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Impact of Rural Infrastructures on Smallholder Farmers' Credit Market Participation in Ethiopia: The *Case of Smallholder Farmers in Jimma Zone, Oromia Region*

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Abstract

This research project was principally intended to examine the impact of rural infrastructure on the smallholder farmers' commercialization in Jimma zone of Oromia regional state. We employed the proportional sample approach to determine a total sample of 397 householders from the four woreda considered. The data set necessary to our analysis was be sourced both from the primary and secondary foundations. Besides, both the descriptive and inferential statistical approaches were employed to analyse the data collected. The regression analysis was employed propensity score matching method of data analysis. The descriptive statistics depict that 76.5% of smallholder farmers responded that rural infrastructure development has significant impact on their credit market participation. The propensity score matching estimation result reveals that out of the three outcome variables; average yearly household income and rural infrastructure development are statistically significant in affecting smallholder framer's credit market participation, but amount of loan accessed was statistically insignificant with positive ATT. Thus, vast infrastructure investment is recommended in the study area.

Keywords: Credit market, Infrastructure development and propensity score matching

1. INTRODUCTION

Agricultural sector serves a crucial part of most low-income economies and remains an important means of rural livelihood in developing economies. It also remains crucial in respect of foreign exchange earnings and the general economic performance of most developing economies. Enhancing agriculture market chain is therefore a key strategic action to boost the life of rural people in particular and the economic position of developing countries. Enhancing the rural access to markets to trade their produces and necessary farm inputs is part of agricultural development policy (Barrett, 2014).

Theories strongly argue for the positive role of rural infrastructure provision in improving farmersô access to markets. Recently, it is a common celebration to advocate that one of the fundamental causes of poverty, lack of economic growth and high income inequality is an insufficient and unequal access and possession of assets. In this regard, advancing the asset foundation of the rural people and raising the marginal returns of these assets, among others, are suggested to be the basic strategic actions in the process of enhancing rural life. With a view of boosting agriculture, the Government of Ethiopia has been diverting much of the resources towards the development of rural infrastructures. From Gebremedhin and Jaleta (2010) despite the obvious importance of investments on rural infrastructure, it has not developed at the speed needed for reforming Ethiopiaôs poverty outline. As it has revealed in most developing nations, infrastructure investment has declined in response to fiscal challenges associated with SAP in the past years. According to them, agriculture has experienced challenges due to this reduced attention against rural infrastructure. Their report justifies for the provision of rural infrastructure for the betterment of the agriculture.

Despite the obviously suggested positive correlation between rural infrastructure and agricultural market development, investment in rural infrastructure has not reached the level necessary to reform the poverty profile of Ethiopia (Kassa et al., 2013). As with a case in most developing countries, infrastructure investment in Ethiopia reduced due to fiscal policy measures associated to structural adjustment programs in the past many years. We argue that, this imbalance in provision and requirement of public rural infrastructure might be an important source of rural poverty in the country. As with the noticeable case in most developing economies, agriculture accounts for dominant share of Ethiopiaôs general macroeconomic performance, viz, employment, output and foreign exchange earnings. Thus, policy ignorance of the agricultural sector could certainly mean dragging down the overall welfare of particularly rural people as agriculture is means to everything to them.

According to the analytical review of World Bank in 2015, it is market participation but not market orientation that matters more in the process of commercial transformation of subsistence agriculture. Commercialization necessitates market orientation (agricultural production decision destined for market signals) and market participation (produce offered for sale and use of purchased inputs). Yet, literatures on commercialization of smallholders make little distinction between these two different but strongly interlinked concepts. Market orientation, to the larger extent, is more of policy concern; while, commercialization is strongly related to technical factors (Jaleta *et al*., 2010). But, plans to enhance commercial transformation of subsistence agriculture drawn from the determinant analysis of household market participation alone could

be insufficient, if in fact, the determinants of market orientation and market participation are different. Thus, we strongly infer that both concepts should be treated and analysed differently. Most of the literature on smallholder commercialization deals only with its output side. However, sustainable commercialization also necessitates integration into the input markets (Pingali and Rosegrant, 1995). To throw in to redressing the gap in the commercialization literature on credit market participation of households, we were intended to analyse credit markets participation of small holder farmers. Thus, uncommon to most previous studies, we deal with the complete rural credit market system while considering rural market in its different dimensions. More importantly, there have been no previous empirical studies integrating various smallholder commercialisations in the study area; i.e. in Jimma Zone smallholding farmers. This research project is principally intended to examine the implication of rural infrastructure for credit market participation of small scale farmers in Ethiopia; with particular focus on Jimma zone of Oromia region.

2. EMPIRICAL LITERATURE

According to G/Medhin and Jaleta (2010), commercial transformation of subsistence agriculture can be determined also by both the determinants of market orientation and market participation in agricultural market, yet market orientation can be strongly transformed into market participation. The involvement to enhance market orientation can be important in developing market participation; and, the involvements to encourage market participation may not be adequate to sustain market orientation. Additionally, distance from the nearest available market and the degree of market related information are suggested in explaining the householdsô degree of commercialization.

Egbetokun and Monona (2012) found that, the factors influencing farmerôs participation in the market include; age, marital position, source of labour, farm experience, and land size. The probability of participating in commercialization depends on family size, distance to the nearest market, price of the good and sex of the household head. The analysis of Pender and Alemu (2014) confirms that increasing production of food staples is the most important factor that contributes more to the level of householdsô degree of market participation. In addition, increased access to roads, farm land, livestock, and farm equipment are keys to enhancing smallholder production and their commercialization. More importantly, Ele et al. (2013) found that volume of crops produced, farming experience, access to extension service, size of cultivated land and others are important determinants of the householdsô participation to agricultural commercialization. Thus, analysis of the determinants of market participation of smallholder farmers will support to design appropriate policy instruments for their sustainable economic development. The degree of commercialization of smallholder farmers is determined also by many factors; as age of household head, family size, food security, access to fertilizers and benefits gained from participating in different farm organizations (Chirwa, 2012).

Mu and Walle (2014) determined whether development institutions should target their resources on areas with no such attributes. Based on the literatures on economic geography and on literatures scrutinizing social development as well as institutional arrangements in missing market environments, they furtherer underline the theoretical ambiguity of the impact of better roads on local markets. The literature reports a multiplicity of prior necessities that could either

enhance the growth of local markets or reinforce the importance of existing markets. Mu and Van and Walle (2014) provide evidence from Vietnam that, on average, rural road provisions have considerable impact towards enhancing local markets through the development of non-farm activities. Besides, due to the reason that those areas possess more scope for road developments to enhance market developments, market-related institutions as well as market related services; their survey provides evidence of a considerable effect on the poor people of their sample community. Nevertheless, other attributes like poor agro climactic conditions, high proportion of ethnic minorities, high rates of illiteracy, and less functioning credit and other markets, which typically relate with higher degree of isolation and low population density, lean to work in opposite directions and will obviously reconcile the impact of rural road developments across communities. Thus, their analysis does not absolutely deviate from previously mentioned assumptions about the significance of human capital on the effect of road improvement. Nonetheless, at least in the areas Mu and Walle (2014) considered, the highest latent return arising from low initial market development was sufficient to offset the impact of these attributes.

While the previously revealed studies analyze the supply angle of infrastructure considering their effect on market creation, Cadot et al. (2014) and Azam et al. (2013) analyze the demand side by looking at the determinants of small farmersô decision to participate in crop markets. Strategies like, move from low-productivity, transition from semi-subsistence to high-productivity of agriculture, commercial agriculture has been a core premise of development and agricultural economics for about two centuries. A vast of literature focusing on small scale farm households emphasizes the essence of transaction costs and institutional condition in their decisions to participate in markets; (For instance, see; Vakis et al., 2013). Vakis et al., 2013 distinguish the impact of fixed and variable transaction costs on the decision to participate in the crop markets. They pronounced in their literature that, fixed transaction costs are those searching and screening costs for better business partners, and of settling and implementing contracts, and then its follow-up and execution. Agents bear these costs so as to reduce the risk of transaction failure. These costs are mainly high in conditions of asymmetrical information. Based on the Peruvian survey by Vakis et al. (2014), costs arising from searching, toning and bargaining are important elements in a farmersô decision on whether or not participate in the markets.

The 2016 World development report reveals a number of programs to progress the diffusion of agricultural information through radios, mobile cell phones and other available Medias (World Bank, 2016). The evidence asserts that investment in mobile phones had a considerable and favourable role in reducing these fixed transactional costs; and thus, in decreasing barriers hindering farmers from utilizing market opportunities. Improved access to rural roads is expected to provide access to markets and then, reduces information asymmetry regarding input quality and prices, and output prices. These costs are not directly linked to the volume traded and hence characterize a larger constriction for small farmer producers. Variable transaction costs, related to the provision of roads should reduce; symbolize the unit cost of relocating products to and from the market. Generally, this literature focusing at farmersô decisions to participate in the market asserts that variations in transaction costs and varying access to important infrastructures to mitigate such costs are likely factors underlying heterogeneous market participation among rural householders.

Conceptual Framework

The overall conceptual framework below is based on the literature on farm commercialization (Kohli and Jaworski, 1990; Goetz, 1992; Lapar et al, 2003; Bellemare and Barrett, 2006). It is adapted by varying and extending the influencing factors considered in the present study as displayed hereunder:

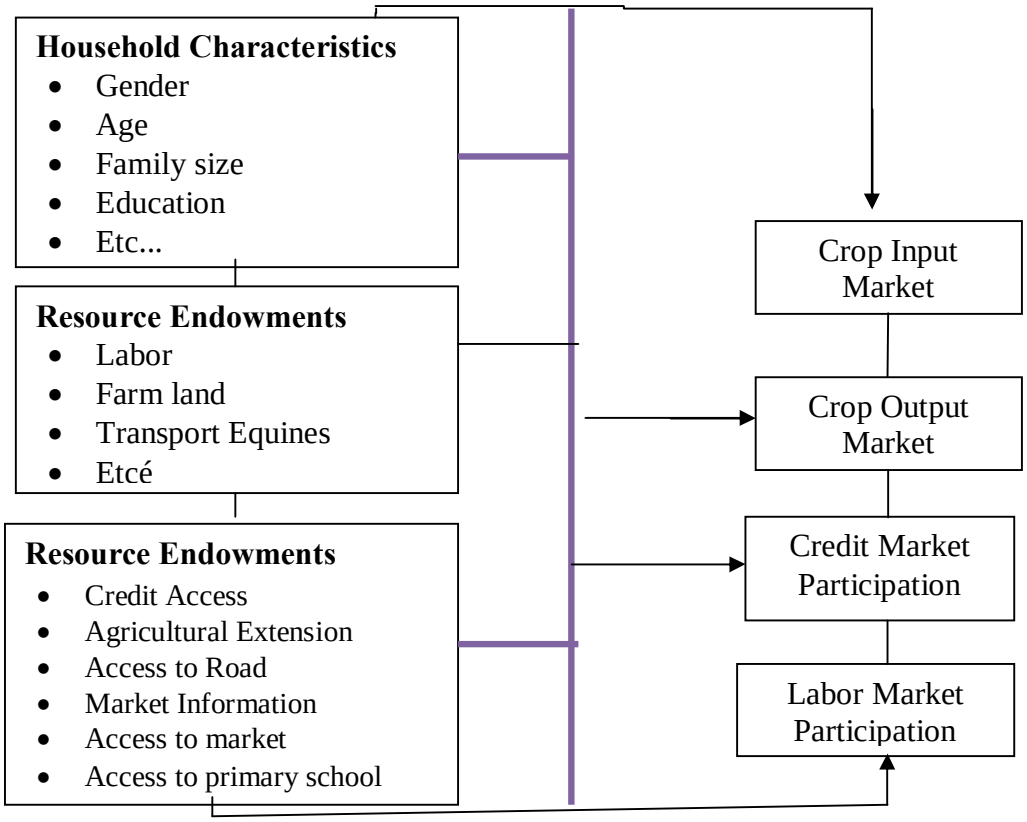


Figure 1: *Conceptual framework of the determinants of household level crop input and output market, credit market and labor market participation.*

3. Methodology

Type and Source of Data

We were employed both primary and secondary data sources. Primary data was sourced from the individual respondents included in the study. Primary data was collected by means of a structured questionnaire.

To determine the appropriate sample of households, we used the method suggested by Noel et al. (2012) given below;

$$n \geq \frac{N}{1+(N-1)\left(\frac{2d}{z}\right)2}$$

Where, N = the total population

n = The required sample size,

d= 0.05 Margin of error,

z= 1.96 for 95 % confidence interval.

The margin of error d is taken as percent point error term and is often calculated for d=1%, d = 2% and d = 5%. Marginal error of 0.05 is best with 95% confidence interval.

The appropriate sample size will be determined using equation 3.1 above from the total households (N = 76,186). Accordingly, the appropriate size is (n = 398). We will select 398 households from six chosen woredas. Our unit of analysis is head of each household.

3.2. Method of Data Analysis

Analysis of the market participation is complex and requires to be treated via diverse methods based on the circumstance and aims of each market channel. For this study both descriptive and regression models were used.

3.2.1Propensity Score Matching (PSM)

Propensity score matching method of impact analysis is a method of comparing Credit market participants and non-participants, where both groups experiences similar communication facilities, socio-economic characteristics, topography, development infrastructure programs and others, to examine whether there is economic variation between program participants and non-participants. The assumption behind this study is that at most credit market participation benefits the poorest of the poor at the grass root level.

The PSM is defined as the conditional probability of receiving treatment (participant) given pre-treatment characteristics (Rosenbaum and Rubin, 1983).

$$p(X) = pr(D = 1/X) = E\{D/X\} \quad (1)$$

Where D= (1, 0) is the binary variable indicating whether a farmer has participated in credit market (=1) or not (=0) and X is a multidimensional vector of pre-treatment characteristics (observable characteristics) and p(X) is the propensity score.

Let F_{i1} and F_{i0}represents the outcome when a farmer are participant in credit market and the outcome when not participate respectively. So, the difference between the treated and control group is given as,

$$\Delta i = Fi1 - Fio \quad \text{.....(2)}$$

Where, F_{i1} is the outcome if treated and F_{i0} is the outcome of untreated. Let equation (2) is expressed as B_io to express the causal effect, the treatment variable takes 1 if the individual I receives treatment and 0 other wise. Then, ATT of an individual I can be expressed as:

$$ATT = E(F_{i1}/B=1) - E(F_{i0}/B=1) \quad \text{.....(3)}$$

The E (Fi0/B=1) from equation (3) is unobservable outcome known as counterfactual. In other words E(Fi0/B=1) is the average outcome of treated individuals had they not received the treatment).

$$E[F_{i1}/B=1] - E[F_{io}/B=0] = ATT + E[F_{i0}/B=1] - E[F_{i0}/B=0] \quad \text{.....(4)}$$

Selection bias is shown by the difference between left hand side of equation (4) and ATT. Since the main parameter interest is ATT, it can be defined as:

ATT=E [F_{i0}/B=1]-E [F_{i0}/B=0]=0é é é é é é é é é é é é é é é .....(5)

In estimating propensity scores, all variables that affect participation in credit market are included. Therefore, the average treatment effect on those treated conditional on propensity score p(x) is given as:

ATT=Ep(x)/B=1{E [F_{i1}/B=1, p(x)]-E [F_{i0}/B=0, p(x)]é é é é é é é é .é é é é é é é é é é .(6)

ATT is the difference between expected outcome values with and without treatment for those who actually participate in treatment. In equation (6), the PSM estimator is the mean difference in outcomes over the common support region, appropriately weighted by propensity score distribution of participants (Caliendo and Kopeinig, 2005).

ATT is average treatment effect on treated (i.e the effect of treatment) if the farmer participate in credit market (B=1) and otherwise (B=0).

By comparing the result of all matching estimators, kernel with band width 0.5 is selected for this study with different criteria. In this regard, kernel matching algorithm matches several non-participants with a participant.

6.5.1. 3.2.2. Estimation of the Propensity Scores

The probability of farmerôs participation in credit market, P_i is given as;

$$P_i = E(Y=1/X_i) = \frac{1}{1+e^{-(\beta_1+\beta_2 X_i)}} \quad \text{..... (7)}$$

The logistic representation of credit market participation is;

$$P_i = \frac{1}{1+e^{-Zi}} = \text{ é é é é é é é é é .....é é .....} \quad (8)$$

The probability of farmerôs does not participate in credit market is given as;

$$1-Pi = \frac{1}{1+e^{Zi}} \text{ é .é é é é é é é ..é é é .é é é é é é .. (9)}$$

$$\frac{p_i}{1-p_i} = \frac{1+e^{Zi}}{1+e^{-Zi}} = e^{Zi} \quad \text{é é é é é é é é é é é é é é é é é ... .(10)}$$

$\frac{p_i}{1-p_i}$= the odds ratio in favour of farmerôs participation in credit market, i.e. ratio of the probabilities that farmerôs participate to the probabilities that not participate in credit market. Taking the natural logarithm;

$$Li = \ln\left(\frac{p_i}{1-p_i}\right) = Z_i = \beta_0+\beta_1 X_1+\beta_2 X_2+\beta_3 X_3+\text{é . }+\beta_n X_{n--} \text{ é ..... (11)}$$

By taking the error term in to consideration, the log odds ratio model becomes

$$Zi = \beta_0+\beta_1 X_1+\beta_2 X_2+\beta_3 X_3+\text{é .}+\beta_n X_n+u_i \quad \text{.....(12)}$$

Where

- ✓ P_i is the probability of participating in a program
- ✓ Z_i is a function of explanatory variables (X_i)
- ✓ Xi is the explanatory variables
- ✓ β_o is an intercept
- ✓ β_1, β_2é $\beta_n$ôs are slopes of the equation in the model

- ✓ L_i is log of the odds ratio which is linear in $X_i$ôs and Bôs
- ✓ $U_i$is the disturbance/error term

Here Z, takes two possible values i.e. z=1 farmers participate in credit market and z=0 if not.

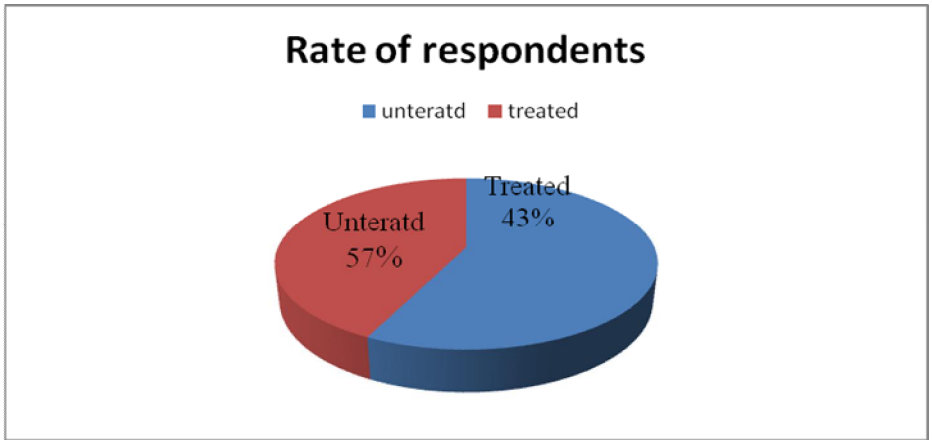
4. Result and Discussion

General Characteristics of the Respondents

From the total sampled respondents, the data was collected from 397 respondents. Of the total respondents 170 of them were credit market participants while remain 227 of them were non-credit market participants or they were control groups of the study. Non-credit market participants are those respondents that have no credit market participation experience from formal credit institution. Regarding the response rate of the questionnaire, 100 % of the questionnaires were returned.

As depicted below in figure 4.1, from the total sampled respondents 43% of them were smallholder credit market participants whereas 57% of the sampled respondents were non-market participants as control groups or counterfactuals. As compared to smallholder farmer credit market participants, control group percentages are relatively higher than credit market participants. This is because in studies of impact analysis counterfactuals should outweigh than program participants since some observation from control groups may discard to make a one to one match for comparison purpose. Of course this kind of action is supported by literature.

Figure 4.1 Descriptions of credit market participants and control groups



Source: own computation, 2019

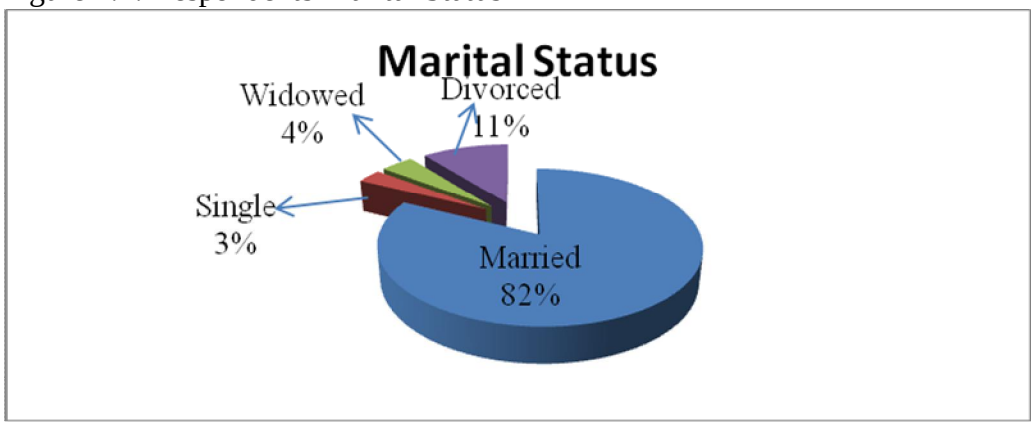
Regarding marital status, the sample result show that 82 % of the respondents were married whereas out of the total respondents 3 %, 4% and 11 % of them are single, widows and divorced respectively. The descriptive statistics depict 93.2% of the respondents replied that they are head of the household while 6.8 % of the respondents are headed by other relatives. The mean household head difference between client and non-clients is 0.160663 with p-value 0.7348 which is in significant at. The result indicates that there is no significant difference between credit market participants and control groups in heading their houses.

Table 4.1. Results of t-test for Household head

Two-sample t test with equal variances			
Group	**Obs**	**Mean**	**Std. Err.**
Untreated	227	1.07489	.0175087
Treated	170	1.058824	.0180995
combined	397	1.06801	.0126516
Diff			.0160663
diff = mean(Untreated) - mean(Treated)			t = 0.6279
Ho: diff = 0			degrees of freedom = 395
Ha: diff < 0			Ha: diff != 0Ha: diff > 0
Pr(T < t) = 0.7348		Pr(T > t) = 0.5304	Pr(T > t) = 0.2652

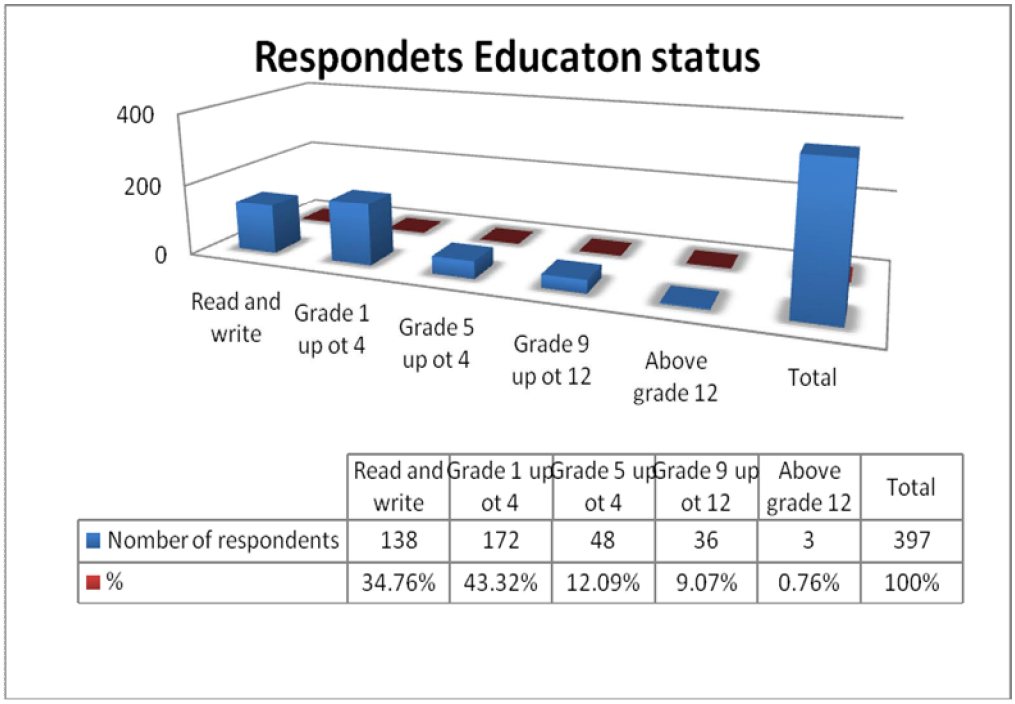
Source: own computation, 2019

Figure 4.2. Respondents Marital Status



Source: own computation, 2019

Education status of respondents show that 34.76 % of them can read and write, 43.32 % of them are learned from grade 1 to 4, 12.09 % of them are learned from 5 to 8, 9.07 % them are learned from grade 9 to 12 and 0.76 % of them are above grade 12. The mean education level difference between client and non-clients is 0.0853071 and the p-value 0.8194 (indicating insignificant) which leads to accept the null hypothesis that is there is no difference between the groups in respondentsô education level (i.e. there is no difference in their education level between credit market participants and non-credit market participants).



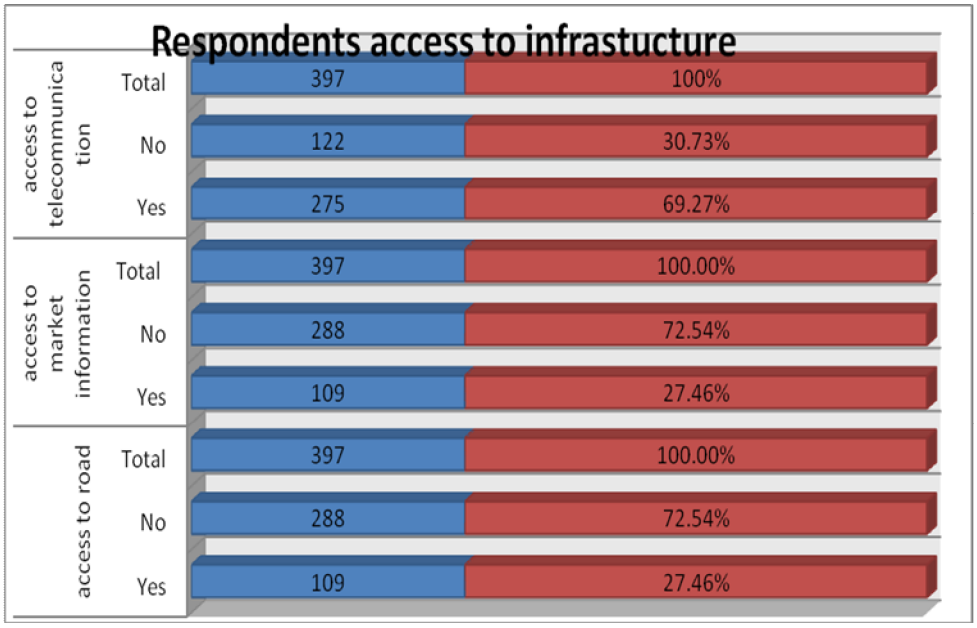
	Read and write	Grade 1 up ot 4	Grade 5 up ot 4	Grade 9 up ot 12	Above grade 12	Total
Nomber of respondents	138	172	48	36	3	397
%	34.76%	43.32%	12.09%	9.07%	0.76%	100%

Source: own computation, 2019

Figure 4.3 Educational statuses of respondents

72.54% of the respondents said that they have no easy access to any weather road while only 27.46% replied that they have access to any weather road. The survey result depicts that, on average, all respondents should travel more than two Kilometres to reach to the nearest road. On the other hand 42.32% and 29.22%of the respondent were replied that they get the nearest market far from their with 2 to 3 kilometres but the reaming 28.21% of them said that they should travel more than 4 kilometres to reach their nearest credit market which is tiresome.

As shown in figure 4.4 below 72.54% of the respondents replied that they have no any access to both any weather road and market information while only 27.46% of them said that they have access to it. Regarding access to telecommunication service, 30.73% of respondents have access to telecom services but majority of the respondents (69.27%) have no any access about any telecom services as depicted in figure 4.4 below.



Source: Own computation, 2019

Figure 4.4: Descriptive statistics depicting access to different infrastructures

4.1.1. Effect on Income

The descriptive two sample t-test result for average yearly household income depict that, the mean difference between credit market participants and non-credit market participantsô average yearly income is -7215.527and the p-value is 0.0363 which is highly significant at 5% significance level (see Table 4.3). This leads to reject the null hypothesis that there is no difference between treated and non-treated groups average yearly household income. The implication is that a client of credit institutions earns better average yearly household income than non-clients in the study area.

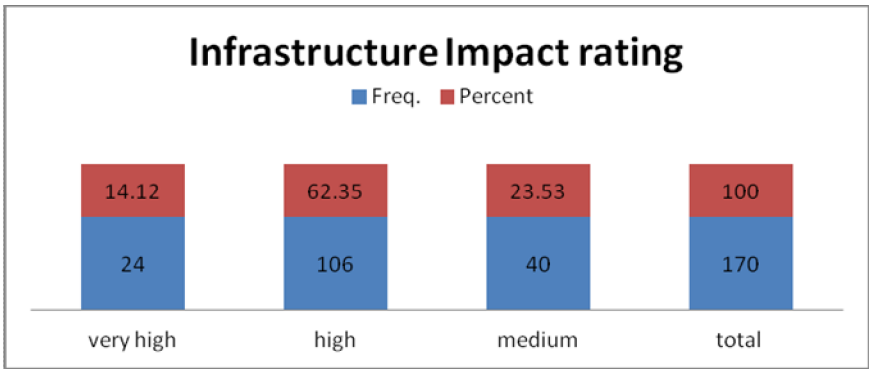
Table 4.2. Results of two sample t-test for householdôs income

Two-sample t-test with equal variances				
Group	Obs	Mean	Std. Err.	Std. Dev.
Untreated	227	38658.59	2420.438	36467.58
Treated	170	45874.12	3318.575	43268.92
combined	397	41748.36	1989.107	39632.67
	diff		-7215.527	4008.54
diff = mean(Untreated) - mean(Treated)				t = -1.8000
Ho: diff = 0			degrees	of freedom = 395
Ha: diff < 0 Ha: diff != 0				Ha: diff > 0
Pr(T < t) = 0.0363Pr(T > t) = 0.0726				Pr(T > t) = 0.9637

Source: Own computation, 2019

Respondents were asked to rate the impact of infrastructure development on credit market participation as very-high, high, medium and low. Accordingly 62.35 % and 14.12 % of credit market clients explained that rural infrastructure development has very-high and high impact in improving our credit market participation habits respectively. While 23.53 % of credit institution clients elucidate that hard and soft infrastructure development has medium impact in their market participation. They argue that, the access to telecommunication, access to extension services or access to a good road doesnôt determine highly their credit market participation rather their interest and the institution criterion matters highly.

Overall we can sum-up that, majority of smallholder farmers replied that is 76.47% of them responded that rural infrastructure development has significant impact on their credit market participation.



Source: Own computation, 2019

Figure 4.5: Descriptive statistics depicting impact of infrastructures development on credit market participation

While we compare the relative relevance between hard and soft infrastructure development to smallholder farmers credit market participation, hard infrastructure particularly easily accessible road takes the priority followed by soft infrastructures. The survey indicates that 81% of the respondents gave priority to hard infrastructure as compared to soft infrastructure. But it doesnôt mean that hard infrastructure development is the only determinant of smallholdersô farmers credit market participation rather it is to depict its relative importance between soft and hard infrastructure development in the study area.

4.2. Estimation Econometric Model

Under this sub-section, the logistic regression model output and the propensity scores for matching of treated and control groups were presented. To estimate the effect of propensity scores, logit model is employed because there is no difference on result between logit and probit model (Caliendo and Kopeinig, 2005).

As usual, before looking the econometric regression result, it was cheeked the fitness of the model and all necessary tests were conducted and it was ready for estimation of the model.

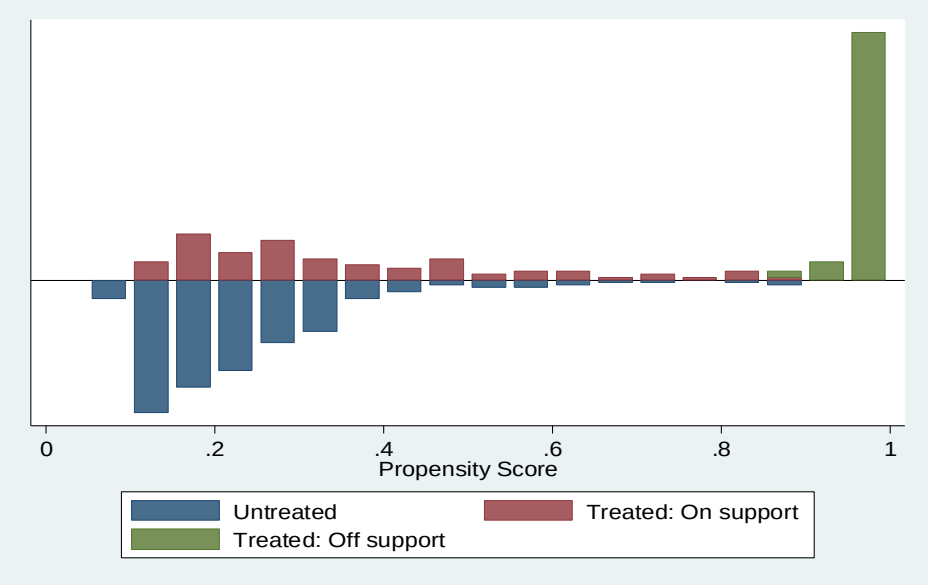
4.2.1 Common support region

From the total sample, propensity score matching estimation result discards eighty eight observations from credit market participants but it doesnôt discard any observation from control groups. As indicated from table 4.9 below, 227 of control groups (untreated) are on common support region and 82 of the credit market participants (treated) are on common support region (see Table 4.3).

Table 4.3 Distribution of common support

psmatch2: Treatment Assignment	psmatch2: Common support		
	Off support	On support	Total
Untreated	0	227	227
Treated	88	82	170
Total	88	309	397

Source: Own computation, 2019



Source: own computation, 2019

Fig 4.6 Figure presentation of common support

Accordingly, the result of estimated propensity score varies in between 0.0840 to 0.8589 with the mean of 0.2382 for untreated and from 0.1091 to 1.000 with the mean of 0.681 for the treated. That is, credit market participants whose estimated propensity scores less than 0.1091 and larger than 1.000 are not included in the matching exercise. That is [0.1091, 1.00] and [0.840, 0.1.00] are propensity scores for treated and untreated respectively. Therefore, by minima and maxima criterion, taking the minimum propensity score from the treated and the maximum score from the

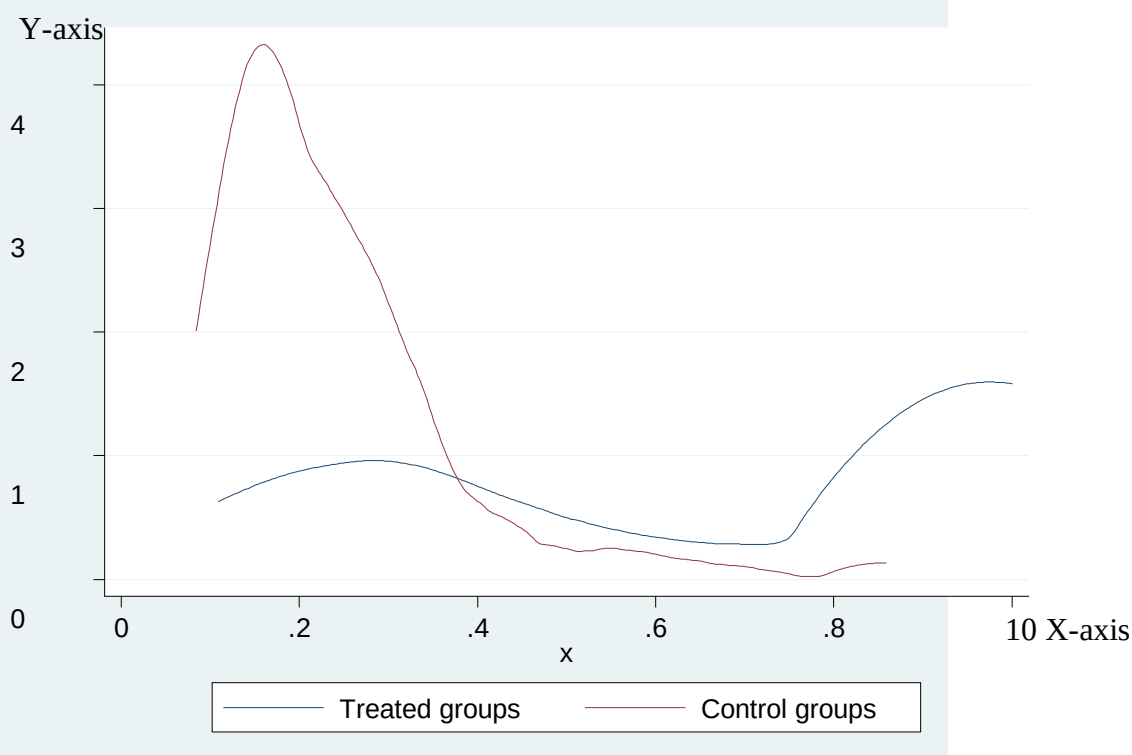
untreated forms the common support region. Thus, the common support regions lie between [0.1091,0.8589] which show none of observations was dropped from non-clients in the sample. Respondents whose estimated propensity score is less than0.1091 and larger than 0.8589 are discarded from the common support region thus 88household from program participant were out of the common support region (see Table 4.4).

Table 4.4Distribution of estimated propensity scores

Variable	Obs	Mean	Std. Dev.	Min	Max
_pscore	397	.4282116	.3307647	.0840664	1
Treated	170	.6813621	.3445221	.1091363	1
Untreated	227	.2386275	.1365117	.0840664	.858969

Source: own computation, 2019

The figure4.7 shows that most of the treated credit market participant smallholder farmers were found in the middle and partly in the right side near to middle while most of control households are found in the left side of the distribution. It also reveals that there is wide area in which the propensity score of both the treatment and the control groups are similar.



Source: own computation, 2019

Fig 4.7Kernel density of propensity score distribution

4.2.2 Choosing Matching algorithms

Four matching algorithms such as Caliper, Nearest Neighbor, Radius and Kernel were checked to choose the best matching methods. As usual, the choice of matching algorithm was based on pseudo R^2, matching sample size and mean test referred to as to balance test. Low pseudoR^2 value, large matched sample size and insignificant mean difference between the two groups is preferable. As a result kernel 0.5 and radius 0.5 was used to estimate ATT.

Table4.50. Matching performance of different estimators

Matching estimator	Performance criteria		
	Balancing test*	Psedo-R^2	Matching sample size
Nearest Neighbor			
NN(1)	10	0.028	309
NN(2)	11	0.014	390
NN(3)	11	0.010	309
NN(4)	11	00.011	309
Radius Matching			
0.1	8	0.071	292
0.25	8	0.071	292
0.5	8	0.071	292
Kernel Matching			
Band width 0.1	11	0.006	309
Band width 0.25	11	0.014	309
Band width 0.5	9	0.056	309

Source: Own computation, 2019

Table4.6: Propensity score and covariates balancing

Variable	Unmatched Matched	Mean		%reduction		t-test	
		Treated	Control	%bias	/bias/	t	p> /t/
_pscore	Unmatched	.68136	.23863	169.0		17.61	0.000
	Matched	.35406	.35316	0.3	99.8	0.03	0.976
Age	Unmatched	38.388	40.176	-19.2		-1.88	0.061*
	Matched	39.805	40.236	-4.6	75.9	-0.29	0.769
Sex	Unmatched	.66471	.79295	-29.1		-2.90	0.004***
	Matched	.71951	.75203	-7.4	74.6	-0.47	0.639
Marital status	Unmatched	.68235	.62115	12.8		1.26	0.208
	Matched	.65854	.68699	-6.0	53.5	-0.39	0.700
Education	Unmatched	1.9706	1.9471	2.5		0.25	0.802
	Matched	1.939	2.0285	-9.7	-281.3	-0.58	0.562
Average yearly income	Unmatched	33568	10886	48.9		5.02	0.000***
	Matched	29684	29693	-0.0	100.0	-0.00	0.999
No. family size	Unmatched	4.6882	3.63	53.3		5.29	0.000***
	Matched	4.1463	4.122	1.2	97.7	0.08	0.939
Access to telecom	Unmatched	1.2588	1.3392	-17.6		-1.72	0.086*
	Matched	1.3049	1.2886	3.6	79.8	0.23	0.821
Access extension service	Unmatched	.41176	.6652	-52.4		-5.18	0.000***
	Matched	.47561	.53252	-11.8	77.5	-0.73	0.469
Access to market info.	Unmatched	1.7118	1.7401	-6.3		-0.63	0.532
	Matched	1.7317	1.7439	-2.7	56.9	-0.18	0.860
Institutional Support	Unmatched	.94706	.97357	-6.3		-0.62	0.536
	Matched	.96341	.97561	-2.9	54.0	-0.19	0.852
Amount of loan accessed	Unmatched	43466	1906.8	92.7		9.87	0.000***
	Matched	2858.5	3164.6	-0.7	99.3	-0.59	0.559

Source: Own computation, 2019

*** and * indicates level of significance at 1% and 10% respectively

As shown in the above table matching reduce total bias, reduce pseudoR^2 from 0.395 before match to 0.006 after match and any difference between the two groups covariates mean in the matched sampled has been reduced and after matching all variables become insignificant and were balanced.

As indicated in Table 4.7below, the values of pseudo-R^2 are very low. This low pseudo-R^2 value and the insignificant likelihood ratio tests support the hypothesis that both groups have the same distribution in the covariates after matching. These results indicate that the matching procedure is

able to balance the characteristics in the treated and the matched comparison groups. Hence, these results can be used to assess the impact of rural infrastructure among groups of smallholder farmers having similar observed characteristics. This enables researcher to compare observed outcomes for treatments with those of a control groups sharing a common support.

Table 4.7. Chi-square test for the joint significance of variables

Sample	PseudoR^2	LRchi^2	p>chi^2
U	0.395	213.97	0.000
M	0.006	1.33	1.000

Source: Own computation, 2019

The result of all the above tests indicate that the matching algorithm being chosen and used is comparatively best for this data and thus, now it is possible to estimate ATT for smallholder farmersô credit participantsô Jimma zone, Ethiopia.

4.2.3. Estimated Result of Average Treatment Effect on Treated (ATT)

As depicted by table 4.8 and table 4.9, the estimation result of the outcome variables were statistically significant except the variable amount of loan accessed (Amloan) in table 4.8is statistically insignificant but positive ATT indicating smallholder farmers credit market participants had benefited more than the counterfactual. Statistically significant variables (i.e. Credit market participation, average income and amount of loan accessed) in both tables indicates that, rural infrastructure has significant impact in affecting farmers credit market participation at 5% level of significance.

From table 4.8, we can deduce that credit market participant farmersô has more income than non-market participants. Thus, credit market participant farmersô hand income of 649.23721 birr more than non-credit market participants as seen by the sample difference between treated and control groups. Similarly, rural infrastructure affects credit market participation by 3.86641269 units than non-participants. Likewise, from table 4.9, we can realize that all the three outcome variables were statistically significant at 5%. The implication is that rural infrastructure has significant impact on farmersô credit market participation explained by positive difference between treated and controlled groups.

Therefore, we can sum-up as, rural infrastructure access had significant impact on the rate of farmers ócredit market participation in the study area (see table 4.8 and 4.9).

Table 4.8: Estimating the impact of rural infrastructure on credit market participation

(Using Kernel 0.5)

Variable	Sample	Treated	Controls	Difference	T-stat
Amloan	Unmatched	43465.5882	1906.82819	41558.76	9.87
	ATT	2858.53659	2209.29938	649.23721	1.47
Av. income	Unmatched	33568	10886.1586	22681.8414	5.02
	ATT	29683.9024	13104.8591	16579.0434	2.72**
Ruifradev	Unmatched	10.6647059	3.73127753	6.93342835	7.92
	ATT	8.02439024	4.15797755	3.86641269	3.24**

Source: Own computation, 2019

Table 4.9: Estimating the impact of rural infrastructure on credit market participation (Using Radius 0.5)

Variable	Sample	Treated	Controls	Difference	T-stat
Amloan	Unmatched	33568	10886.1586	22681.8414	5.02
	ATT	29683.9024	10886.1586	18797.7438	3.23**
Av. income	Unmatched	43465.5882	1906.82819	41558.76	9.87
	ATT	2858.53659	1906.82819	951.708392	2.26**
Ruifradev.	Unmatched	10.6647059	3.73127753	6.93342835	7.92
	ATT	8.02439024	3.73127753	4.29311271	3.78**

Source: Own computation, 2019

5. CONCLUSION AND RECOMMENDATION

Theories strongly argue for the positive role of rural infrastructure provision in improving farmersô access to markets. Recently, it is a common celebration to advocate that one of the fundamental causes of poverty, lack of economic growth and high income inequality is an insufficient and unequal access and possession of assets. This study was principally intended to analyse the impact of rural infrastructure on credit market participation in Jimma zone of Oromia regional State. The propensity score matching estimation result reveals that out of the three outcome variables; average yearly income and rural infrastructure development (Ruifradev) are statistically significant in affecting smallholder framerôs credit market participation, but amount of loan accessed was statistically insignificant with positive ATT. As it is shown ATT is positive indicating hard and soft rural infrastructure development has high impact on credit market participation on both kernels 0.5 and radius 0.5.

Summing up, the findings of this study, both the descriptive and econometric analysis result explicitly depict that, with its limitation, rural infrastructure development has high impact on smallholder farmerôs credit market participation in the study area.

As a policy indicator, rural infrastructure development is expected to improve credit market participation and empower the living standard of the poorôs particularly smallholder farmerôs at the grass root level and hence reduces poverty. As such access to rural infrastructure will open the way to credit market participation which will then significantly improve the economic status of smallholder farmerôs.

- As descriptive result depicts that, 72.54% of the respondents said that they have no easy access to any weather road, thus government has high mandate to construct and build those rural infrastructures and it is important to strength the action of URRAP program to connect framers and credit institution. Hence, essay access to telecom service, easy access to extension services, and easy access to institutional support should get priority in the study area.
- Agricultural Offices and credit institutions like Oromia credit and saving institutions should take appropriate measures to ensure its organizational mandates, objectives and commit to benefit smallholder framers from its services by providing training, advisory services and continuous follow-up to improve their economic status.
- Linkages with governmental organizations like Telecommunication, Agricultural Offices, and Transport offices should be made to work cooperatively and address problems.

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