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THE EFFECT OF MICROFINANCE ON LIVESTOCK HOLDINGS OF RURAL HOUSEHOLDS IN TIGRAY REGION: CASE OF OFLA WOREDA, Ethiopia

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Abstract:Food insecurity and vulnerability to poverty is a chronic issue in Ethiopia as the majority of the country's population depends on agriculture for their livelihood. The recurring lack and a high variability of rainfall causes persistent shocks of droughts which forces households to disinvest in assets and leave poor farming families without food crops which can be in turn a cause for the famine of millions of people in the country. To address the severe challenges of food insecurity and poverty, and abolishing recurrent famines in the country, emergency food aid has been taken as a solution for a long period of time. Programs, such as Food for Work and Employment Generation Scheme, were also used as social protection programs in the country since 1980's. In addition to other productive programs, such as productive safety net program, significant consideration has also been given for the inception of Microfinance institutions which solves the obstacles of credit constraint of the needy rural households that are neglected by the formal financial institutions, such as Banks. This study is, therefore, done to evaluate the effect of microfinance on livestock holdings of the rural households in Tigray Region, Oflaworeda, and investigate its impact disparities across sex of the household head and drought experience of households. The study used primary cross sectional data collected from both credit participants and non-participants of 395 rural households. Random sampling technique was applied to select the respondent households from 6 rural kebeles. We used both descriptive and econometric methods for data analysis. Econometric models such as logit model and propensity score matching were employed to estimate the effect of credit on livestock holdings measured in Tropical Livestock Unit (TLU). The balancing condition is tested by using standardized bias approach. To avoid very poor matches the common support condition was imposed using the "minima and maxima" approach. Generally, findings of this study confirmed that microfinance had positive effect on livestock holdings (even if not statistically significant) with considerable effect disparities across sex of the household head and drought experience of households. The policy implication of the study is that the accessibility of microcredit should be scaled up since it has an effect on the livestock holdings which in turn increase the livelihood of the rural households, thereby plays positive role on poverty reduction.

Index Terms **- Microcredit, Oflaworeda, TLU, Propensity Score Matching**

1. INTRODUCTION

Microfinance is globally appreciated and accredited for its role in fighting poverty as evidenced by many countries around the world that use it. The United Nations (UN) supports microfinance as a suitable tool for helping poor people and bringing about community prosperity (Bernanke, 2007). This global gravitation towards microfinance in the development process is parallel with its primary objective of providing poor individuals and households with access to affordable micro-loans and other financial services for self-employment; through which they can boost their incomes and alleviate poverty (Bernanke, 2007; Westover, 2008).

Despite the recent good overall growth in Ethiopia, millions of people are still living in poverty (MoFED, 2012; UNICEF, 2012). Several studies (such as MoFED, 2012; Regassa*et al*., 2011) indicate that smallholder farmers form the largest group of poor people in Ethiopia, and, hence, the persistent and severity of poverty is also more common in large rural households who engaged in mixed farming (i.e., both crop production and raising livestock). In order to combat such transitory and/ chronic poverty and ensure food security, several short and long term intervention programs have been taken by the Government of Ethiopia.

The government has been implementing polices to expand financial access to the poor including promoting microfinance credit access to the poor that are neglected by the formal financial institution such as banks. As various studies indicate microfinance has been hailed as one of the most effective tools for combating poverty through loans, grants, insurance and other financial products offered to those marginalized parts of the society. For instance, Berhaneand Gardebroek (2012) assessed the impact of microfinance on rural poverty. Their results also suggest that microfinance has a significant effect on the reduction of rural poverty. In addition, by using panel data set, Haftom (2011) found that microfinance (dedebit credit and saving institution (DECSI)) has a positive and significant effect on long-term permanent consumption expenditure.

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Existing studies (such as Deaton, 1991; Rosenzweig and Wolpin, 1993) indicate that under income uncertainty and borrowing constraints, households in developing countries smooth consumption using livestock as a coping response. In Ethiopia, livestock are important factors for of crop production and a source of livelihood for the rural households. Thus, depletion of livestock (particularly distress sales during the time of shocks) has long term adverse effect on farm productivity (Webb *et al.*, 1992). Recognizing this, protecting livestock depletion in times of shocks and increasing investment on livestock is included as one of the main objectives of creating access to credit for rural needy households via microfinance.

To the best of the researchers' knowledge, even if various studies have been conducted on the impact of microfinance on different welfare indicators and socio-economic issues, the effect of microfinance on livestock holdings of rural households in the study area has not yet been studied. Thus, the main objective of this study is, therefore, to answer three research questions, namely, Does microfinance (DECSI) have a significant effect on livestock holdings of rural households? Does credit protect livestock holdings in times of shocks? And, is there impact heterogeneity across households (in terms of sex of household head and kebele) in Tigray region, Oflaworeda?

Objectives of the study

The general objective of this study is to investigate the effect of microfinance on livestock holdings of rural households in Tigray region, case of Oflaworeda.

More specifically, the objective of the study is to investigate

- The effect of Dedebit credit and saving institute on livestock holdings of rural households.
- The effect of credit on protecting livestock holdings in times of shocks.
- Impact heterogeneity across households (in terms of sex of household head).

Empirical Literature

As different empirical literature reveals, the impact of microfinance is still mixed because of non-random program placement, self-selection bias of the control groups with their counterfactual and difficulty in measurement problem in outcome indicators. Some empirical studies shows access to microfinance brings poor household out of poverty through self-employment profits, investing in productive resources and empowering women. For example, a study by (Morduch , 1999; Mosley, 2001; Hashemi et al., 1996; Hulmed, 2000; and Khandker et al., 1998) shows there was an improvement for microfinace praticipant in their economic welfare, consumption and income. Similarly, Stephen and Shamiso (2013) indicated that, taking credit from microfinance enhances asset accomulation than household consumption outcome which made them less vulnerable to different idyosancratic shocks. Morover, a study by Hashemi et al.,(1996), Steele et al., (2001) and Schuler et al.,(1998) reveals that microfinance participation exerts a statistically significant impact on female empowerment such as conctraceptive usage and intra household decision making.

By using data from a randomized controlled trial conducted in 2003–2006 in rural Amhara and Oromiya regions of Ethiopia, Tarozzi, Desai, & Johnson (2015), investigated the impacts of increasing access to microfinance on a number ofsocioeconomicoutcomes, including income from agriculture, animalhusbandry, nonfarm self-employment, labor supply, schooling andindicators of women's empowerment. They estimated that in areas assigned to microcredit the value of livestock owned is consistent both with a 25% increase and a 10% decrease relative to communities assigned to control groups.

On the other hand, Colman (1999) and Alessandro et al.(2014) indicated that microfinance did not have any impact on household consumption, expendture in food items or education but postive and significant impact on health outcomes. A study by Aschale, Hilhorst and Pankhurst (2012) in South Gonder zone, Ethiopia shown that, credit failed to enable poor households to move out of poverty and food insecurity. For poor households, rather than achieving long-term livelihood improvements, access to credit only means short-term consumption smoothing with a risk of being trapped into a cycle of indebtedness.

3.1Data Collection Methods/ Sample Size and Sampling Technique

This study is conducted in Southern zone of Tigray, case of Oflaworeda. The study area, Oflaworeda, is selected purposively. This is because of the reality that, relative to other woredas in the southern zone, this woreda is more comfortable for small ruminant animals (sheep and goat) and others such as chicken and bee which are relatively liquid and there is a readily market in the vicinity of the households. In addition, it is harder to expect investment on expensive animals, like oxen, by a liquidity constrained households within short period of time.

This woreda has a total rural population of 138,372 with household size of 29,571 (CSA, 2007). Oflaworeda consists of 20 kebeles, of which 18 are rural kebeles. Our target was on the households of rural kebeles, where access to microfinance and investment on livestock is a common practice.

According to Yamane (1967), minimum sample size can be determined by using

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

Where n is the sample size, N is the number of households in the woreda, and e is the level of precision with 95% confidence level.

Thus, $n = \frac{29571}{1 + 29571(0.05)^2}$

= 395

On the basis of the availability of microfinance service, 6 kebeles were selected from 18 rural kebeles by using simple random sampling technique. Moreover, depending on the number of households in each selected kebele, the proportionate probability sampling technique was followed to determine sample household numbers for each kebele.

To summarize it, we used primary data which is collected from 395 rural households by using structured questionnaire and semi-structured interview. In addition, to supplement the primary source of data, research articles on Ethiopian economy and livestock, and a number of research articles, books and journals done on area of microfinance were critically reviewed in the study.

Method of Analysis/ Econometrics Model

As far as analysis is concerned, both descriptive and econometric methods are used. Descriptive statistics (mean, percentage, range) are employed to summarize the variables in the model. Econometric models, logit model, for the estimation of propensity scores, and propensity score matching are employed to estimate the effect of credit on livestock holdings measured in Tropical Livestock Unit.

In this paper, the treatment variable is participation in the micro-credit, T_i , a binary treatment indicator which equals 1 if the household i has participated in the microfinance credit[1], and zero otherwise. Since the access to credit is not random, i.e., participants differ from non-participants not only in their treatment status but also in many ways that affect livestock, the simple difference in livestock holdings between treated and non-treated will not identify the true impact of the program. That is the Average Treatment Effect on the Treated (ATT) can be calculated as $ATT = E(Y_1 - Y_0 | T = 1) = E(Y_1 | T = 1) - E(Y_0 | T = 1)$, where Y_1 and Y_0 are the livestock holdings for household with and without credit respectively. However, since the livestock holdings of the treated household without credit ($E(Y_0 | T = 1)$) cannot be observed, using the livestock holdings of untreated household as an estimate of counterfactual will generate bias. To circumvent the problem, we constructed proxy counterfactual outcome from untreated groups by using the Propensity Scores Matching (PSM) approach (following Rosenbaum and Rubin (1983); Dehejia and Wahba (1999)). This method hinges on two main identifying assumptions, i) the conditional independence assumption(CIA), which implies, given the observable covariates (X), the potential outcomes in the absence of treatment do not depend on treatment status ($X: y_1, y_0 \perp T|X$), and ii) the common support (overlap) assumption, the probability of each household participation in the microfinance credit should be between zero and one ($0 < Pr[\mathrm{T} = 1|\mathrm{X}] < 1$), i.e., for each treated household, there is another matched untreated household with similar observed covariates (X). In addition, the balancing condition which states $T \perp X|p(x)$is also considered.

To predict the propensity score, i.e., the probability of assignment to treatment participation, conditional on pre-intervention observed covariates ($p(x) = Pr[T = 1|X] = E(T|X)$), we used the binary choice model (logit model)[2]on key pre-intervention covariates that are expected to affect both the participation in the program and the outcome variable, livestock holdings in TLU. Following the prediction of the propensity scores, we applied various matching algorithms (for the purpose of robustness), such as Nearest-Neighbor Matching, Radius Matching, Kernel Matching, and Stratification Matching, which use the predicted propensity scores to match untreated households to treated households. To check the quality of matching, we employed balancing test (using t-test and *F*-test) for both before and after matching (Dehejiaand Wahba, 1999). The overlapping assumption is checked using graphical examination. In addition, the sensitivity to the specification of the propensity scores and selection on observables is tested.

As indicated in Caliendo and Kopeinig (2005), the Nearest Neighbor [NN] matching method is the most straightforward matching estimator with several variants, such as NN without replacement, NN with replacement, and NN with replacement and caliper. The NN matching without replacement indicates that only a single NN untreated household is considered as a match for a treated household, i.e., it is a one-for-one NN matching variant. On the other hand, in the case of NN matching with replacement, an untreated household can be used more than once as a match for treated households.

It is also suggested to use more than one nearest neighbor ('oversampling') which is important to see the influence of the inclusion of more comparison households for the construction of the counterfactual outcome on the estimated effects (Caliendo and Kopeinig, 2005). This k-NN matching method, where k > 1, takes more than one nearest neighbor for each treated household. In this matching method, the outcome of each treated household is contrasted to a weighted average of the outcome of the k-nearest neighbors; where an equal weight for each of the k neighbors is assumed, i.e., a simple average of the k-NN outcomes is estimated.

Another matching method used in this study is the radius matching method. This matching method is a variant of caliper matching method, but has an advantage to use not only the k-NN within each caliper but all of the control members within the caliper (Caliendo and Kopeinig, 2005). This means that in the caliper matching method, we focus on only k-nearest neighbors of the treated household if the difference in propensity scores of the treated and the control households is less than the predetermined tolerance, the caliper. In the radius matching, however, the number of control households may be more than k-NN as long as the difference in the propensity scores of the treated and the control households is less than the specified caliper. For instance, in the case of NN matching using k nearest neighbors of control households with a certain caliper, we can take k=3 but there may be other control households within the specified caliper which can be included by the radius matching method.

In the kernel matching method, all treated are matched with a weighted average of all controlswith weights that are inversely proportional to the distance between the propensity scores of treated and controls. The advantage of using kernel method is that by using all the information in the control set for each treated household the variance of the estimator is reduced. However, since even control households

[1]. We considered a household as beneficiary of credit if there is participation either in the group form or in the individual form of credit. The study uses the ex-post cross sectional data. That is households who took credit last year and paid the loan and currently ready to be participant of it.

[2]Following Gujarati (2004),$Pr[T = 1|X] = \frac{1}{1+e^{-(Z_i)}}$, where $Z_i = \beta_i X_i$

very far from the treated are used this can increase the bias (Caliendo and Kopeinig, 2005). In this study, the weights are calculated using the Gaussian kernel function, since it one of the widest employed kernel functions.[3]

Thus, by following the approach of Caliendo and Kopeinig (2005), after estimating the propensity score and implementing the matching estimator of choice, the PSM estimator for the ATT can then be written as: $ATT = \frac{\sum_{i\in T}[Y_i - \sum_{j\in M(i)} w_{ij} Y_j]}{N_T}$. This means that the observed outcome Y_i of each treated household i is compared with an estimate of $i's$ counterfactual outcome, $\sum_{j\in M(i)} w_{ij} Y_j$. The estimate of this counterfactual is obtained as the average outcome in the matching set for household $i, M(i)$ that represents the set of control households which are selected to match with i. Different methods choose differently the $M(i)$ and the weights to assign to matched controls, j belonging to $M(i)$. After an estimate of the counterfactual has been obtained for each treated household, the difference in the square bracket is calculated, and finally, the average over the treated is taken, dividing by N_T, the number of treated households.

For the purpose of improving the overlap (common support) assumption (Heckman, Ichimura, & Todd, 1997), treatment observations whose estimated propensity score was greater than the maximum or less than the minimum of the PS of comparison group were dropped. Similarly, comparison group observations were also dropped if their PS were below the minimum or above the maximum of PS of their counterparts. Most importantly, by using Absolute Standardized Bias [ASB] test and t-test the quality of balancing was also checked by testing that both treatment and comparison observations had the same mean distribution of propensity scores and of covariates in the case of both before and after matching. As suggested by Rosenbaum and Rubin (1985), the ASB is a measure of the average imbalance in each covariate X existing between treated and control units. For each covariate X, the ASB can be defined as the difference of sample means in the treated and matched control subsamples as a percentage of the square root of the average of sample variances in both groups. Generally, the ASB before and after matching is given by $ASB = \left| \frac{\bar{X}_T - \bar{X}_C}{\sqrt{0.5(S_T^2 + S_C^2)}} (100) \right|$ where $\bar{X}_T$ and $\bar{X}_C$ indicate the mean in the treatment and control groups, respectively, S_T^2 and S_C^2 are the variances in the treatment and control groups, respectively.[4]

RESULTS AND DISCUSSION

Descriptive Statistics

From the total sample size, 76.47% were beneficiaries of microcredit, whereas the remaining 23.53% were not participants. Female-headed households accounted for 17.14% of the sample households. From the total credit participant households, 82.61% were male-headed households and the remaining 17.39 % were female-headed participants. This reflects that male-headed households are more likely to be participants in the microcredit program than female-headed households (See Table 1 below).

Table 1: Distribution of sample by sex of household head and participation

Households Type	Obs.	**percent**
Participants		
Male-headed	247	82.61
Female-headed	52	17.39
Total	299	100
Non- Participants		
Male-headed	77	83.70
Female-headed	15	16.30
Total	92	100
Total	391	

Source: Own computation
Obs. = Observations

The mean of livestock holdings for both treated and non-treated households is presented in Table 2. Not surprisingly, given the targeting of the program, including all livestock, non-participant households had higher average livestock holdings than their microcredit beneficiary counterparts. It also reveals that even by excluding oxen that the households had, non-participant households had higher average livestock holdings. However, by including only the remunerative animals (such as sheep, goat, bees, chicken, etc), the mean livestock holdings of treated households is slightly higher than their counterparts. However, it is important to keep in mind that this is a descriptive analysis that exploits only the variation in the data between the two groups and it does not reveal anything about the underlying causal relationship between participation in the microcredit program and the outcome variable, livestock holdings (see Table 2 below).

Table 2: Mean value of livestock holdings (in TLU) by treatment status of respondents

[3] Each matching method has its own pros and cons; a trade-off between bias and variance (see Caliendo and Kopeinig, 2005).
[4] As a rule of thumb, balancing is considered acceptable for values of the ASB after matching smaller than 5% (caliendo and Kopeinig, 2005). There are also other approaches used to test the quality of matching. For instance, the joint significance and Pseudo-R^2 test (Sianesi, 2004) and the stratification test (Dehejia and wahba, 1999).

TLU including all		**TLU excluding Oxen**		**TLU for only remunerative animals**	
Treated	Non- treated	Treated	Non- treated	Treated	Non- treated
4.38	5.41	3.49	4.12	0.87	0.75

Source: Own computation

Table 3 presents the mean value of livestock by sex of household head. It shows that, regardless of the treatment status, male headed households had higher average livestock holdings in the study area. In addition, male headed treated households had higher average livestock holdings than treated female headed households. The variation in mean value of livestock for female headed participants and male-headed participants is statistically significant at 1% level (see Table 3 below).

Table 3: Mean value of livestock holdings (in TLU) by sex of the household head

Household																	
Female-headed									Male-headed								
Participant			Non-participant			Total			Participant			Non-participant			Total		
Mean	SD	ob	Mean	SD	Ob	Mean	SD	ob	Mean	SD	Ob.	Mean	SD	Ob.	Mean	SD	Ob
1.71	1.51	52	1.14	1.22	15	1.58	1.46	67	3.87	2.27	247	4.71	2.94	77	4.1	2.47	324

Source: Own computation
SD=standard deviation Ob. =observation

Table 4 presents the mean value of the livestock holdings by drought experience of households. It shows that the mean value of livestock holdings in TLU for drought affected households and non-affected households were 3.76 and 3.32 respectively. However, the mean average livestock holdings of treated drought affected households and treated non-drought affected households were 3.51 and 3.44 TLU, respectively. The simple t-test for mean value difference confirms that there is no a significant mean difference of livestock holdings between participant drought affected and non-affected households.

Table 4 Mean value of livestock holdings (in TLU) by drought dummy

Household type																	
Drought affected									Drought non-affected								
Participant			Non-participant			Total			Participant			Non-participant			Total		
Mean	SD	ob	Mean	SD	ob	Mean	SD	Ob	Mean	SD	Ob	Mean	SD	ob	Mean	SD	ob
3.51	2.37	229	4.8	2.72	56	3.76	2.49	285	3.44	2.1	70	3.1	3.25	36	3.32	2.53	106

Source: Own computation
SD=standard deviation Ob. =observation

Results from Propensity Score Matching

Table 5 presents the effect of credit participation on livestock holdings from various matching methods. It shows that the differences in the effect of the program among the employed matching methods are not large. However, since the Kernel matching resulted in the best balancing, the interpretation is done only from this matching algorithm. Hence, the result portrays that credit slightly enhanced livestock holdings by 0.10 TLU. Nevertheless, the effect is low and it is not statistically significant.

Table 5: Effect of credit on livestock holdings (in TLU)

Out come	Matching method		
	5-NN (0.05)	Radius (0.05)	Kernel
TLU	0.16 (0.13) [1.23]	0.17 (0 .13) [1.25]	0.10 (0.12) [0.88]

Source: Own computation
The outcome TLU indicates livestock holdings estimated using the PSM matching
-The first column under the matching method indicates nearest neighbor matching using 5 nearest neighbors with a caliper of 0.05, the second column indicates radius matching with a caliper of 0.05, and the last column implies Kernel matching using Normal density function with a bandwidth of 0.06 (the default).
- Values in parenthesis and bracket are standard errors and t-values, respectively. For the kernel matching method, bootstrap standard errors with replication of 100 is used.

Disaggregation

The disaggregation of the effect of the program was also conducted to see the impact disparities across sex of household head and drought experience of households. Hence, we create four subsamples; two subsamples of male-headed and female-headed households, and the remaining two were from drought affected and non-affected households. Accordingly, using the same econometric approach used in the full sample analysis, the propensity scores estimation and balancing test were also conducted for each subsample. However, when all observed covariates (including higher order and interactions terms) that were used in the estimation of propensity scores of the full sample were included in the estimation of propensity scores of each subsample, the balancing test indicates the existence of imbalance between the treated and non-treated households. As a result, the matching method which was applied and resulted in best balancing in the full

sample did not work for the subsamples. Thus, it is important to note that the key observed covariates which are expected to affect both the participation in the program and the outcome variable were the same for both the full sample and subsamples in the estimation of propensity scores. The inclusion of the higher order and interaction terms in the estimation of the propensity scores of subsamples was, however, conducted if and only if adding these terms resulted in an improved balancing condition.

Following the estimation of the propensity scores for each observation using each subsample,[5] the balancing test was conducted for various matching methods. Thus, using the subsamples from drought affected areas, the balancing test was checked using nearest neighbor matching using 5 nearest neighbors with a caliper of 0.05, radius matching with a caliper of 0.05, and kernel matching methods. Among these matching methods, the nearest neighbor matching using 5 nearest neighbors with a caliper of 0.05 resulted in the best balancing. The overall average bias before and after matching was found to be 17.6% and 9.5%, respectively. However, using this matching algorithm and specification, the balancing test indicates that bias for covariates such as number of dependent family members, dummy for death of livestock, dummies for illiterate and informal education level of the household head, and wealth index was above 10% after matching, but the imbalance on these covariates was not statistically significant.

Table 6 presents the estimated effect of the microfinance, credit, on livestock holdings using various matching methods listed above. However, since the nearest neighbor matching using 5 nearest neighbors with a caliper of 0.05 resulted in the best balancing, the interpretation of the results for drought affected households subsample is based on this matching method. The result from the PSM approach shows that participation in credit component deteriorated the livestock holdings; but not statistically significant.

Similarly, using the same matching methods used in for the drought affected households, the kernel matching resulted in the best matching quality for the subsample of households that were not affected by drought. The overall average bias was 17% and 3.2% before and after matching, respectively. This matching was also very strong; none of the differences was statistically significant.

Table 6: Disaggregation of effect of credit on livestock holdings

Sample	Out come	Matching methods		
		5-NN(0.05)	Radius (0.05)	Kernel
Drought affected households	TLU	**-0.36** **(0.43)** **[-0.83]**	-0.45 (0.44) [-1.01]	-0.45 (0.43) [-1.04]
Drought non-affected households	TLU	0.08 (0.28) [0.27]	0.20 (0.23) [0.85]	**0.14** **(0.22)** **[0.63]**

Source: Own computation

The first column under the matching method indicates the nearest neighbor matching using 5 nearest neighbors with a caliper of 0.05, the second column indicates radius matching with a caliper of 0.05, and the last column implies Kernel matching using Normal density function with a bandwidth of 0.06 (the default).

- Values in parenthesis and bracket are standard errors and t-values, respectively. For the kernel matching method, bootstrap standard errors with replication of 100 is used.

Considering the sex of household head, the estimation of propensity scores and the balancing test were also conducted on subsamples of female-headed and male-headed households using the same matching algorithms stated above. For both female-headed and male-headed subsamples, the kernel matching algorithm resulted in the best balancing; and hence the interpretation of the effect of the program for these subsamples hinges on this matching method.

The disaggregation on the effect of credit participation by sex of the household head is presented in Table 7. The result from both PSM shows that participation in the credit deteriorated livestock holdings for female-headed households. However, this effect was not statistically significant. On the contrary, for male-headed participant households, the result from PSM indicates that credit participation increased livestock holdings by 0.25 TLU. However, the effect was not statistically significant.

Table 7: Disaggregation of effect of participation in credit on livestock holdings by sex of the household head

Sample	Out come	Matching methods		
		5-NN(0.05)	Radius (0.05)	Kernel
Female-headed	TLU	0.14 (0.34) [0.39]	-0.10 (0.38) [-0.27]	**-0.13** **(0.36)** **[-0.38]**
Male-headed	TLU	0.47 (0.25) [1.91]	0.34 (0.24) [1.40]	**0.25** **(0.23)** **[1.11]**

Source: own computation

-The first column under the matching method indicates the nearest neighbor matching using 5 nearest neighbors with a caliper of 0.05, the second column indicates radius matching with a caliper of 0.05, and the last column implies Kernel matching using Normal density function with a bandwidth of 0.06 (the default).

- Values in parenthesis and bracket are standard errors and t-values, respectively. For the kernel matching method, bootstrap standard errors with replication of 100 is used.

Conclusion and Recommendations

[5]The result of propensity scores estimation using each subsample is available on request by the authors.

The study was set out to investigate the effect of microfinance, particularly credit, on livestock holdings of the rural households in Oflaworeda, Tigray region. Specifically, the study sought to answer the following research questions: 1) Does the microfinance have a significant effect on livestock holdings? 2) Does microfinance protect livestock holdings in times of shocks (such as drought)? 3) Does the effect of credit participation vary across gender of the household head?

Propensity score matching technique was used to analyze the effect of credit participation on livestock holding in the study area, Oflaworeda. Various matching methods such as nearest neighbor matching using 5 nearest neighbors with a caliper of 0.05, radius matching with a caliper of 0.05, and the kernel matching methods were used for the purpose of robustness check. Albeit the result from the PSM was not statistically significant, it indicates that credit participation had positive effect on the livestock holdings. Moreover, we found evidence of large and significant heterogeneities in outcomes depending on experience of shocks (drought) and sex of the household head. Specifically, even if the result is not statistically significant, taking households' experience of drought shocks, there was evidence that credit participation had more adverse effect on livestock holdings for participant households that were affected by drought than participant households that were not affected by the shock. Similarly, participating male-headed households have benefited more from participation in credit in terms of livestock holdings than female-headed participant households.

The policy implication of the study is that the accessibility of microcredit should be scaled up since it has an effect on the livestock holdings which in turn increase the livelihood of the rural households, thereby plays positive role on poverty reduction. However, due to lack of panel data, we could not able to look at changes in outcomes, livestock accumulation, at the household level, and hence, it is open for further investigation.

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