	8	206	214
Total	8	414	422

Table 14: ATT estimation before choice of matching method.

Variable	Sample	Treated	Control	Difference	S.E	T-stat
Income	Unmatched	44043.2	65089.14	-21045.9	4054.665	-5.19
	ATT	44390.9	56884.94	-12494	5338.084	-2.34
Consumption	Unmatched	13089.9	9255.106	3834.796	703.5423	5.45
	ATT	13323.09	8920.85	4402.238	802.5027	5.49

Table 15: Common support after choice of matching method.

Psmacth 2: Treatment assignment	Psmatch 2: Common support		Total
	Off support	On support	
Untreated	4	204	208
Treated	6	208	214
Total	10	412	422

Table 16: ATT Estimation after choice of matching.

Variable	Sample	Treated	Control	Difference	S.E	T-stat
Income	Unmatched	44043.2	65089.14	-21045.9	4054.665	-5.19
	ATT	44409.25	58895.76	-14486.5	4670.088	-3.1
Consumption	Unmatched	13089.9	9255.106	3834.796	703.5423	5.45
	ATT	13198.94	9989.143	3209.795	781.9841	4.1

CONCLUSION

This study has examined the impact of credit access on households' poverty reduction in terms of income and welfare case study in ACSI, rural South Gondar zone. The grand objective of the study is analyzing the impact of ACSI credit access on households' income and welfare. The study has estimated the average treatment effect of credit access of ACSI on the borrowers (ATT) in terms of income and consumption. Since the nature of data in non-experimental, the study has used counterfactual. To have best matching between treatment and control group, the study has tested different matching methods like Kernel, Caliper, nearest neighbor, and radius. The best matching method to this study is kernel (0.1). The study found that the ATT on the treatment group in terms of income is less than the control group. This implies that the role of ACSI credit access did not increase the income of borrowers. This may be due to that borrowers did not allocate their credit in the productive economic activity. However, The ATT of treatment group in terms of consumption is higher than the controlled group. This implies that the role of ACSI credit has improved the welfare of borrowers.

RECOMMENDATIONS

The study has suggested the following recommendation to responsible body regarding to the impact of microfinance on household's income and welfare.

- The estimation of ATT on the treated group in terms of income is less than its counterpart. This finding is somewhat surprising and the impact of microfinance on households' income is questionable. The expectation regarding to the impact of microfinance on client households' income was higher relative to non-clients. However, the finding is on the contrary. This may be due to that borrowers would allocate the loan on unproductive area of economic activity. Hence, the responsible body should aware households who take credit to allocate their credit on productive area of economic activity, and if it is feasible and possible design follow up scheme that will restrict the loan allocation that would be taken by borrowers. In other word, government or microfinance sector should follow borrowers' loan allocation.
- Based on the estimation of ATT on the treated group in terms of welfare, it is higher than the ATT of control group. This implies that ACSI credit access has improved welfare of borrowers relative to non-borrowers. Therefore, microfinance sector should continue its credit access to households.

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DATA AVAILABILITY STATEMENT

Data will be made available on request.

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