LIVES WORKING PAPER 21

Factors determining household allocation of credit to livestock production in Ethiopia

Factors determining household allocation of credit to livestock production in Ethiopia

Kaleb Shiferaw, Berhanu Geberemedhin and Dereje Legesse

International Livestock Research Institute
Corresponding author: Kaleb Shiferaw. E-mail: k.shiferaw@cgiar.org

May 2016

Editing, design and layout—ILRI Editorial and Publishing Services, Addis Ababa, Ethiopia.

Cover photo—ILRI/Dereje Legesse

ISBN: 92–9146–471-6

Citation: Shiferaw, K., Gebremedhin, B. and Legesse, D. 2016. *Factors determining household allocation of credit to livestock production in Ethiopia.* LIVES Working Paper 21. Nairobi, Kenya: International Livestock Research Institute (ILRI).

Patron: Professor Peter C Doherty AC, FAA, FRS
Animal scientist, Nobel Prize Laureate for Physiology or Medicine–1996

Box 30709, Nairobi 00100 Kenya
Phone +254 20 422 3000
Fax +254 20 422 3001
Email ilri-kenya@cgiar.org

ilri.org
better lives through livestock

ILRI is a member of the CGIAR Consortium

Box 5689, Addis Ababa, Ethiopia
Phone +251 11 617 2000
Fax +251 11 667 6923
Email ilri-ethiopia@cgiar.org

ILRI has offices in East Africa • South Asia • Southeast and East Asia • Southern Africa • West Africa

Contents

Tables

Acronyms

ASF	Animal-source food
DFATD	Foreign Affairs, Trade and Development Canada
GDP	Gross domestic product
IWMI	International Water Management Institute
LIVES	Livestock and Irrigated Value chains for Ethiopian Smallholders
NGO	Non-governmental organization
PA	Peasant association
SNNPR	Southern Nations, Nationalities, and Peoples' Region
TLU	Tropical livestock unit

Acknowledgement

We would like to thank the Canadian Department of Foreign Affairs, Trade and Development (DFATD) for its financial support. We are also deeply grateful to the many farmers who patiently and willingly responded to our numerous questions.

Abstract

Access to credit is often viewed as a key to transforming semi-subsistence smallholder farmers into market-oriented producers. However, only a few studies have examined the factors that affect farmers' decisions to allocate credit to farm activities in general and livestock production in particular. A trivariate probit model with double selection is employed to address the issue using data collected from smallholder farmers in Ethiopia. After using a two-step procedure to adjust for sample selection bias, gender of household head, land ownership and access to a livestock centred extension service are found to have a significant effect on farmers decision to use credit for livestock production. The results showed female-headed households, farmers with a large plot of land and farmers that have access to livestock centred 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 lessens for those who own a very large plot of land. The study highlights the fact that lending to female-household heads may lead to increased access to animal-sourced foods for rural households. Furthermore, the study shows that improving farmers' access to credit should be supported by a focused extension service that addresses the special needs of female farmers.

Key word: livestock production, credit access, credit allocation, household decision, double sample selection

JEL Code: Q12. Q14. Q16. D13.C34

1. Introduction

In Ethiopia, the agriculture sector contributes significantly to the country's economic growth. The sector provides employment opportunity for 80% of the country's 97 million inhabitants and contribute nearly 42% of gross domestic product (GDP) and 85% of foreign export earnings (EEA 2014).

The other salient feature of the agriculture sector in Ethiopia is that the majority of the agriculture sector consists of smallholder farmers who make their living from less than two hectares of land. The implication is that for the country to reach its aspiration of becoming middle income country status by 2025, the agriculture sector needs to be transformed.

Recent studies showed that by increasing the productivity level of the agricultural sector, it is possible to improve the living condition of smallholders (Tesema et al. 2015; Tesfay et al. 2016) and thus transform the sector.

In this regard, limited access to credit has been identified as one of the constraints that hamper agricultural productivity as it discourages technology adoption by smallholders (Dercon and Christiaensen 2011). This is particularly so in Ethiopia where farmers often operate with minimum capital and trapped in a vicious circle where low investment leads to low productivity, which in turn leads to low income, which then leads to low levels of saving and investment.

In this case, agricultural credit is considered an important factor for increased agricultural production and rural development because it enhances productivity and promotes the standard of living by breaking the vicious cycle of poverty of small-scale farmers (Shimamura and Lastarria-Cornhiel 2010; Kohansal and Mansoori 2009; Gatti and Love 2006).

Similarly, Ali and Deininger (2014) using village-level data showed that particularly in high-potential surplus-producing areas, eliminating credit constraints increases crop productivity in Ethiopia. Similar findings are reported for China where removing credit constraints increased agricultural productivity by 75% (Dong et al. 2012). At macro level, limited access to credit has been identifited as a major constraint preventing people escaping poverty (Kumar et al. 2013).

The main argument 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 and Ekpebu 2011). This also has an implication on the repayment and loan default rates among farmers.

Martins and Pereira (2012) by focusing on the livestock sector which, in Ethiopia account about 33% and 12% of the agricultural and total GDP respectively (Solomon et al. 2003), showed that particularly for small farms improving their access to credit is key to developing their livestock production.

However, the flow and impact of credit and other financial services to the livestock sector in Ethiopia have not been properly documented Amha (2008). To the best of our knowledge there are no studies that try to identify factors influencing farmers' decisions to allocate credit for livestock production.

In this regard, it is important to understand why some farmers use credit for productive purposes, while others spend it on non-productive activities or use it to meet their daily consumption needs. A better understanding of farmers' behaviour in allocating credit would provide useful information for project implementers and financial institutions working with small-scale farmers.

The main objective of this paper is to explore the factors affecting farmers' decisions to allocate credit to livestock production. For this purpose, a probit model with double sample selection is used.

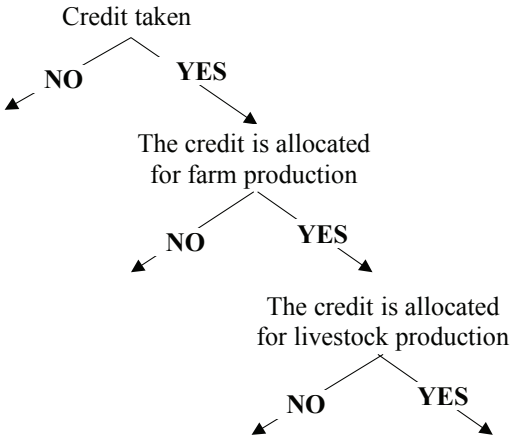
The contribution of this paper is twofold. First, it is one of a very few empirical studies that try to identify factors that affect household credit allocation decisions. Given the huge number of smallholders in sub-Saharan African countries and the fact that emphasis has already been given to improve household access to credit, new empirical insights on household credit allocation decisions are essential to improving development interventions. Secondly, the analysis relies on a comprehensive dataset that represents the major agricultural sector of the country and uses a 'trivariate probit' model with double sample selection, which to the best of our knowledge, has not previously been conducted anywhere else. The estimation method can be applied to a broad range of empirical problems.

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 econometric results. Section five discusses the findings followed by section six which concludes the paper and draws implications.

2. Conceptual framework

In this section, we develop a conceptual framework that allows us to identify factors that affect household decisions regarding whether to allocate credit to livestock production. In order to do so, we begin by identifying two hurdles a household should overcome: whether a household has taken loan and for those who took loan, whether household allocated the loan to farm production.

Figure 1: The three stages of credit allocation decision.



Farm household access to credit is a function of socio-economic and demographic factors, which among other things indicate their ability to pay, and their access to rural institutions and information. Rural institutions in this context include extension services, microfinance institutions and the market. Community characteristics also affect household access to credit. In a rural setting, farmer ability to pay has a big role in determining access to credit. This is largely because the agricultural sector is considered a high-risk investment.

Total amount of cultivated land owned by a household and household asset value indicate household ability to pay. For instance, wealthy households and those who own relatively large plot of land would be perceived by financial institutions as less risky borrowers and therefore relatively more likely to get a loan.

Access to rural institutions such as extension services, rural financial institutions and the market can also play a role in determining the probability of accessing credit. Farmers must have access to information about the availability and sources of credit before they can apply for credit. Farmers can gain information about credit from extension agents or from other farmers they meet during market transactions. As such, access to extension services and markets can be used to measure access to information. Households that have access to extension services and are located near to markets are more likely to get the right information about the availability of credit. This in turn would help them to identify the right institution from which to apply for credit. Thus, compared to those who do not have access to extension services and live in relatively remote areas, they are more likely to get credit.

It is also important to address the role of transaction costs in accessing credit. Households that are located far from rural credit institutions as measured by distance to the nearest financial institution would incur a higher cost to access these institutions and thus, visit them less frequently. This would negatively affect their likelihood of getting credit.

At this point, it should be noted that distance to rural financial institutions is a transaction cost, which is expected to affect the probability of getting a loan. Theoretically, the transaction costs of accessing rural credit institutions does not affect households' subsequent decisions. Thus, distance to rural finiancial institutions can effectively be used to identify the second stage decision problem of whether households allocate the credit to farm or non-farm activities.

Community characteristics such as availability of communal grazing land and wage rate for off-farm employment are also included in the model to control the difference among communities.

The literature review revealed that household's characteristics (e.g. age, gender, education, farm household size and dependency ratio) also affect the probability of getting a loan. For instance, Shallone and Munongo (2013) concluded that among other things age, household size and gender of household head are the primary factors that determine household access to rural credit in Zimbabwe. Similarity Amjad and Hasnu (2007) analysed smallholders' access to rural credit (formal and informal sources) in Pakistan and found that family labour and literacy status of the household head are among the factors that affect farmers' access to credit. In South Africa, Sebopetji and Belete (2009) gender, farmers' age and education levels have a significant effect on farmers' access to credit. A study by Amha (2009) using binary logit model identified that land size, age of the household head, level of education and access to extension services affect farmers' access to credit in Ethiopia. This is consistent with a study by Jabbar et al. (2002), who found that gender and education of the household head affect farmer access to credit in Ethiopia, Kenya, Uganda and Nigeria.

For access to credit to be translated into improved quality and quantity of farm products, households should decide to allocate the credit to productive activities. In fact, the negative effect of credit diversion and misallocation has been recognized by different authors (Nwaru and Onuoha 2010; Oboh and Ekpebu 2011; Kuwornu et al. 2012).

Identifying factors that affect household credit allocation decisions is the next step to be taken in relation to those who managed to secure a loan from credit institutions. These households main decision would be whether to allocate the credit to farm or non-farm activities.

In this case also, we hypothesize that socio-economic and demographic factors, household access to rural institutions and community influence household credit allocation decisions. For instance, high dependency ratios indicate the extent of non-productive household members and as the number of non-productive household members increase, it is more likely that productive resources, such as credit, are used to cover household consumption. Another key factor that can affect household credit allocation decisions is the availability of labour supply. In rural settings, most farm activities are labour intensive and the market for labour is either non-existent or highly imperfect. As such, most of the time a household depends on own labour supply. In this context, we hypothesize that households with more able-bodied members are more likely to allocate credit to farm activities.

Another key variable that can affect household decisions to allocate credit to farm activities is farmers' opportunity cost. When a farmer decides to allocate credit to farm activities, it is more likely that s/he engage in that activity. As such, the opportunity cost would be income s/he would have gotten had s/he been employed on other farms. In this paper, wage rate for off-farm employment is used as a proxy to measure this opportunity cost. The higher the wage rate for off-farm labour, the higher the opportunity cost of engaging in farm activities and thus the less likely a household would use the credit on farm activities. The nice feature of this variable is that theoretically it does not influence the third and the last household decision problem—the decision to use the credit for livestock versus non-livestock farm activities. As such, it serves as the second identification variable at the third decision stage.

Those households who decided to use the credit for farm activities would have two options: either use the credit on livestock production or non-livestock production. Since these two alternatives nested into the same broad category called farm activities, the same set of explanatory variables are expected to determine farmers' decisions at this stage. The only exceptions are the wage rate for off-farm employment and the additional two variables, which are unique to

this decision problem, namely access to livestock focused extension services and distance to livestock watering points. Farm households are more likely to use the credit for livestock production if they have access to livestock focused extension services. On the other hand, they will be discouraged to engage in livestock production if they are located farther from water sources. This is because the cost of production increases with the distance to a watering point.

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 analysis. However, restricting our analysis to a sample of households who took credit leaves us with a self-selected sample. The immediate consequence is that the results we obtain from this sub-sample could not be generalized to other households and this would lead us to draw misleading conclusions. This paper, therfore, considered all households who needed credit during the production year.

3.1. Theoretical model

The paper assumes that household decisions on whether to allocate credit to livestock production would first have to take credit and then decide to allocate the credit for agricultural productive activities. To estimate the above three-stage decision hypothesis, 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 to farm activities whether the household decided to allocate the credit to livestock production). Thus, the three dependent variables (Y_{1i},Y_{2i} and Y_{3i}) are dichotomous. Following the standard treatment of dichotomous dependent variables, the paper assumes the existence of three latent variables corresponding to the above three dichotomous dependent variables.

$$Y_{1}^{i*}=x_{1i}\,\beta_{1}+u_{1i}$$

$$Y_{2i}^{*}=x_{2i}\,\beta_{2}+u_{2i}$$

$$Y_{3i}^{*}=x_{3i}\,\beta_{3}+u_{3i} \quad (1)$$

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 follows. For credit participation equation

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

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

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

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

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

By making the following assumptions β_1, β_2 and β_3 can be estimated jointly (Carreon and Garcia 2011; Dubine 1989). First the explanatory variables x_{1i}, x_{2i} and x_{3i} are assumed to be independent of u_{1i},u_{2i} and u_{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 likelihood function for the specification above, we need the probabilities for the four possible outcomes. A household not taking credit at all during the production year (Y_{1i} =0), a household taking credit, deciding to allocate it to farm activities and actually using it for livestock production (Y_{1i} =1 and Y_{2i} =1 and Y_{3i} =1), a household taking credit, deciding to allocate it to farm activities and actually using it on non-livestock production (Y_{1i} =1 and Y_{2i} =1 and Y_{3i} =0) and a household taking credit but using it on 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, deciding to use the credit on farm activity and actually using it on 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, deciding to use it on farm activity and actually using it on 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 outcomes 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 involves the evaluation of trivariate normal distributions. Hajivassiliou and Ruud (1994) argue that standard linear numerical approximations are inefficient and may provide poor approximations. In such cases, simulation-based methods provide a better result (Cappellari and Jenkins 2006). From the families of simulation-based methods, Geweke-Hajivassiliou-Keane (GHK) smooth recursive conditioning simulators 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 a method of simulated maximum likelihood. For this purpose Roodman (2011) cmp's modeling framework is used to estimate the model coefficients.

3.2. Empirical model

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

The first selection equation is a farmers' decision to participate in a credit market. It captures whether farmers get credit in the production period and is given by:

$$\begin{aligned} Y_{1i} &= x_{1i}\beta_1 + u_{1i} \\ credit_i &= \beta_{10} + \beta_{11}hhsex_i + \beta_{12}tdratio_i + \beta_{13}age15\_64_i + \beta_{14}lando\_ha_i \\ &\quad + \beta_{15}lando\_hasq_i + \beta_{16}hhwealth\_n_i + \beta_{17}hhysch2_i \\ &\quad + \beta_{18}hhysch3_i + \beta_{19}hhysch4_i + \beta_{110}hhage_i + \beta_{111}hhagesq_i \\ &\quad + \beta_{112}hhdistmt_i + \beta_{113}hhext\_g_i + \beta_{114}tglptlu_i \\ &\quad + \beta_{115}hhdistmfi_i + \beta_{116}offfarmwage_i + u_{1i} \end{aligned} \tag{10}$$

The second selection equation which explain why farmers allocate credit to farm activities is given by:

$$\begin{aligned} Y_{2i} &= x_{2i}\beta_1 + u_{2i} \\ cruse\_a_l &= \beta_{20} + \beta_{21}hhsex_i + \beta_{22}tdratio_i + \beta_{23}age15\_64_i + \beta_{24}lando\_ha_i \\ &\quad + \beta_{25}lando\_hasq_i + \beta_{26}hhwealth\_n_i + \beta_{27}hhysch2_i + \beta_{28}hhysch3_i \\ &\quad + \beta_{29}hhysch4_i + \beta_{210}hhage_i + \beta_{211}hhagesq_i + \beta_{212}hhdistmt_i \\ &\quad + \beta_{213}hhext\_g_i + \beta_{214}tglptlu_i + \beta_{215}offfarmwage_i + u_{2i} \end{aligned} \tag{11}$$

Finally, the outcome equation is given by:

$$\begin{aligned} Y_{3i} &= x_{3i}\beta_3 + u_{3i} \\ cruse\_l_i &= \beta_{30} + \beta_{31}hhsex_i + \beta_{32}tdratio_i + \beta_{33}age15\_64_i + \beta_{34}lando\_ha_i \\ &\quad + \beta_{35}lando\_hasq_i + \beta_{36}hhwealth\_n_i + \beta_{37}hhysch2_i \\ &\quad + \beta_{38}hhysch3_i + \beta_{39}hhysch4_i + \beta_{310}hhage_i + \beta_{311}hhagesq_i \\ &\quad + \beta_{312}hhdistlw_i \\ &\quad + \beta_{313}hhdistmt_i + \beta_{314}hhext\_g_i + \beta_{315}hhext\_l_i \\ &\quad + \beta_{316}tglptlu_i + u_{3i} \end{aligned} \tag{12}$$

Variables that entered in EQ (10–12) together with their descriptions and their expected effects on the three dependent variables are summarized in Table 1.

Table 1: Data definition and description

Dependent variables				
Variable name	Variable Description			
Credit (Y_{1i})	Credit status of the household during the production period (1=if the household took credit 0 if otherwise			
Credit (Y_{2i})	Dummy variable that takes 1 if the household decides to allocate the credit to farm activities and 0 if otherwise			
Credit (Y_{3i})	Dummy variables that take 1 if the household allocated the credit to livestock production and 0 if otherwise			
Explanatory variables				
		Expected effect on		
Variable name	Variable description	Y_{1i}	Y_{2i}	Y_{3i}
hhsex	Household head sex (1=Male)	+	+/-	+/-
tdratio	Total dependency ratio (number household member aged <15 and > 64 divided by the those aged 15–64	+	-	+/-
age15_64	Labour supply of the household (number of household members between 15 and 64 years of age)	+	+	+/-
lando_ha	Total amount of cultivated land owned by the household (in hectares)	+/-	+	-
lando_hasq	Total amount of cultivated land owned by the household squared	+/-	+/-	+/-
hwealth_n	Household asset value (ETB 10,000, 2013)	+	+/-	+/-
hhdistlw	Distance to a livestock watering point (in kilometres)			-
hhdistmt	Distance to a market town (in kilometres)	-	-	-
hhext_g	Access to general extension services (1=Yes)	+	+	-
hhext_l	Access to livestock focused extension services (1=Yes)			+
tglptlu	Communal grazing land (in hectare per tropical livestock unit (TLU)	+/-	+	+
hhdistmfi	Distance to rural saving and credit institutions (in kilometres)	-		
offfarmwage	Off-farm employment opportunity quantile (1 = low opportunity, 5 = low opportunity)	+/-	-	
hhysch2	1 to 4 years (1=yes)	+	+	+
hhysch3	5 to 8 years (1=yes)	+	+	+
hhysch4	More than 8 years (1=yes)	+	+	+
hhage	Household head age	+	+	+/-
hhagesq	Household head age square /100)	+/-	+/-	+/-

3.3. Data

This analysis is based on data drawn from LIVES[1] baseline survey conducted in 2014. The data was collected from February–April 2014 from randomly selected rural households in four regions of Ethiopia (Amhara, Oromia, Southern Nations, Nationalities, and Peoples (SNNP) and Tigray). These four regions jointly constitute the largest share of the nation's crop and livestock production and cover the major agro-ecologies of the country. The sampling followed a multistage sampling strategy that involves stratification and clustering of peasant associations (PAs) based on their agro-ecological zone and suitability for the project commodities. Random sampling was used to select housholds from sample PAs.

1 Livestock and Irrigated Value chains for Ethiopian Smallholders (LIVES)—an ongoing collaborative research for development project implemented by International Livestock Research Institute, International Water Management Institute (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—aims 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 SNNP) of Ethiopia. Supported by Foreign Affairs, Trade and Development Canada (DFATD) the project is expected to end in March 2018.
As part of the project monitoring and evaluation framework, a baseline survey was conducted from February–April 2014 on 5000 households randomly selected using a multistage cluster sampling techniques from the ten project zones. Using an electronic data collection method detailed data on socio-economic status and agricultural activities of the households during the production season (June 2012–July 2013) was collected. The survey were led by senior scientists from ILRI (Project website: http://lives-ethiopia.org).

4. Results and discussion

This section first summarizes smallholders' credit sources, the amount of credit received during the production year and credit use pattern by smallholders. This is followed by a discussion of the model results.

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. The focus of this study is cash credit i.e. loans that farmers received from any financial institution.

4.1. Credit sources and use by smallholders

(a) Source and access to credit

Microfinance institutions are the primary source of credit for the majority of households (Table 2). Of those who managed to get credit 715 households which account 77.5% got their credit from microfinance. Informal sources such as friends, relatives and neighbours also serve the credit needs of our sampled households. Not surprisingly formal banks have a very limited role in providing credit to the small-scale farmers.

Table 2: Source of credit by gender of household head

Source of credit	Male		Female		Total	
	Obs	%	Obs	%	Obs	%
Banks	4	0.5	0	0.0	4	0.4
Friends/relatives/neighbours	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 reflects 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 neighbours and cooperatives. Non-governmental organizations (NGOs) engaged in giving credit to farmers seemed to prefer female household heads. This is because in rural settings female household 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 3). The results of our analysis suggest that there is no statistically significant difference between male- and female-headed household physical access (measured by distance in km) to the 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 the results in Table 3, the results indicate that female-headed households limited access to credit is not due to the lack of physical access.

Table 3: 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

(b) Credit amount

The average amount of credit was about ETB 3886 which ranges from ETB 100 to 70,000. The amount of credit disaggregated by the gender of the household head reveals that on average the amount of credit received by male-headed households is higher (ETB 4075 compared to ETB 3156) than their female counterparts (Table 4) and the difference is found to be statistically significant ($t = 3.230$, $p = .000$). This is in contrast to the results obtained by Okonya and Kroschel (2014) which found no statistically significant difference between the amount of credit received by male- and female-headed households in Uganda.

Table 4: Amount of credit by gender of household head

Gender of household head	Amount of credit taken (ETB)							Total obs.
	Mean	Standard deviation	Percentile					
			10	25	50	75	90	
Male	4075	3763	1130	2000	3500	5000	7000	732
Female	3156	2167	872	2000	3000	4000	5000	190

Households who received credit from formal financial institutions, such as microfinance institutions and banks, on average get larger amount of credit than those who received credit from informal sources (Table 5) 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 received by a household from microfinance institution is estimated at ETB 4351.64, while on average only ETB1599 is received from friends/relatives/neighbours. This could be because credit received 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 would be needed for other purposes, such as crop and livestock production.

Table 5: Credit amount by source of credit

Source of credit	Mean	Standard deviation	Maximum	Minimum	Total obs.
Banks	3510.00	1759.13	5060.00	980.00	4
Friends/relatives/neighbours	1598.90	3303.85	20,000.00	100.00	73
Buying traders	1700.00	2042.06	4000.00	100.00	3
Microfinance	4351.64	3614.31	70,000.00	150.00	715
Others	2577.27	2198.04	10,000.00	100.00	22
Cooperatives	2181.61	1369.15	7000.00	300.00	70
NGOs	3605.43	2639.81	10,000.00	500.00	21
Government	3602.14	2329.23	10,000.00	430.00	14

On average, households spend more on livestock and crop production than on households' expenditure (Table 6) 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 ETB 5340 of the credit money on dairy production as compared to ETB 3110 on household expenses.

Table 6: Amount of credit used for different purpose (in 000 ETB)

Purpose the credit is used	Mean	Std Dev.	Percentile					Total obs.
			10	25	50	75	90	
Crop production	3.82	1.25	2.00	3.00	5.00	6.00	4.24	387
Dairy production	5.34	2.00	3.00	5.00	7.00	10.00	3.40	34
Cattle production	5.04	2.50	3.50	4.80	6.00	10.00	2.60	79
Small ruminant production	3.21	1.20	2.00	3.00	4.50	5.74	1.59	76
Other livestock activities	3.26	0.84	1.10	2.90	5.00	8.00	2.51	7
Household expenditure	3.11	0.30	1.00	2.50	4.45	6.00	2.78	184
Trading	4.63	1.70	2.61	4.00	5.00	10.00	3.60	88
Others	4.17	2.00	3.00	4.00	5.00	7.00	2.30	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 (ETB 3993 compared to ETB 3621).

(c) Credit term and interest rate

Households on average have 13.60 months to repay their debt (Table 7). The term of credit seem 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 6 months before getting any return on their investment in agricultural activities. Thus, a farmer who is required to pay his loan within 6 months has a very limited option on which he/she could use the credit.

Table 7: Terms 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 0–50% (Table 7). Zero interest rate is not uncommon in a rural setting where farmers revert to family or friends for credit with no interest rate. On the other hand, it is conceivable that significantly higher interest rates, such as 50%, are charged by informal sources. Higher interest rates have a similar effect as short-term credit. As a result, borrowers who face higher interest rates have an incentive to use the credit on activities that guarantee a quick return, such as petty trade.

(d) Purpose and use of credit

Crop production is the primary reason for taking credit for the largest number of sample households (316 out of 922) followed by livestock production which accounts about 30.4% (280) of our sample households (Table 8). On the other hand, the gender disaggregated data shows that 37.8% of female- and 28.4% of male-headed households received credit for livestock production, such as dairy production, cattle fattening and production, small ruminant production, apiculture and poultry production. This indicates that compared to female-headed households, male-headed households prefer to use credit for livestock production. This could be because crop production compared to livestock production tends to be more resource (land, capital and labour) intensive and most of the time female-headed households in rural settings have less resource endowments (Buvinić and Gupta 1997).

Table 8: Purpose for which credit is received by gender of household head

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

Of those who received credit during the production season 583 (63.23%) households allocated it to agricultural activities, such as the purchase of inputs for crop and livestock production (Table 9). On the other hand, 184 (20%) utilized the credit to cover household expenditures and 88 (9.5%) made use of it to start a small trading business. The remaining 67 households which account for about 7.3% spent the credit on different activities, other that those mentioned above.

Table 9: Actual credit use by gender of household head

Purpose for which 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
Other	53	7.2	14	7.4	67	7.3
Total	732	100.0%	190	100.0	922	100.0

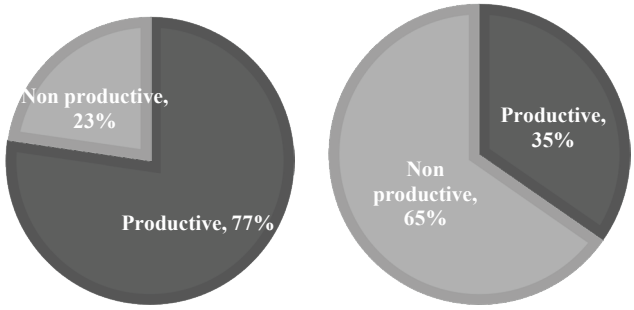
Further disaggregation of credit use shows that of those who allocate the credit for agricultural activities, most (66.38%) utilized it for crop production (387), while 196 households (33.62%) engaged in livestock production with the funds.

Though about 30.4% of households intended to use the credit on livestock production (Table 10), only 21.3% of them actually used it for that purpose (Table 10). In contrast, compared to those who planned to use the credit for crop production (316 households), a higher number of households (387) actually used the credit on crop production. More worrisome, however, is that 184 (20%) households used the credit to cover household expenditure, while only 84 (9.1%) planned to do so. Gender disaggregated data shows that 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-headed households, their male counterparts are more likely to use credit on crop production. On the other hand, females-headed households are more likely to use the credit on livestock production, particularly on small ruminant production (12.6% compared to 7.1%) than their male counterparts.

Our data seems to suggest that credit received from formal sources like banks, microfinance institutions and cooperatives are more likely to be used on productive activities (77% compared to 35%), such as crop and livestock production (Figure 2). This is not surprising because in most cases it is difficult to get credit for household expenses from formal credit institutions. As a result, those who seek credit to cover expenses are more likely to approach informal sources, such as friends.

Figure 2: Productive and non-productive use of credit by source of credit.



Formal credit source Informal credit sources

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 money for its intended purpose (Table 10). This accounts 24.7% (23% of male- and 31.6% of female-headed) households who received credit during the production season. A test for relationship between credit diversion and the gender of the household head 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. In the literature, credit diversion is associated with a lack of sustainable incomes (Behrouz et al. 2012) and in rural settings, female household heads have less access to income-generating activities than their male counterparts (de Janvry and Sadoulet 2001).

Table 10: Credit diversion by gender of household head

Obs		Male		Female		Total	
		%	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 11, the proportion of households using the credit for unintended purposes seems to differ by source of credit. However, a test for a 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 11: Credit diversion by source of credit

Source of credit	Credit is diverted			
	Yes	%	No	%
Banks	2	50.0	2	50.0
Friends/relatives/neighbours	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 of households allocate the credit to activities other than its intended purpose. This is disconcerting because most credit institutions extend credit based on the purpose of its intended use. The use of credit for unintended purposes may hamper the households' ability to pay back their loans which decreases their future credit ratings.

Table 12 presents the relationship between credit diversion and household groups in receipt of credit. Credit received by household members other than the household heads, spouses or heads and spouses jointly seems more likely (38.5% compared to 24.7%) to be allocated to activities other than its intended purpose. However, the chi square test of associations reveals that credit diversion in our sample does not differ significantly among household groups in receipt of credit (chi-square with six degrees of freedom 2.093, p = .553).

Table 12: Credit diversion by household group in receipt of 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

4.2. Model results and discussions

The model is based on 1400 (275 female- and 1125 male-headed) households. These are households that have a positive demand for credit during the production season. The descriptive findings, followed by the results of the econometrics analysis, are presented in this section.

Descriptive statistics

Descriptive statistics (percentiles, means and standard deviations) of the continuous variables used in our model are presented in Table 13, and means of the binary variables are presented in Table 15. Looking at the socio-economic characteristics of the households, the results show that the average age of the household is 44 years and one quarter

of the household heads are less than or equal to 36 years. The results further show that on average a household has about 3.22 members of working age (ages15–64) and has a total dependency ratio of 1.11. A typical household in the sample owns about 1.33 hectare of land, while half of the sample households own less than 1 hectare of land. The average value of assets owned by a typical household is estimated at ETB 33,000[2].

We use a wage index based on principal component analysis of various daily wage rates for different kinds of off-farm activities: wage rates for land preparation/sowing, cultivating/weeding, harvesting and threshing. We assume that there is a common factor, 'off-farm employment opportunity' that explains the common covariation in the wage rate, and allows the principal component analysis to define this factor. Though the index value is not interpretable, it does permit us to rank communes by degree of off-farm employment opportunity, and consequently to define quintiles. Note that a high index value indicates a significant off-farm opportunity.

Table 13: Distribution of continuous explanatory variables

	Percentile						
Explanatory variable	10	25	50	75	90	Mean	Std. dev.
Age of the household head	30	36	43	50	60	44.249	11.130
Total dependency ratio	0.25	0.5	1	1.5	2	1.114	0.801
Number of household members between 15 and 64	2	2	3	4	5	3.221	1.486
Total amount of cultivated land owned by the household (in hectares)	0.25	0.5	1	1.75	2.75	1.330	1.281
Household asset value (ETB10,000, 2013)	0.25	0.83	1.81	3.30	6.26	3.308	5.934
Communal grazing land (in hectares per TLU)	0.01	0.02	0.04	0.09	0.17	0.078	0.135
Distance to a livestock watering point (in kilometres)	0.05	0.08	0.17	0.50	0.75	0.353	0.488
Distance to market town (in kilometer)	2.00	5.00	8.00	15.00	20.00	10.138	8.456
Off-farm employment opportunity quantile (1 = low opportunity, 5 = high opportunity)	1	2	3	4	5	3.149	1.381
Distance to rural saving and credit institutions (in kilometres)	0.2	1	3	6	12	5.053	6.345

Table 14 shows that 80% of the samples are male-headed households. Almost 82% reported receiving general extension services and only 66% received livestock-focused extension services during the production period under study.

The education levels of the household head is an important indicator of farmers' ability to process information. In this regard, the results reveal that a significant number of farmers (more than 50%) have no formal education, while 18% and 20% of farmers have 1–4 years and 5–8 years of schooling respectively. Only 6% of the farmers attained more than eight years of schooling.

Table 14: Distribution of binary explanatory variables

Explanatory variable	Share of households
Male-headed households	0.80
Households who received general extension services	0.82
Households who received livestock-focused extension services	0.66
No education	0.57
1–4 years	0.18
5–8 years	0.20
More than 8 years	0.06

2 The official exchange rate of USD1 is equal to ETB 20.4322 as of 23 February 2015.

Results of estimation

Farmers' decision of whether to allocate the credit for livestock production is modelled as a three-stage decision problem. The use of credit for livestock production is modelled as a probit equation. However, this is preceded by two probit selection equations: namely the decision to take credit and the decision 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, but it would be irrelevant to the subsequent decision. Thus the variable is excluded from the second equation. Similarly, between stages two and three the exclusion restriction is imposed on the wage rate for off-farm activities.

The model assumes a non-zero correlation among the three error terms in EQ (1). To test the assumption, we estimated a restricted model by setting the correlation among the error terms equal to zero and conducted an LR test. With chi^2 of 8.30 (P=0.04) the null hypothesis of zero correlation among the error terms is rejected. In addition, the results from Table 15 indicate that ρ_{12} and $\rho_{23}$are statistically different from zero at 5% and 1% significant levels. These tests suggest that the trivariate probit model with a double sample selection is appropriate and failing to adjust for the two sample selection bias would lead to erroneous inferences.

Table 15: Model estimate of factors affecting household credit allocation decisions

	Dependent variables		
Explanatory Variable	Y_{3i} (=1 if the household allocate credit for livestock production, =0 otherwise)	Y_{2i} (=1 if the household allocate credit for farm activities, 0 otherwise)	Y_{1i} (=1 if the household took credit, =0 otherwise)
Household characteristics			
Household head gender (1=Male)	-0.331** (0.013)	0.237** (0.033)	-0.174* (0.095)
Total dependency ratio	0.0382 (0.639)	0.0146 (0.817)	0.0139 (0.81)
Labour supply	0.0362 (0.456)	-0.0279 (0.464)	-0.00371 (0.915)
Total amount of cultivated land owned by the household (in hectares)	-0.522*** (0.000)	0.230*** (0.000)	-0.0677 (0.194)
Total amount of cultivated land owned by the household squared	0.0287*** (0.000)	-0.0126** (0.04)	0.00318 (0.53)
Household asset value (ETB10,000, 2013)	0.0198** (0.041)	-0.00698 (0.303)	0.0163** (0.029)
Household head: education level and age			
1–4 years (1=yes)	0.122 (0.372)	-0.00848 (0.939)	0.102 (0.326)
5–8 years (1=yes)	0.212 (0.126)	-0.0392 (0.727)	0.0495 (0.622)
More than 8 years (1=yes)	0.258 (0.246)	-0.266 (0.127)	0.282 (0.111)
Age of household head	0.00937 (0.789)	0.0102 (0.7)	0.0635*** (0.003)
Age of household head squared/100)	-0.00518 (0.881)	-0.0109 (0.681)	-0.0597*** (0.007)
Access to extension services and rural institutions			
Distance to a livestock watering point (in kilometres)	0.0243 (0.793)	-	-
Distance to a market town (in kilometres)	0.00142 (0.821)	-0.00243 (0.683)	-0.00152 (0.743)
Access to general extension services (1=Yes)	-0.482** (0.034)	0.383** (0.026)	0.274*** (0.005)

Explanatory variable	Dependent variables		
	Y_{3i} (=1 if the household allocate credit for livestock production, =0 otherwise)	Y_{2i} (=1 if the household allocate credit for farm activities, 0 otherwise)	Y_{1i} (=1 if the household took credit, =0 otherwise)
Access to livestock focused extension services (1=Yes)	0.381** (0.034)	-	-
PA characteristics			
Communal grazing land (in hectares per TLU)	-0.538 (0.292)	0.207 (0.52)	-0.297 (0.286)
Distance to rural saving and credit institutions (in kilometres)	-	-	-0.0240*** (0.000)
Off-farm employment opportunity quantile (1 = low opportunity, 5 = low opportunity)	-	0.0269 (0.435)	0.0613** (0.028)
Constant	0.17 (0.866)	-0.262 (0.732)	-1.262** (0.015)
ρ_{12}	-1.032 (0.14)		
ρ_{13}	0.624* (0.088)		
ρ_{23}	-1.304 (0.313)		
Log likelihood	-1692.38		
Likelihood ratio	199.07***		
Number of observation	1338		

Note: *, ** and *** denote significance at 10, 5 and 1% levels respectively, p-value in parentheses

The likelihood ratio is asymptotically distributed as c^2 with 47 degrees of freedom.

The 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 199.07 ($p < .0001$), 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.

(a) Credit market participation

Table 15 presents the results of the model. The model estimates the parameters for the three equations discussed in EQ (1). As shown above, male-headed households are less likely to receive credit than their female counterparts. This is in contrast with a recent study by Nikaidoa and Sarmac (2015) in India where they found that female owners are less likely to receive formal credit than their male counterparts. The reason is that microcredit programs, which are the major source of credit for rural people, deliberately target female-headed households.

The age of the household head was found to be statistically significant (P<0.01) indicating that older households are more likely to get credit than younger ones. As shown in Table 16, age squared is also statistically significant (P<0.01) implying that age has a non-linear relationship with the independent variable. The negative coefficient for age squared indicates that beyond a certain age farmers are less likely to take credit. This could be because as farmers get older they become more risk averse or may not be considered suitable for credit.

Surprisingly household landholding is found to have no significant effect on household access to credit. This is because the land tenure system in Ethiopia does not allow land to be used as collateral. Thus, farmers with large land holdings do not necessarily present a lesser risk to credit institutions. This is consistent with the findings of Bastin and Matteucci (2007).

Household wealth has positive and statistically significant effect (P =0.029) indicating that wealthy farmers are more likely to get credit. Wealthy farmers are an attractive choice for credit institutions as they could easily provide

collateral. This finding is in line with a recent study by Yuan and Xu (2015) where they found that poorer households have limited access to the informal credit market.

The results also show that wage rate index for off-farm activities (P=0.028) increases the probability of receiving credit. An increase in wage rate for off-farm activities increases farmers earning potential and this makes them more attractive to creditors.

As expected, access to extension services (P<0.01) is found to be 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 farmers' 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.

(b) Agricultural and non-agricultural use of credit

About 63% of those who took credit allocate the credit for agricultural activities. The model results indicate that the gender of the household head, land ownership and access to extension services have a statistically significant effect on household decisions to allocate the credit to agriculture-related activities.

Male-headed households are less likely to receive credit. However, if they did receive the credit they are more likely to spend it on agricultural activities than their female counterparts. This is consistent with Swaminathane et al. (2010) study where they found that in Malawi compared to women, the majority of men use loans from formal credit sources to purchase agricultural inputs.

As expected, land ownership positively affects (P<0.001) the probability of using the credit money for agricultural activities (Table 15). This could be because an increase in farm size requires more farm inputs, which leads to more resources diverted to the farm. However, a positive effect of land ownership and a negative effect of land ownership squared (P=0.04) means that for those who own a large amount of land the effect of land ownership is lessened.

Access to extension services is significantly associated (P=0.026) with farmers using credit money for agricultural production. One reason is that the households that have access to agricultural extension services are more likely to be exposed to a range of new agricultural technologies and are motivated to apply these new technologies. Thus, they are more likely to use credit for agriculture production.

(c) Use of credit for livestock production

The ultimate objective of this paper is to identify factors that affect households' decision to allocate credit for livestock production. After controlling for possible sample selection bias, the results show that the gender of the household head, land ownership and access to extension services, both livestock-focused as well as general extension services, have statistically a significant effect on household decisions to allocate credit to livestock production.

Female-headed households are more likely (P=0.013) to use credit for livestock production than their male counterparts. In Ethiopia, women are more involved in cattle production. It is worth noting that animals are the primary source of micronutrients for rural households. Combined with our results the implication is that lending to females improve households' wellbeing. In fact, Jin and Iannotti, (2014) using data from a large-scale impact evaluation conducted in Kenya, found that targeting females in livestock production ensures improvements in child nutrition.

The results also show that household who own a large plot of land are less likely (P<0.001) to allocate the credit to 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 plots of land as indicated positive and significant (P<0.001) coefficients of land ownership squared. This is because in Ethiopia where drought is a regular phenomenon, livestock production is riskier than crop production. As such, farmer preferences are towards crop production. In this setting, livestock is used to store wealth and also used to meet emergency cash needs.

Access to general extension services is also found to have a significant (P=0.034) negative effect on the probability of using credit for livestock production. The extension service in Ethiopia is mainly geared towards crop production and as such households that have access to credit and extension services are more likely to allocate the credit to crop production.

In contract, but as expected, access to livestock extension services is found to have a significant (P=0.034) and positive impact on the probability of allocating credit to livestock production. Those households who have access to livestock extension services are more likely to allocate their credit to livestock production.

5. Conclusions and implications

By identifying the factors that affect household decisions to allocate credit, particularly to livestock production, this study tries to fill the knowledge gap in our understanding of household credit allocation decisions in Ethiopia. The results of this study are expected to enhance the understanding of the behaviour of smallholders and guide project implementers and lending institutions working with farmers.

The paper uses a probit model with double selection equations to identify factors that affect farmer decisions to allocate credit to livestock production. Different specification tests of the model show that accounting for the selection bias is a significant improvement to the one that excludes the stepwise selection process.

The paper argues that socio-economic and institutional factors have a statistically significant effect on small-scale farmer decisions as to whether to allocate credit to livestock production. This has implications for programs and projects that aim to improve small-scale livestock production. The fact that female household heads are more likely to allocate credit to livestock production indicates that extending credit to females may lead to improved household access to animal-source foods (ASFs). Thus, efforts to develop the livestock sector should adopt a gender sensitive approach that addresses the specific needs of female farmers. On the other hand, land ownership has significant and negative influence of farmer decisions to allocate credit to livestock production, suggesting that support services should target those households with small farms. Intuitively this makes sense, those who own large farms 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-scarce households.

The results also show that access to livestock-focused extension services has statistically positive effect on farmer decisions to allocate credit to livestock sector. In fact, agricultural economists have long noted the relationship between extension services and credit. For instance, Gebremedhin 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 inputs and adopt technologies which the extension service entails or requires.

A non-negligible proportion of households use the credit for non-productive activities, such as to cover household expenditure. This highlights 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 supported by focused-extension services to ensure the proper utilization of the available opportunities.

Previous studies have already identified this as an important component in improving livestock productivity. This paper clearly shows the link between access to livestock extension service and household tendencies to engage in livestock sector. Thus, together with the already existing results, the paper shows that it is possible to increase livestock production and productivity by combining improved access to credit with livestock-focused extension services.

As a final note, the study’s findings should also be viewed with some caution, as only households who needed credit were the subjects of the research.

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

References

Ali, D.A. and Deininger, K. 2014. Causes and implications of credit rationing in rural Ethiopia; The importance of zonal variation. *Journal of African Economies* 23(4):493–527. Available at: http://jae. oxfordjournals.org/cgi/doi/10.1093/jae/eju008

Amjad, S. and Hasnu, S.A.F. 2007. Smallholders' access to rural credit: Evidence from Pakistan. *The Lahore Journal of Economics*, 12(2):1–25.

Amha, W. 2009. Meeting the Financial Needs of Smallholder Farmers in Ethiopia. *Proceedings of the 10th Anniversary of Association of Ethiopian Microfinance Institutions,* pp. 9–46.

Amha, W. 2008. Value Chain Financing: Changing the perspective of providing financial services to the livestock sector in Ethiopia. *Proceedings of the fifth bi-annual conference on microfinance development in Ethiopia, Association of Ethiopian Microfinance Institutions*, pp. 26–75.

Solomon, A., Workalemahu, A., Jabbar, M.A., Ahmed, M.M. and Hurissa, B. 2003. *Livestock marketing in Ethiopia: a review of structure, performance and development initiatives*. Socio-economics and Policy Research Working Paper 52. Nairobi, Kenya: ILRI.

Bastin, A. and Matteucci, N. 2007. Financing coffee farmers in Ethiopia: Challenges and opportunities. *Savings and Development*, 3:251–282.

Behrouz, Y., Mehdi, M.C. and Akbar, H. 2012. An analysis of effective factors on diversion of agricultural credits in rural areas: A case study of Ghani Bigloo sub district of Zanjan county. *Roosta Va Towse' E,* 15(2):37–58.

Borsch-Supan, A. and Hajivassiliou, V. 1993. Smooth unbiased multivariate probability simulators for maximum likelihood estimation of limited dependent variable models. *Journal of Econometrics*, 58:347–368.

Buvinić, M. and Gupta, R.G. 1997. Female-headed households and female-maintained families: Are they worth targeting to reduce poverty in developing countries? *Economic Development and Cultural Change*, 45(2):259–280.

Cappellari, L. and Jenkins, S. 2006. Calculation of multivariate normal probabilities by simulation, with applications to maximum simulated likelihood estimation. *Stata Journal*, 6(2):156–289.

Carreon, V. and Garcia, L.J. 2011. *Trivariate Probit with Double Sample Selection: Theory and Application.* Mexico City: Mexico: Centro de Investigación y Docencia Económicas A.C. (CIDI).

de Janvry, A. and Sadoulet, E. 2001. Income strategies among rural households in Mexico: the role of off-farm activities. *World Development,* 29:467–480.

Dercon, S. and Christiaensen, L. 2011. Consumption risk, technology adoption and poverty traps: evidence from Ethiopia. *J. Dev. Econ*., 96:159–173.

Dong, F., Lu, J. and Featherstone, A.M. 2012. Effects of credit constrints on household productivity in rural China. *Agricultural Finance Review*, 72(3):402–415.

Ethiopian Economics Association. 2014. *Report on the Ethiopian Economy*. Addis Ababa, Ethiopia.

Gatti, R. and Love, I. 2006. *Does access to credit imporve productivity? Evidence from Bulgarian firms*. The World Bank. Available at: http://elibrary.worldbank.org/doi/book/10.1596/1813-9450-3921 (Accessed 21 June 2016).

Gebremedhin, B., Hoekstra, D. and Tegegne, A. 2006. Commercialization of Ethiopian agriculture: extension service from input supplier to knowledge broker and facilitator. IPMS Working Paper 1. Nairobi, Kenya: ILRI.

Greene, W.H. 2008. *Econometric Analysis*, sixth edition. New Jersey, USA: Prentice Hall.

Hajivassiliou, V. and Ruud, P. 1994. Classical estimation methods for LDV models using simulation. In: R. Engle and D. McFadden, (ed), *Handbook of Econometrics* 4:2383–2441. Amsterdam: Netherlands.

Heckman. 1979. Sample Selection Bias as a Specification Error. *Econometrica* 47:153–161.

Jabbar, M.A., Ehui, S.K. and Von Kaufmann, R. 2002. Supply and demand for livestock credit in sub-Saharan Africa: Lessons for designing new credit schemes. *World Development*, 30(6):29–1042.

Jin, M. and Iannotti, L.L. 2014. Livestock production, animal source food intake, and young child growth: The role of gender for ensuring nutrition impacts. *Social Science & Medicine* 105:16–21.

Kumar, C.S., Turvey, C.G. and Kropp, J.D. 2013. The impact of credit constraints on farm households: Survey results from India and China. *Applied Economic Perspectives and Policy*, 35(3):508–527. Available at: http://aepp.oxfordjournals.org.lookup/doi/10.1093/aepp/ppt002.

Kuwornu, K.M.J., Ohene-Ntow, D.I. and Asuming-Brempong, S. 2012. Agricultural credit allocation and constraint analyses of selected maize farmers in Ghana. *British Journal of Economics, Management & Trade,* 2(4):353–374.

Kohansal, M.R. and Mansoori, H. 2009. Factors affecting loan repayment performance of farmers in Khorasan-Razavi province of Iran. Accessed on 20 July 2015 www.tropentag.de/2009/abstracts/full/264.pdf.

Lehner, M. 2009. Group lending versus individual lending in microfinance. Discussion paper no. 299. University of Munich. http://epub.ub.uni-muenchen.de/13255/1/299.pdf.

Martins da, S.P. and Pereira, da S.Z.T. 2012. Cattle-raising and public credit in rural settlements in Eastern Amazon. *Ecological Indicators.* 20:316–323. doi:10.1016/j.ecolind.2012.02.031.

Nikaidoa, Y. and Mandira, S.J. 2015. What hinders and what enhances small enterprises' access to formal credit in India? *Review of Development Finance*, 5(1):43–52. doi:10.1016/j.rdf.2015.05.002.

Nwaru, J.C. and Onuoha, R.E. 2010. Credit use and technical change in smallholder food crop production in Imo state of Nigeria. *New York Science Journal* 3(11):44–152.

Oboh, V.U. and Ekpebu, I.D. 2011. Determinants of formal agricultural credit allocation to the farm sector by arable crop farmers in Benue state. Nigeria. *African Journal of Agricultural Research,* 6(1):181–185.

Okonya, S.J. and Kroschel, J. 2014. Gender differences in access and use of selected productive resources among sweet potato farmers in Uganda. *Agriculture & Food Security*, 3(1). doi 10.1186/2048-7010-3-1.

Roodman, D. 2011. Estimating fully observed recursive mixed-process models with cmp. *Stata Journal*, 11(2):159–206.

Sebopetji, T.O. and Belete, A. 2009. An application of probit analysis to factors affecting small-scale farmers' decision to take credit: a case study of the Greater Letaba local municipality in South Africa. *African Journal of Agricultural Research*, 4(8):718–723.

Shallone, K.C. and Munongo, S. 2013. Determinants of farmers' decision to access credit: the case of Zimbabwe. *Russian Journal of Agricultural and Socio-Economic Sciences*, 5(17)7–12.

Shimamura, Y. and Lastarria-Cornhiel, S. 2010. Credit program participation and child schooling in rural Malawi. *World Development*, 38(4):567–580 doi:10.1016/j.worlddev.2009.11.005.

Swaminathan, H., Du Bois, R.S. and Findeis, L.J. 2010. Impact of access to credit on labor allocation patterns in Malawi. *World Development*, 38(4):555–566. doi:10.1016/j.worlddev.2009.11.002.

Tessema,Y., Asafu-Adjaye, J., Rodriguez, D., Mallawaarachchi, T. and Shiferaw, B. 2015. A bio-economic analysis of the benefits of conservation agriculture: The case of smallholder farmers in Adami Tulu district, Ethiopia. *Ecological Economics*, 120:164–174, doi:10.1016/j.ecolecon.2015.10.020.

Tesfayea, A., Brouwera, R., van der Zaagb, P. and Negatu, W. 2016. Assessing the costs and benefits of improved land management practices in three watershed areas in Ethiopia. *International Soil and Water Conservation Research*. In Press, Accepted Manuscript, Available online 17 February 2016. doi:10.1016/j.iswcr.2016.01.003.

Yuan, Y. and Xu, L. 2015. Are poor able to access the informal credit market? Evidence from rural households in China. *China Economic Review*. 33:232–246. doi:10.1016/j.chieco.2015.01.003.

ISBN 92–9146–471-6

Livestock and irrigation value chains for Ethiopian smallholders project aims to improve the competitiveness, sustainability and equity of value chains for selected high-value livestock and irrigated crop commodities in target areas of four regions of Ethiopia. It identifies, targets and promotes improved technologies and innovations to develop high value livestock and irrigated crop value chains; it improves the capacities of value chain actors; it improves the use of knowledge at different levels; it generates knowledge through action-oriented research; and it promotes and disseminates good practices. Project carried out with the financial support of the Government of Canada provided through Foreign Affairs, Trade and Development Canada (DFATD). lives-ethiopia.org

The International Livestock Research Institute (ILRI) works to improve food security and reduce poverty in developing countries through research for better and more sustainable use of livestock. ILRI is a member of the CGIAR Consortium, a global research partnership of 15 centres working with many partners for a food-secure future. ILRI has two main campuses in East Africa and other hubs in East, West and southern Africa and South, Southeast and East Asia. ilri.org

The International Water Management Institute (IWMI) is a non-profit, scientific research organization focusing on the sustainable use of water and land resources in developing countries. It is headquartered in Colombo, Sri Lanka, with regional offices across Asia and Africa. IWMI works in partnership with governments, civil society and the private sector to develop scalable agricultural water management solutions that have a real impact on poverty reduction, food security and ecosystem health. IWMI is a member of CGIAR, a global research partnership for a food-secure future. iwmi.org

CGIAR is a global agricultural research partnership for a food-secure future. Its science is carried out by15 research centres that are members of the CGIAR Consortium in collaboration with hundreds of partner organizations. cgiar.org

Foreign Affairs, Trade and Development Canada
Affaires étrangères, Commerce et Développement Canada