What factors affect households' decision to allocate credit for livestock production? Evidence from Ethiopia

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Abstract

Access to credit is often viewed as a key to transform semi-subsistence smallholders into market oriented producers. However only few studies have examined factors that affect farmers' decision to allocate credit on farm activities in general and livestock production in particular. A trivariate probit model with double selection is employed to identify factors that affect farmers' decision to allocate credit on livestock production using data collected from smallholder farmers in Ethiopia. After controlling for two sample selection bias – taking credit in the production season and decision to allocate credit on farm activities – land ownership and access to a livestock centered extension service are found to have a significant ($p<0.001$) effect on farmers decision to use credit for livestock production. The result showed farmers with large land holding, and access to a livestock centered extension services are more likely to utilize credit for livestock production. However since the effect of land ownership squared is negative the effect of land ownership for those who own a large plot of land lessens. The study highlights the fact that improving access to credit does not automatically translate into more productive households. Improving farmers' access to credit should be followed by a focused extension services.

Key word: livestock production, credit access, credit allocation, household decision, double sample selection
JEL Code: Q12. Q14. Q16. D13.C34

Introduction

There has been a general consensus about the importance of credit as a tool for agricultural development. This is particularly more so in developing countries where farmers often operate with minimum capital and trapped in a vicious ‘‘low investment → low return → low investment’’ cycle. In this case agricultural credit is considered an important factor for increased agricultural production and rural development because it enhances productivity and promotes standard of living by breaking the vicious cycle of poverty of small scale farmers.

The main argument for this is that provision of credit will increasingly lead to increased incomes of rural populations, mainly by mobilizing resources for more productive uses. Thus, the usefulness of any agricultural credit program apart from its availability, accessibility and affordability also depends on its proper and efficient allocation and utilization for the intended purpose by farmers (Oboh VU, Ekpebu ID, 2011). This has also an implication on repayment rate and loan default among farmers.

In this regard it is important to understand why some farmers use credit for productive purposes while other spends it on non-productive activities or uses it to meet their daily consumption. A better understanding of the farmers' behavior in allocating credit would provide useful information for project implementers and financial institutions that works with small-scale farmers.

Credit to farmers can be categorized into cash credit (loans given to farmers by financial institutions), and non-cash credit which comprise the supply of inputs to farmers by government or cooperatives for which these farmers make payments after harvesting. This study is focused on cash credit (i.e., loans that farmers received from the financial institutions).

The main objective of this paper is to explore factors that affect farmer's decision to allocate credit on livestock production. For this purpose a probit model with double sample selection is used.

This rest of the paper is organized as follows. Section two provides the literature review. Section three describes the research methodology that includes analytical techniques, the data source and collection procedures as well as description of explanatory variables used in the model. Section four presents the descriptive and econometrics result. Section five discuss the findings followed by section sex which concludes the paper and draw implication.

Credit and Agriculture

Financial services (including Credit, Savings & Insurance) are crucial inputs required by the smallholder farmers in developing countries. Credit & savings help small holders to establish and expand their farms with the aim of increasing agricultural production, invest in land improvements or agricultural technology, enhancing food sufficiency, promoting household and national income, and augmenting the individual borrower's ability to repay borrowed fund. It enables the poor farmers to tap the financial resources and take advantage of the potentially profitable investment

opportunities and establish or expand family enterprises in their immediate environment (Zeller & Sharma 2000).

Using time series data, Wakilur M. Rahman et al. (2011) assessed the relationship between agricultural credit and farm production. The study found that overall the relationships between credit disbursement and Livestock production - milk, meat and eggs were correlated with the point of 0.772, 0.938 and 0.688 respectively and statistically significant at 1% level.

Freeman H.A., et.al (1998) assessed the impact of credit on smallholder dairy farms in the East African highlands using farm level data from Ethiopia and Kenya. This study showed there is no consistent relationship between farmers' credit constraint condition and their borrowing status. Rather there was variation in milk output per farm that was explained by the number of crossbred milking cows in the dairy herd. The study also showed that availability of credit would more likely facilitate investment in crossbred dairy cows and its impact will be more if it target credit constrained farms.

From the demand side, the need for credit facilities is necessitated by the limitations of self-financing, uncertainty pertaining to the levels of output, and the time lag between inputs and output. Thus credit access play an important role and increase farmer's income and stabilize the rural economy by improving the quality and quantity of farm products (Kohansal and Mansoori, 2009).

The agriculture sector plays an important role in the employment and production of the Ethiopian economy. In 2012/2013, the sector employs 80 percent of the population and the share of agriculture in the GDP stood at 42.70 percent (EEA 2014). This sector is dominated by small holder producer who are resource poor. This limits the extent to which they self-finance their production activities. Furthermore the sector they are engaged is less attractive for financial institution.

Though there are a number of financial institutions operating in the country 19 banks, 31 MFIs, 17 insurance companies and 5,900 RUSACCOs (NBE Annual Report, 2013/2014) recent data shows that the agricultural sector received an average of only 9.6 of the total loan portfolio of commercial banks. Furthermore though MFIs and RUSACCOs are a major source of agricultural credit the combined contribution is a little more than 7% of the national loan portfolio (World Bank, 2012).

This is largely because the agriculture sector is considered as a high-risk investment and conventional finance always aimed at reducing the risk of loan default using different mechanisms such as pledging of collateral, third-party credit guarantee, use of credit rating and collection agencies, etc. (Kohansal and Mansoori, 2009). Collateral requirement is one of the major reasons that constrain access to credit and loan size.

In Ethiopia a World Bank study (2009) shows that all loans require collateral and usually the value of collateral is higher than the amount of credit requested and granted. This practice by financial institution further hinder smallholder from participating in the credit market. In addition to collateral received literature identified a number of factors that affect farmers' access to credit. By analyzed the demand and use of financial services among rural clients in China, Cheng (2007) found out that household income, off-farm and farm investment opportunities and access to rural credit cooperatives increase demand for credit. Shehla Amjad and SAF Hasnu (2007) analyze smallholders' access to rural credit (formal and informal sources) in Pakistan and found out that tenure status, family labor, literacy status, off-farm income, value of non-fixed assets, infrastructure quality and total operated area are factors that affect farmers' access to credit.

Similar study by Shallone K. Chitungo and Simon Munongo (2013) concluded that the type of crop, age, household size and gender of household head are primary factor that determine household access to rural credit in Zimbabwe.

Sebopetji and Belete (2009) in South Africa, found out that farming experience, gender and marital status have positive significant effect on farmers' decision to use credit. And in contrast, farmers' age, education level and membership to farmers' association had negative significant effect.

A study by Amha W. (2009) on factors influencing the decision of smallholder farmers in Ethiopia using binary logit model identified that land size, age of the household head, level of education and access to extension services are significant factors influencing the decision. Amount of land owned has a positive & significant effect on access to credit indicating that farmers with large land size have higher probability of taking loan compared to farmers with lower land size. Also farmers with relatively higher level of education have higher probability of accessing loan from diverse finance providers. The age of the household head has a negative and significant effect on access to loan implying that relatively younger household heads have higher probability of taking loans. With 10% significant level, farmers who were frequently visited by extension agents had higher probability of borrowing loan from diverse finance providers.

The study by Jabbar M.A. et.al (2002) looked at the livestock credit supply of public institutions in Ethiopia, Kenya, Uganda and Nigeria. The analysis revealed that sex and education of the household head, training in dairy, prevalence of outstanding loan and the number of improved cattle on the farm had significant influence on both borrowing and liquidity status of the household.

Our review of the existent literature indicates that both socio-economic characteristics of households and access to rural institutions as well as quality of infrastructure affect household access credit. The fact that rural institutions and infrastructure paly a determinate role in small holder access to credit indicates that there is room to improve and make credit play significant role by focusing on these important rural institutions.

For access to credit to be translated into improved quality and quantity of farm products households should decide and allocate available credit on productive investments. In fact the negative effect of credit diversion and misallocation has been recognized by different authors (Awoke, 2004; Nwaru, J. C. and R. E. Onuoha, 2010; Ugbem Oboh and Ineye Douglas Ekpebu (2011) and John K. M. Kuwornu et.al, 2012)

One of such studies is by Victor Ugbem Oboh and Ineye Douglas Ekpebu (2011) who used cross sectional data to identify determinants credit allocation to the farm sector in Nigeria. Their result showed that age, education, farm size, household size, length of loan delay and visitation by bank officials have significant effect of household decision to allocate credit on agricultural activities.

A related study by Kuwornu K. M. J et.al (2012) looked at both factors influencing agricultural credit allocation and constraint condition of maize farmers in the Upper-Manya Krobo District in the Eastern region of Ghana using Tobit model. Their study find out that age, bank visits before credit acquisition and the amount (size) of credit received have significant influence on the rate of agricultural credit allocation to the farm sector.

As mentioned earlier improving access to credit has an important role in improving the agricultural sector in general and the livestock sector in particular. In Ethiopia where the livestock sector account about 33% and 12% of the agricultural and total Gross Domestic Product (GDP) respectively, 12–15% of total export earnings, 37% – 87% household cash income and provides livelihood for 65% of the population (Ayele et.al, 2003) improving access to credit and creating favorable environment so that households allocate credit for livestock production is expected would bring considerable gain.

However the flow and impact of credit and other financial services to the livestock sector in Ethiopia has not been properly documented Amha W. (2008). To the best of our knowledge there is no studies that try to identify factors that influence farmer's decision to allocate credit for livestock production. This study is expected fill this literature gap.

3. Method and material

Our aim is to understand why households allocate credit on livestock production such as dairy production, cattle fattening, small ruminant production, poultry and apiculture and non-livestock activities. Thus only those who took credit are going to be included in our analyses. However restricting our analysis to sample of household who took credit leaves us with a self-selected sample. The immediate consequence is that the result we obtain from this sub-sample could not be generalized to the households and this will lead us to producing misleading conclusion.

The paper assume that household's decision whether to allocate credit on livestock production would first have to take credit and then decided to allocate the credit on agricultural productive

activities. To estimate the above three stage decision problem the paper uses a modified version of a method developed by Heckman (1979).

The model has three dependent variables namely Y_{1i}(credit market participation), Y_{2i}(given that a household took credit whether or not the credit is allocated for farm activities) and Y_{3i}(given that the household took credit and decided to allocate the credit on farm activities whether the household decided to allocate the credit on livestock production). Thus the three dependent variables (Y_{1i},Y_{2i} andY_{3i}) are dichotomous. Following standard treatment of dichotomous dependent variables the paper assume the existence of three latent variables corresponding to the above three dichotomous dependent variables.

$$\begin{aligned} Y_{1i}^{*} &= x_{1i}\beta_1 + u_{1i} \\ Y_{2i}^{*} &= x_{2i}\beta_2 + u_{2i} \\ Y_{3i}^{*} &= x_{3i}\beta_3 + u_{3i} \end{aligned} \qquad (1)$$

Where β_j are vector of coefficients to be estimated and x_{ji} are vector of explanatory variables that reflect the household characteristics, their socio-economic status and access to infrastructures and institutions. Following Greene (2008), the dependent are mapped as follow

For credit participation equation

$$Y_{1i} = \begin{cases} 1, & if\ Y_{1i}^{*} > 0 \\ 0, & Otherwise \end{cases} \qquad (2)$$

For household decision whether to allocate the credit on farm activities provided that the household took credit ($Y_{1i} = 1$)

$$Y_{2i} = \begin{cases} 1, & if\ Y_{2i}^{*} > 0 \\ 0, & Otherwise \end{cases} \qquad (3)$$

For household decision whether to allocate the credit on livestock production provided that the household took credit ($Y_{1i} = 1$) and decided to use the credit on farm activities ($Y_{2i} = 1$)

$$Y_{3i} = \begin{cases} 1, & if\ Y_{3i}^{*} > 0 \\ 0, & Otherwise \end{cases} \qquad (4)$$

By making the following assumptionsβ_1, β_2 and β_3 can be estimated jointly (Carreon V. and Garcia L. J., 2011; Dubine, R., 1989). First the explanatory variables x_{1i} , x_{2i} and x_{3i} are assumed to be independent of u_{1i},u_{2i} andu_{3i}. Second, x_{1i}, x_{2i}, x_{3i}, u_{1i} , u_{2i} and u_{3i} are assumed to be independently and identically distributed. Third the error terms in EQ (1) have a trivariate normal distribution of $\Phi(x_{1i}\beta_1,\ x_{2i}\beta_2,\ x_{3i}\beta_3; \rho_{12}, \rho_{13}, \rho_{23})$ with the following parameters.

$$u_i = \begin{bmatrix} u_{1i} \\ u_{2i} \\ u_{3i} \end{bmatrix} \sim i.i.d.N\left(\begin{bmatrix} u_{1i} \\ u_{2i} \\ u_{3i} \end{bmatrix}, \begin{bmatrix} 1 & \rho_{12} & \rho_{13} \\ \rho_{21} & 1 & \rho_{23} \\ \rho_{13} & \rho_{32} & 1 \end{bmatrix} \right)$$

To construct the log likely hood function for the specification above we need the probabilities for the four possible outcomes. Household not taking credit at all during the production year (Y_{1i} =0), a household taking credit, deciding to allocate on farm activities and actually using it on livestock production (Y_{1i} =1 and Y_{2i} =1 and Y_{3i} =1), a household taking credit, deciding to allocate on farm activities and actually using it for non-livestock production (Y_{1i} =1 and Y_{2i} =1 and Y_{3i} =0) and household taking credit but using it for non-farm activities. (Y_{1i} =1 Y_{2i} =0).

The probability of a household not taking credit at all during the production year (Y_{1i} =0) is given by

$$\begin{aligned}\Pr(Y_{1i}=0) &= \Pr(Y_{1i}^{*}\leq 0)\\ &= \Phi(-x_{1i}\beta_1)\end{aligned} \quad (5)$$

The probability of a household taking credit, decided to use the credit on farm activity and actually using the credit for livestock production is given by;

$$\begin{aligned}&\Pr(Y_{1i}=1, Y_{2i}=1, Y_{3i}=1)\\ &= \Pr(Y_{1i}^{*}>0)*\Pr(Y_{2i}^{*}>0|Y_{1i}^{*}>0)*\Pr(Y_{3i}^{*}>0|Y_{1i}^{*}>0, Y_{2i}^{*}>0)\\ &= \Phi(x_{1i}\beta_1, x_{2i}\beta_2, x_{3i}\beta_3; \rho_{12}, \rho_{13}, \rho_{23})\end{aligned} \quad (6)$$

The probability of a household taking credit, decided to use the credit on farm activity and actually using the credit for non-livestock production is given by;

$$\begin{aligned}&\Pr(Y_{1i}=1, Y_{2i}=1, Y_{3i}=0)\\ &= \Pr(Y_{1i}^{*}>0)*\Pr(Y_{2i}^{*}>0|Y_{1i}^{*}>0)*\Pr(Y_{3i}^{*}\leq 0|Y_{1i}^{*}>0, Y_{2i}^{*}>0)\\ &= \Phi(x_{1i}\beta_1, x_{2i}\beta_2; \rho_{12}) - \Phi(x_{1i}\beta_1, x_{2i}\beta_2, x_{3i}\beta_3; \rho_{12}, \rho_{13}, \rho_{23})\end{aligned} \quad (7)$$

The probability of a household taking credit and using it on non-livestock activities is given by;

$$\begin{aligned}\Pr(Y_{1i}=1, Y_{2i}=0) &= \Pr(Y_{1i}^{*}>0)*\Pr(Y_{2i}^{*}\leq 0|Y_{1i}^{*}>0)\\ &= \Phi(x_{1i}\beta_1) - \Phi(x_{1i}\beta_1, x_{2i}\beta_2; \rho_{12})\end{aligned} \quad (8)$$

Given the above possible outcome together with their probabilities as given in EQ 5- 8, the log likelihood function can be written as;

$$\begin{aligned}&lnL(\beta_1, \beta_2, \beta_2; \rho_{12}, \rho_{13}, \rho_{23})\\ &= \sum_{i=1}^{n}\{Y_{1i}Y_{2i}Y_{3i}\ln\Phi(x_{1i}\beta_1, x_{2i}\beta_2, x_{3i}\beta_3; \rho_{12}, \rho_{13}, \rho_{23})\\ &+ Y_{1i}Y_{2i}(1 - Y_{3i})\ln[\Phi(x_{1i}\beta_1, x_{2i}\beta_2; \rho_{12}) - \Phi(x_{1i}\beta_1, x_{2i}\beta_2, x_{3i}\beta_3; \rho_{12}, \rho_{13}, \rho_{23})]\\ &+ Y_{1i}(1 - Y_{2i}\ln[\Phi(x_{1i}\beta_1) - \Phi(x_{1i}\beta_1, x_{2i}\beta_2; \rho_{12})]\\ &+ (1 - Y_{1i}\ln\Phi(-x_{1i}\beta_1)\}\end{aligned} \quad (9)$$

Maximizing the above likelihood function involve evaluation of trivariate normal distributions. Hajivassiliou and Ruud (1994) argue that standard linear numerical approximations are inefficient and may provide poor approximations. In such case simulation-based methods provide better result (Cappellari and Jenkins, 2006). From the families of simulation-based methods, Geweke-

Hajivassiliou-Keane (GHK) smooth recursive conditioning simulator are the most widely used simulation method and are found to be efficient in the context of multivariate normal limited dependent variable models (Borsch-Supan and Hajivassiliou 1993). Thus the above likelihood function is maximized using method of simulated maximum likelihood. For this purpose Roodman, D. (2011) cmp's modeling framework is used to estimate the model coefficients.

Empirical model

Following from the aforementioned discussion the empirical model for quantifying the factors which influence farmer's decision to allocate credit for livestock production is specified as follows. The model has one outcome equations and two selection equations.

The outcome equations is given by

$$
\begin{aligned}
&Y_{3i} = x_{3i}\beta_3 + u_{3i} \\
&cruse\_l_i = \beta_{30} + \beta_{31}hhsex_i + \beta_{32}hhysch_i + \beta_{33}hhage_i + \beta_{34}lando\_ha_i \\
&\qquad + \beta_{35}lando\_ha2_i + \beta_{36}tdratio_i + \beta_{37}adequive_i \\
&\qquad + \beta_{38}hhwealth_i + \beta_{39}hhdistlm_i + \beta_{310}knowinfool_i \\
&\qquad + \beta_{311}hhdistawr_i + \beta_{312}hhdistlm_i + \beta_{313}tglptlu_i + u_{3\mathrm{i}}
\end{aligned}
\qquad (10)
$$

The credit market participation equation which deals with whether farmers get credit in the production period is given by

$$
\begin{aligned}
&Y_{1i} = x_{1i}\beta_1 + u_{1i} \\
&\quad credit_i = \beta_{10} + \beta_{11}hhsex_i + \beta_{12}hhysch_i + \beta_{13}hhage_i \\
&\qquad + \beta_{14}hhage2_i + \beta_{15}lando\_ha_i + \beta_{16}lando\_ha2_i + \beta_{17}tdratio_i \\
&\qquad + \beta_{18}adequive_i + \beta_{19}hhwealth_i + \beta_{110}hhext\_a_{i_i} \\
&\qquad + \beta_{111}hhdistawr_i + \beta_{112}hhmobile_i + \beta_{113}hhdismif_i + u_{1\mathrm{i}}
\end{aligned}
\qquad (11)
$$

Finally the second selection equations which explain why farmers allocate credit for farm activities is given by;

$$
\begin{aligned}
&Y_{2i} = x_{2i}\beta_1 + u_{2i} \\
&\quad cruse\_a_l = \beta_{20} + \beta_{11}hhsex_i + \beta_{12}hhysch_i + \beta_{13}hhage_i + \beta_{14}lando\_ha_i \\
&\qquad + \beta_{15}lando\_ha2_i + \beta_{16}tdratio_i + \beta_{17}adequive_i \\
&\qquad + \beta_{18}hhwealth_i + \beta_{19}hhdism\_a_i + \beta_{110}hhext\_a_i + \beta_{111}irraccess_i \\
&\qquad + \beta_{112}agridens_i + \beta_{113}hhdistawr_i + u_{2\mathrm{i}}
\end{aligned}
\qquad (11)
$$

Variables that entered in EQ (10-12) together with their description and their expected effect on the three dependent variables is summarized in table 1.

Table 1: Data definition and description

Dependent variables				
Variable name	Variable Description			
credit	Credit status of the household during the production period (1=if the household took credit 0 otherwise			
credit_a	Dummy variable that takes 1 if the household decide to allocate the credit for farm activities and 0 otherwise			
credit_l	Dummy variables that takes 1 if the household allocated the credit for livestock production and 0 otherwise			
Explanatory variables				
Variable name	Variable Description	Expected sign		
		Y_{1i}	Y_{2i}	Y_{3i}
hhsex	Sex of household head (1= Male 0= Female)	+	+/-	+/-
hhysch	Highest schooling of the household head	+/-	+/-	+/-
hhage	Age	+/-	+/-	+/-
hhage2	Age square. Included to see if there is non-linear relationship with the dependent variable	+/-	+/-	+/-
lando_ha	Land owned by the household in hectare	-	+/-	+/-
lando_ha2	Land owned square. Included to see if there is non-linear relationship with the dependent variable	+/-	?	+/-
tdratio	Total dependency ratio (number household member aged <15 and > 64 divided by the those aged 15-64	+	-	+/-
Aequive_n	Labor supply of the household measured in terms of adult equivalent	+	+	+/-
hhwealth	Household wealth	+	+/-	+/-
hhdistlm	Distance to livestock market (in walking minute)			+
exten_l	Household access to extension services on livestock production (1 if the household received extension services 0 otherwise			+
hhdistawr	Distance to all weather road (in walking minute)		+	+
hhdisvetp	Distance to veterinary post (in walking minute)			+
tglptlu	Amount of land available for grazing in hectare			+
hhdism_a	Distance to agricultural market (in walking minute)		+	
hhext_a	Household access to general extension services (1 if the household received extension services 0 otherwise		+	
irraccess	Household access to irrigation water(1 if the household has access to irrigation water 0 otherwise		+	
agridens	Agricultural density measured by dividing total cultivable land by total number of household in the PA		-	
hhmobile	Dummy variable that taks 1 if the household has mobile phone and 0 otherwise	+		
hhdismfim	Distance to microfinance institution (in walking minute)	-		

This analysis is based on data drawn from LIVES[1] baseline survey conducted in 2014. The data was collected from February to April 2014 from randomly selected rural households in four regions of Ethiopia (Amhara, Oromia, SNNPR and Tigray). These four regions jointly constitute the largest share of the nation's crop and livestock productions and cover the major agro-ecologies of the country. The sampling followed a multistage sampling strategy that involves stratification and clustering of PAs based on their agro-ecological zone and suitability for the project commodities. Households were selected based on proportionality to size random sampling.

Result and discussion

The analysis is based on 1,400 (275 female and 1,125 male headed) households. These are household that has a positive credit demand during the production season. The descriptive result followed by the result of the econometrics analysis is presented in this section.

Household characteristics

The socio-economic characteristics of the household reveal that the average age of the household is 44 years. The younger household head included in the sample was 20 years while the oldest and the more experienced was found to be 87 years old (table 2). On average the household head had 2.4 years of formal education with 1.44 and 2.6 years for female and male household head.

[1] Livestock and Irrigated Value chains for Ethiopian Smallholders (LIVES)—an ongoing collaborative research for development project implemented by ILRI, IWMI, the Ministry of Agriculture, the Ethiopian Institute of Agricultural Research, the Ethiopian Ministry of Agriculture, regional bureaus of agriculture, livestock development agencies, regional agricultural research institutes—aim to improve competitiveness, sustainability and equity in value chains for selected high-value livestock and irrigated crop commodities in four regions (Tigray, Amhara, Oromia and SNNPR) of Ethiopia. Supported by Foreign Affairs, Trade and Development Canada (DFATD) the project is expected to last until March 2018.

As part of the project monitoring and evaluation framework a baseline survey was conducted in February –April 2014 on 5,000 households randomly selected using a multistage cluster sampling techniques from the ten project zones. Using electronic data collection method detailed data on socio-economic status and agricultural activities of the households during past production season (June 2012-July 2013) were collected. The survey were led by senior scientists from ILRI (Project website: http://lives-ethiopia.org)

Table 2: Descriptive statistics of variables

Variable	Obs	Mean	Std.Dev	Min	Max
hhysch	1400	2.389286	3.202353	0	15
hhage	1400	44.24857	11.13018	20	87
lando_ha	1400	1.329643	1.28136	0	17.75
tdratio	1397	1.113611	0.80094	0	4
aequive_n	1400	4.288071	1.372843	1	11.5
hhwealth	1400	33078.56	59338.16	0	843220
hhdistawr	1323	43.98828	69.18416	0	650
hhdistlm	1369	88.63002	63.49122	0	600
tglptlu	1389	0.077625	0.134723	0	1.583269
hhdism_a	1377	78.35784	53.52518	0	360
agridens	1393	1.055154	0.941818	0.160938	14.11207
hhdismfim	1362	53.45338	65.86911	0	540
credamt	922	3885.946	3513.114	100	70000
credterm	922	13.59761	8.638205	1	60
intrate	922	13.63015	6.778878	0	50
credsourcdis	922	101.7798	83.87167	1	600

	Frequency				
Variable name	Yes		No		
	Obs	%	Obs	%	Total obs
Household own mobile phone (hhmobile)	638	45.57	762	54.43	1400
Household received extension service on livestock production (knowinfol)	924	66	476	34	1400
Household had irrigation access(irraccess)	102	7.29	1298	92.71	1400
Household received extension service on agricultural production (knowinfol)	1146	81.86	254	18.14	1400
Household took credit in the production season (credit)	922	65.86	478	34.14	1400
Household decided to allocate the credit for farm activities (credit_a)	583	63.23	339	36.77	922
Household decided to allocate the credit for livestock production (credit_l)	196	33.62	387	66.38	583

The result (Table 2) further shows that the average household has about 6.17 household members and has 3.22 members with working ages (ages15-64). A typical household in the sample own about 1.32 hectare of land and has total wealth estimated at 3,078 birr[2].

Source and access to credit

Microfinance institutions are the primary source of credit for the majority of households (Table 3). Of those who managed to get credit 715 household which account 77.55% get their credit from microfinance. Informal sources such as friends, relatives and neighbors also serve the credit needs of our sampled households. Not surprisingly formal banks have very limited role in providing credit to the small scale farmers.

Table 3: Source of credit by household head sex

Source of credit	Male		Female		Total	
	Obs	%	Obs	%	Obs	%
Banks	4	0.5%	0	0.0%	4	0.4%
Friends/relatives/neighbors	58	7.9%	15	7.9%	73	7.9%
Buying traders	1	0.1%	2	1.1%	3	0.3%
Microfinance	580	79.2%	135	71.1%	715	77.5%
Other sources	13	1.8%	9	4.7%	22	2.4%
Cooperatives	57	7.8%	13	6.8%	70	7.6%
NGOs	9	1.2%	12	6.3%	21	2.3%
Government	10	1.4%	4	2.1%	14	1.5%
Total	732	100.0%	190	100.0%	922	100.0%

The gender disaggregated data also reflect the same pattern. Microfinance is the primary source of credit for both male (79.2%) and female (71.1%) household heads followed by informal sources such as friends, relatives or neighbors and cooperatives. NGOs that are engaged in giving credit to farmers seemed to prefer female household heads. This could be because in rural setting female households heads are among the vulnerable groups and get priority in development efforts as a form of affirmative action.

On average the sample households have to travel 9.9 km (10 km for male and 9.3 km for female headed households) to reach the credit source (Table 4). This translated into about 1.41 walking hours. The result of our analysis suggest that there is no statistically significant difference between male and female headed household physical access (measured by distance to credit source in km and walking distance to the credit source in minutes) to credit source. This should not be interpreted as male and female headed household having equal access to credit since physical access is only one variable in determining household access to credit. Rather in conjunction with

[2] The official exchange rate of 1USD is equal to 20.4322 birr as of February 23, 2015

the result in table 3 the result indicate that female headed household limited access to credit is not due to the lack of physical access.

Table 4: Physical accessibility of credit sources by gender

Physical accessibility of credit source		Mean	Standard Deviation	Maximum	Minimum	Total obs.
Distance (km) from home to source of credit (one way)	Male	10.077	8.673	60.000	.100	732
	Female	9.364	7.575	42.000	.100	190
Distance (walking minutes from home to source of credit (one way)	Male	102.42	85.32	600.00	1.00	732

Credit amount

The average credit amount was about 3,886 birr which ranges from 100 to 70,000 birr. Credit amount disaggregated by sex of the household head reveals that on average the amount of credit received by male headed households is higher (4,075 birr compared to 3,156 birr) than their female counterpart (Table 5) and the difference is found to be statistically significant ($t = 3.230$, $p = .000$). This is in contrast to the result obtained by Okonya and Kroschel (2014) which found no statistically significant difference between credit amount received by male and female headed household in Uganda.

Table 5: Credit amount by sex of household head

Sex of household head	Amount of credit taken (Birr)				Total obs.
	Mean	Standard Deviation	Maximum	Minimum	
Male	4,075.35	3763.03	70,000.00	100.00	732
Female	3,156.23	2167.92	18,000.00	100.00	190

Household who took credit from formal financial institutions such as microfinance and banks on average get higher amount of credit that those who took credit from the informal sources (Table 6) and the difference is found to be statistically significant (chi-square with seven degrees of freedom 192.634, $p = .000$). For instance the average amount of credit taken by a household from microfinance is estimated at 4,351.64 birr while on average only 1,599 birr is taken from friends/relatives/neighbors. This could be because credit taken from informal sources is mainly used to cover household expenditure and it is highly likely that the amount needed to cover household expenditure is less than what is needed for other purposes such as crop and livestock production.

Table 6: Credit amount by source of credit

Source of credit	Mean	Standard Deviation	Maximum	Minimum	Total obs.
Banks	3,510.00	1759.13	5,060.00	980.00	4
Friends/relatives/neighbors	1,598.90	3303.85	20,000.00	100.00	73
Buying traders	1,700.00	2042.06	4,000.00	100.00	3
Microfinance	4,351.64	3614.31	70,000.00	150.00	715
Others	2,577.27	2198.04	10,000.00	100.00	22
Cooperatives	2,181.61	1369.15	7,000.00	300.00	70
NGOs	3,605.43	2639.81	10,000.00	500.00	21
Government	3,602.14	2329.23	10,000.00	430.00	14

On average household spend more on livestock and crop production than on household expenditure (Table 7) and chi square test for association indicates that the difference is statistically significant (chi-square with seven degrees of freedom 69.526, p = .000). For instance households spend about 5,338.24 birr of the credit money on dairy production as compared to 3,111.53 birr on household expenses.

Table 7: Amount of credit used for different purpose

Purpose the credit is used	Mean	Standard Deviation	Maximum	Minimum	Total obs.
Crop production	3,816.25	4243.93	70,000.00	100.00	387
Dairy production	5,338.24	3398.31	18,000.00	2,000.00	34
Cattle production	5,039.87	2602.36	15,000.00	1,000.00	79
Small ruminant production	3,212.88	1594.58	7,000.00	500.00	76
Other livestock activities	3,263.43	2509.40	8,000.00	844.00	7
Household expenditure	3,111.53	2783.32	20,000.00	100.00	184
Trading	4,630.80	3601.86	20,000.00	300.00	88
Others	4,167.91	2303.17	10,000.00	200.00	67

As a form of risk sharing strategy some credit institutions adopt a group lending scheme where only one member of the group gets the credit at a time. The other members receive credit only after the first one repaid. In this regard the data indicates 479 households which account about 52% get their credit through group lending scheme. Consistence to other studies (Lehner, 2009) the average loan amount is higher for group lending (3,993 birr 3,621 birr).

Credit term and interest rate

Households on average has 13.60 months to repay their debt (Table 8). The term of credit seam to differ for male and female headed households (13.41 for male and 14.33 for female). However test result shows that the difference is not statistically significant (t=-1.315, p=.189). The result further reveals that 109 households which account about 12% had to pay back their debt within 6 months. In most cases smallholders have to wait more than more than 6 months before getting any retune on their investment in agricultural activities. Thus a farmer who is required to pay their loan within 6 months has very limited option on which he/she could use the credit.

Table 8: Term of credit and interest rate

		Mean	Standard Deviation	Minimum	Maximum	Total obs.
Terms of credit (months)	Male	13.41	8.63	1.00	60.00	732
	Female	14.33	8.65	1.00	60.00	190
	Total	13.60	8.64	1.00	60.00	922
Annual interest rate (%)	Male	13.67	6.69	.00	50.00	732
	Female	13.47	7.14	.00	50.00	190
	Total	13.63	6.78	.00	50.00	922

The average interest rate was found to be 13.63% and ranges from 0% to 50% (Table 8). Zero interest rate is not uncommon in rural setting where farmers revert to family or friend for credit with no interest rate. On the other hand it is conceivable that significantly higher interest rate such as 50% is charged by informal sources. It should be noted that a higher interest rate has similar effect as short term of credit. As a result borrower who face higher interest rate have an incentive to use the credit on activities that guarantee quick return such as petty trade.

Purpose and use of credit

Crop production is the primary reason for taking credit for the majority of the sample households (316 out of 922) followed by livestock production which account about 30.4% (280) of our sample households (Table 9). On the other hand the gender disaggregated data shows that 37.8% of female and 28.4% of male headed households took credit for livestock production such as dairy production, cattle fattening and production, small ruminant production apiculture and poultry production. This indicates that compared to male female headed households prefer to use the credit money on livestock production. This could be because crop production compared to livestock production tend to be more resource (land, capital and labor) intensive and most of the time female headed households in rural setting have less resource endowment (Buvinić and and Gupta, 1997).

Table 9: Purpose of for which credit is taken by household head sex.

Purpose the credit is received	Male		Female		Total	
	Obs.	%	Obs.	%	Obs.	%
Crop production	263	35.9%	53	27.9%	316	34.3%
Dairy production	39	5.3%	13	6.8%	52	5.6%
Cattle production	92	12.6%	22	11.6%	114	12.4%
Small ruminant production	74	10.1%	32	16.8%	106	11.5%
Other livestock activity	3	0.4%	5	2.6%	8	0.9%
Household expenditure	66	9.0%	18	9.5%	84	9.1%
Trading	61	8.3%	19	10.0%	80	8.7%
Others	134	18.3%	28	14.7%	162	17.6%
Total	732	100.0%	190	100.0%	922	100.0%

Out of those who took credit during the production season 583 (63.23%) households allocate the credit on agricultural activities such as purchase of input for crop production livestock production (Table 10). On the other hand 184 (20%) utilized the credit to cover household expenditures, 88 (9.5%) make use of the credit money to start small trading business. The remaining 67 households which account about 7.3% spend the credit on different activities other that those mentioned above.

Table 10: Actual credit use by sex of household head

Purpose the credit is used	Male		Female		Total	
	N	%	N	%	N	%
Crop production	326	44.5%	61	32.1%	387	42.0%
Dairy production	26	3.6%	8	4.2%	34	3.7%
Cattle production	72	9.8%	7	3.7%	79	8.6%
Small ruminant production	52	7.1%	24	12.6%	76	8.2%
Other livestock activity	2	0.2%	5	2.6%	7	0.8%
Household expenditure	139	19.0%	45	23.7%	184	20.0%
Trading	62	8.5%	26	13.7%	88	9.5%
Others	53	7.2%	14	7.4%	67	7.3%
Total	732	100.0%	190	100.0%	922	100.0%

A further disaggregation of credit use shows that out of those who allocate the credit money for agricultural activities the majority (66.38%) utilized the credit for crop production (387) while 196 households (33.62%) start livestock production with their credit money.

Though about 30.4% of the household intended to use the credit on livestock production (Table 9) only 21.3% of them actually used the credit for that purpose (Table 10). In contrast compared to

those who planned to use the credit for crop production (316 households) higher number of household (387) actually used the credit on crop production. More worryingly however, is that 184 (20%) households used the credit money to cover household expenditure while only 84 (9.1%) planned to use the credit for same purpose. At gender disaggregate level, 139 (19%) male and 45 (23.7%) female headed households used the credit to cover for household expenses such as health, schooling, clothing, and food.

Male and female headed households use the credit money for different activities and the difference was found to be significant ($p = .000$, two-tailed Fisher's exact test). However the strength of association was found to be weak (Cramer's $V = 0.195$). For instance compared to female, male headed households are more likely to use credit money on crop production. On the other hand female household head are more likely to use credit on livestock production particular on small ruminant production (12.6% compared to 7.1%) than their male counterpart.

Our data seems to suggest that credit taken from formal sources like bank, microfinance and cooperatives are more likely to be used on productive activities such as crop and livestock production (Table 11). For instance about only 15.2% (109) of those who took credit from microfinance spend the credit money on household expenses whereas about 64.4% (47) and 45.5% (10) of household who took credit from friend/relatives/neighbors and other sources in that order used the money to cover household expenditure (Table 11). This is not surprising because in most cases it is difficult to get credit for household expenses from formal credit sources. As a result those who want to use the credit to cover expenses are more likely to approach informal credit sources such as friends rather than the formal one.

Table 11: Purpose the credit is used for by source of credit.

Purpose the credit is used		Banks	Friends/ relatives/ neighbors	Buying traders	Microfinance	Others	Cooperatives	NGOs	Government
Crop production	Number	3	15	1	314	2	43	6	3
	%	75.0%	20.5%	33.3%	43.9%	9.1%	61.4%	28.6%	21.4%
Dairy production	Number	0	0	0	28	1	1	1	3
	%	0.0%	0.0%	0.0%	3.9%	4.5%	1.4%	4.8%	21.4%
Cattle production	Number	0	2	0	73	0	2	1	1
	%	0.0%	2.7%	0.0%	10.2%	0.0%	2.9%	4.8%	7.1%
Small ruminant production	Number	0	2	0	57	4	6	6	1
	%	0.0%	2.7%	0.0%	8.0%	18.2%	8.6%	28.6%	7.1%
Other livestock activities	Number	0	1	0	3	0	1	2	0
	%	0.0%	1.4%	0.0%	0.4%	0.0%	1.4%	9.5%	0.0%
Household expenditure	Number	1	47	1	109	10	11	3	2
	%	25.0%	64.4%	33.3%	15.2%	45.5%	15.7%	14.3%	14.3%
Trading	Number	0	2	1	75	3	3	2	2
	%	0.0%	2.7%	33.3%	10.5%	13.6%	4.3%	9.5%	14.3%
Others	Number	0	4	0	56	2	3	0	2
	%	0.0%	5.5%	0.0%	7.8%	9.1%	4.3%	0.0%	14.3%

Comparing the purpose of the credit with that of the actual use of credit reveals that about 228 (168 male and 60 female headed) households did not use the credit money for the intended purpose (Table 12). This account 24.7% (23% of male and 31.6% of female headed) of households that took credit during the production season. A test for relationship between credit diversion and sex of household head indicate was found to be statistically significant (chi-square with one degree of freedom = 6.033, p = 0.014). This indicates that female household heads are more likely to engage in credit diversion behavior. This could be because in the literature credit diversion is associated with lack of sustainable incomes (Behrouz, Y. M, et.al (2012) and in rural setting female household heads have less access to income generating activities that their male counterpart (de Janvry and Sadoulet, 2001; FAO, 1990).

Table 12: Credit diversion by sex of household head

		Male		Female		Total	
		Obs	%	Obs	%	Obs	%
Credit is diverted	No	168	23.0%	60	31.6%	228	24.7%
	Yes	564	77.0%	130	68.4%	694	75.3%
	Total	732	100.0%	190	100.0%	922	100.0%

As shown in table 13 proportion of household that use the credit for unintended purpose seem to differ by source of credit. However test for relationship between credit diversion and source of credit is moderately significant with weak association (p = .083, two-tailed Fisher's exact test Cramer's V = 0.110).

Table 13: Credit diversion by source of credit

Source of credit	Credit is diverted			
	Yes	%	No	%
Banks	2	50.0%	2	50.0%
Friends/relatives/neighbors	10	13.7%	63	86.3%
Buying traders	1	33.3%	2	66.7%
Microfinance	189	26.4%	526	73.6%
Other sources	3	13.6%	19	86.4%
Cooperatives	13	18.6%	57	81.4%
NGOs	5	23.8%	16	76.2%
Government	5	35.7%	9	64.3%

The implication is that irrespective of the source of the credit about a quarter allocate the credit money for activities other than its intended purpose. This is discontenting because most credit institutions extends credit based on the purpose of the credit and use of credit for unintended purpose may hamper households' ability to pay back their loan which decreased their credit rating in the future.

Table 14 presents the relationship between credit diversion and who among the households took credit. Credit received by other household member except household head, spouse or head and spouse jointly is more likely (38.5% compared to 24.7%) to be allocated for activities other than its intended purpose (table 7). However, chi square test of associations reveals that credit diversion in our sample does not differ significantly among who received the credit (chi-square with six degrees of freedom 2.093, p = .553).

Table 14: Credit diversion by household group that received credit

Household member that received credit	Credit is diverted				Total Obs
	Yes	%	No	%	
Head only	147	25.5%	430	74.5%	577
Spouse only	27	22.9%	91	77.1%	118
Head and spouse	49	22.9%	165	77.1%	214
Others	5	38.5%	8	61.5%	13
Total	228	24.7%	694	75.3%	922

Econometric result

Farmers' decision of whether to allocate the credit for livestock production is modeled as a three stage decision problem. Use of credit for livestock production is modeled as a probit equation. However this is preceded by two probit selection equations namely the decision to take credit and once decided to take credit whether to use the credit money for agricultural activities. To fully identify the model exclusion restriction were applied to the two selection equations. Distance to the credit source is expected to affect the decision to take credit or not but does not affect farmers decision on how to use the credit. Similarly access to agricultural extension, distance to agricultural market and access to irrigation are expected to affect primarily farmers' decision of whether to allocate the credit for agricultural activities.

The model assumes a nonzero correlation among the three error terms in EQ (1). To test the assumption a restricted model is estimated by setting the correlation among the error term zero and LR test is conducted. With chi2 of 13.37 ($P<0.01$) the null hypothesis of zero correlation among

the error terms is rejected. In fact the result from table 15 indicates that ρ_{12} and ρ_{23} are statistically different from zero at 5% and 1% significant level. These tests suggest that the trivariate probit model with double sample selection is appropriate and failing to account the two sample selection bias would result in wrong inference.

Table 15: Model estimate of factors that affect household's credit allocation decision

```
Mixed-process regression                        Number of obs   =       1305
                                                LR chi2(38)     =     201.17
Log likelihood = -1639.3491                     Prob > chi2     =     0.0000
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
cruse_l      |
       hhsex |  -.1672535   .1643237    -1.02   0.309    -.4893221     .154815
      hhysch |   .0134813   .0185568     0.73   0.468    -.0228893    .0498519
       hhage |    .004649   .0055676     0.84   0.404    -.0062633    .0155613
    lando_ha |  -.3846425** .1026623    -3.75   0.000    -.5858569   -.1834282
   lando_ha2 |    .021044***.0069783     3.02   0.003     .0073668    .0347211
     tdratio |   .0515435    .071311     0.72   0.470    -.0882235    .1913106
     aequive |   .0392777   .0480932     0.82   0.414    -.0549832    .1335386
    hhwealth |   1.63e-06   1.05e-06     1.55   0.121    -4.28e-07    3.69e-06
   knowinfol |   .4318239***.1233257     3.50   0.000     .1901099    .6735379
   hhdistawr |  -.0014094   .0010039    -1.40   0.160     -.003377    .0005583
    hhdistlm |  -.0001782   .0008575    -0.21   0.835    -.0018589    .0015025
     tglptlu |  -.3860054    .531976    -0.73   0.468    -1.428659    .6566484
       _cons |  -.9114492** .3834125    -2.38   0.017    -1.662924   -.1599745
-------------+----------------------------------------------------------------
cruse_a      |
       hhsex |   .2237925*  .1164921     1.92   0.055    -.0045277    .4521128
      hhysch |  -.0139119   .0142211    -0.98   0.328    -.0417847    .0139609
       hhage |   .0025895   .0043871     0.59   0.555    -.0060089     .011188
    lando_ha |   .1788838** .0637691     2.81   0.005     .0538987    .3038689
   lando_ha2 |  -.0093597*  .0054564    -1.72   0.086     -.020054    .0013346
     tdratio |   .0963229*  .0569893     1.69   0.091    -.0153741      .20802
     aequive |  -.0071995   .0372082    -0.19   0.847    -.0801263    .0657273
    hhwealth |  -8.74e-07   7.13e-07    -1.23   0.220    -2.27e-06    5.24e-07
    hhdism_a |  -.0001055    .000784    -0.13   0.893    -.0016421    .0014312
     hhext_a |   .4185926***.1239687     3.38   0.001     .1756184    .6615668
   irraccess |   .3487521*    .18555     1.88   0.060    -.0149192    .7124235
    agridens |  -.0868093** .0400271    -2.17   0.030    -.1652609   -.0083577
   hhdistawr |  -.0019115** .0007921    -2.41   0.016    -.0034639   -.0003591
       _cons |  -.0692325   .2942315    -0.24   0.814    -.6459156    .5074506
-------------+----------------------------------------------------------------
credit       |
       hhsex |  -.1073835   .1096419    -0.98   0.327    -.3222776    .1075106
      hhysch |   .0050192   .0129848     0.39   0.699    -.0204305    .0304689
       hhage |   .0604955***.0216325     2.80   0.005     .0180966    .1028944
      hhage2 |    -.00057***.0002187    -2.61   0.009    -.0009986   -.0001415
    lando_ha |  -.1282402** .0533661    -2.40   0.016    -.2328359   -.0236445
   lando_ha2 |   .0062256   .0053582     1.16   0.245    -.0042763    .0167275
     tdratio |   .0198488   .0490327     0.40   0.686    -.0762536    .1159512
     aequive |  -.0055127   .0352602    -0.16   0.876    -.0746215     .063596
    hhwealth |   1.42e-06*  7.27e-07     1.96   0.050    -3.09e-09    2.85e-06
     hhext_a |   .2969779***.0985793     3.01   0.003     .1037659    .4901899
   hhdistawr |  -.0008147   .0005551    -1.47   0.142    -.0019027    .0002734
    hhmobile |   .1801007** .0792352     2.27   0.023     .0248026    .3353987
   hhdismfim |  -.0022757***.0005863    -3.88   0.000    -.0034249   -.0011265
       _cons |  -1.027152   .5129666    -2.00   0.045    -2.032548   -.0217558
-------------+----------------------------------------------------------------
```

/atanhrho_12	.9580738	.5199564	1.84	0.065	-.0610219	1.97717
/atanhrho_13	-.1223744	.3879425	-0.32	0.752	-.8827277	.6379788
/atanhrho_23	-.7520627	.3459666	-2.17	0.030	-1.430145	-.0739807
rho_12	.7434165	.2325931			-.0609463	.9623786
rho_13	-.1217672	.3821903			-.7077832	.5635218
rho_23	-.6363779	.2058581			-.8916963	-.073846

Note: *, ** and *** denote significance at 10%, 5% and 1% level respectively

Likelihood ratio test is reported in table 15. This ratio tests all coefficients in the regression model (except constant) being zero. This test gauges the goodness of fit of the model. With chi2 201.14 ($p < .0001$), it can be concluded that the explanatory variables used in the regression model may be appropriate and at least one of the explanatory variables has an effect that is not equal to zero.

Credit market participation

Table 15 presents the result of the model. The model estimate the parameters for the three equations discussed in EQ (1). For credit market participation equation (Y_{1i}) age of household head was found to be statistically significant (P<0.01) indicating that older household are more likely to get credit than younger one. As shown in table 15 age square (hhage2) is also statistically significant (P<0.01) implying that age has a non-linear relationship with the independent variable. The negative coefficient for hhage2 indicates that beyond a certain age farmers are less likely to take credit. This could be because as farmers get older beyond 52.25 years they become more risk averse or may not be considered suitable for credit.

Household land holding is also found to be statistically significant (P<0.05) but with opposite direction. Farmer who own large agricultural land are less likely to get credit. This could be because the land tenure system in Ethiopia does not allow land to be taken as collateral thus farmers with large land holding does not necessarily present lesser risk to credit institutions. This is consistent with (Bastin A. and Matteucci N. 2007).

Household wealth has positive and statistically significant effect (P <0.1) indicating that wealthy farmers are more likely to get credit. This could be because wealthy farmers are attractive choice for credit intuitions as they could easily provide collateral. As expected access to extension service (P<0.01) and mobile ownership (P<0.05) which is used as a proxy for access to information are found to have a positive and significant. On the other hand distance to microfinance institutions which is considered as a fixed cost of accessing credit is found to have a negative effect on farmer's access to credit (P<0.01). Those farmers located in remote areas relative to credit institutions are less likely to get credit even if they have a positive demand for credit.

Agricultural and non-agricultural use of credit

About 63% percent of those who took credit, allocate the credit on agricultural activities. The model result indicates that sex of household head, land ownership, dependency ratio, access to

extension service and infrastructures such as irrigation water as well as all-weather road and agricultural density have a statistically significant effect on household decision to allocate the credit on agricultural productive activities. As expected land ownership positively affect (P<0.05) the probability of using the credit money on agricultural productive activities (Table 15). This could be because increase in farm size requires more farm inputs which leads to more resource diverted to the farm. However a positive effect of land ownership and a negative effect of land ownership squared (P<0.1) means that for those who own a large amount of land the effect of land ownership is lessened.

The result shows that the wealthier households are less likely they are to allocate credit for agricultural purpose. This could be because as farmers build more wealth they start to move to urban centers and invest on urban real properties or start business.

It is expected that higher dependency ratio means household are more likely to use the credit to cover household consumption. However our result shows that higher dependency ratio increase the probability of using credit for agriculture activities. The dependency ratio is computed by dividing dependents—household member younger than 15 or older than 64--to the working-age household member—those ages 15-64. In Ethiopia rural setting however, young member of household particularly those between 8 and 15 ages contribute to the agricultural labor force in the form of herding. Similarly those older than 64 also actively engage in agricultural activities. Thus household members under 15 years and over 65 years (65+) are not necessarily outside of the labor force which means the usual definition of dependency ratio does not necessarily measure the pressure on productive member of the households. Assess to irrigation (P<0.1) and extension services (P<0.01) positively affect the probability of using credit on farm activities

In contrast but not surprisingly assess to infrastructure as measured by distance to all-weather road have a negative effect (P<0.05). The result further reveals the higher the agricultural density in the PA the less likely the household to use the credit on agricultural activities (P<0.05). This could be because the livelihoods of households in densely populated areas rely less on farm income. This is further attested by Ricker-Gilbert, J. et.al, (2014) study which found that in Malawi households in densely populated areas increasingly rely on off-farm income.

Use of credit for livestock production

The ultimate objective of this paper is to identify factor that affect household decision to allocate credit for livestock production. After controlling for possible sample selection bias the result indicates that only land ownership and access to extension services on livestock production has a statistically significant. The result shows that household who own a large plot of land are less likely (P<0.05) to allocate the credit for livestock production (Table 15). However the negative effect on the likelihood of utilizing the credit on livestock production decreases for those who own sufficiently large plot of land as indicates by a positive and significant (P<0.01) coefficient of land ownership squared.

In contract access to livestock extension service is found to be highly significant (P<0.001). Those households who have access to extension services particularly on livestock activities are more likely to allocate their credit on livestock production.

Conclusion and implication

By identifying factors that affect household's decision to allocate credit particularly for livestock production, this study tries to fill the knowledge gap of credit allocation by small scale farmers in Ethiopia. The result of this study is expected to enhance the understanding of credit allocation decisions of smallholders in Ethiopia and guide project implementers and lending institutions that works with farmers.

The paper uses a probit model with double selections equations to identify factors that affects farmers' decision to allocate credit for livestock production. Different specification test of the model shows that accounting for the selection bias is a significant improvement to the one that exclude the step wise selection process.

The paper argue that socio-economic and institutional factors are found to have a statistically significant effect on small scale farmers' decisions to allocate credit for livestock production. This has implications for programs and project that aim to improve small scale livestock production. The fact that land ownership has significant and negative influence of farmers decision to allocate credit for livestock production suggest that support services should target those households with small land size. Intuitively this makes senses first those who own large farm size are more likely to engage in crop production and second compared to crop production livestock production requires less land which makes it more appropriate for land scares households.

On the other hand the result shows that access to extension services particularly targeting livestock production has statistically positive effect on farmers' decision to allocate credit for livestock sector. In fact agricultural economist long noted the relationship between of extension services and credit. For instance Berhanu et.al (2006) argued that for extension services to be effective access to credit is important. Those with access to credit would be able to acquire new input and adopt technologies which the extension service entails or requires.

The study shows that a non-negligible proportion of households use the credit on non-productive activities such as to cover household expenditure. This highlight the fact that improving access to credit does not automatically translate into more productive households. Rather there is a need to adopt a ''credit-plus'' approach where credit access should be followed by a focused extension services to ensure proper exploitation of the available opportunities.

Received literature shows that access to credit is associated with improve in livestock productivity. This paper clearly shows the link between access to livestock extension service and household tendency to engage in livestock sector. Thus together with the already existing results the paper

shows that it is possible to increase livestock products and productivity by combining improved access to credit with livestock focused extension service.

The paper combined different livestock activities as one. Extending this study by further disaggregating the livestock sectors and understanding farmers' credit allocation decision to specific livestock sector such as dairy, large and small ruminant, apiculture and poultry are areas worth exploring in the future.

Disclosure statement

The authors declare that no conflict of interest exists in relation to the content of the article.

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