

Multiple Credit Constraints and Borrowing Behavior of Farm Households: Panel Data Evidence from Rural Ethiopia

Hailu Elias¹

Abstract

Promoting an inclusive rural credit market in developing countries is a re-emerging and pressing development agenda, given its importance in the poverty reduction and economic growth process. Existing literature mainly focuses on the supply side of the market with little or no attention given to demand aspects. This paper analyzes both the demand and supply side factors affecting credit constraints and borrowing behavior of farmers. Two waves of survey data, which included about 1,200 randomly selected households from four zones of the Amhara region in Northern Ethiopia, were used for the analysis. The Generalized Linear Latent and mixed model (gllamm) was employed to account for unobserved heterogeneity and potential correlations across credit constraint categories. The results show that the probability of quantity rationing increased in the study area between the years 2011 and 2013. Exposure to climatic shocks, age, and lack of education were found to increase the probability of being constrained while female and married heads were relatively less constrained. The results further indicate that borrower's perceived probability of rejection due to strict lending policies and institutional rigidities; the transaction cost of borrowing; and risk aversion behavior of farmers highly reduced the probability of borrowing from the formal credit market. Compared to North Shewa, farmers living in South Wollo zone were found to be discouraged and hence did not prefer borrowing from the formal sector. However, farmers in West Gojjam were less discouraged and had a higher probability of participating in the formal credit market, signifying zonal variation in credit constraints and borrowing behavior. This suggests the need to work on more innovative lending approaches by giving attention to context-specific factors to build demand-driven, climate-smart, and inclusive rural credit market.

Key words: credit constraint, borrowing behavior, rural credit market, inclusive finance, gllamm, Ethiopia.

JEL codes: C23, G29, G30, Q12, Q54

¹ Assisant Professor of Economics, Department of Economics and Institute of Development and Policy Research (IDPR), Addis Ababa University. email: hailuelias7@yahoo.com

1. Introduction

In developing countries where agriculture takes the lion's share of the GDP, rural credit market plays a crucial role in enhancing agricultural growth and transformation. For farm households, access to rural credit services is crucial as it facilitates access to recommended agricultural technologies and farming tools to improve productivity and produce marketable surpluses. It also helps farm households to build assets and smooth out consumption in the face of fluctuating agricultural income due to climatic shocks.

However, prior studies show that most farm households in developing countries are credit constrained. It is estimated that only five percent of farmers in Africa and about fifteen percent in Asia and Latin America have access to formal credit. On average, 80 percent of this credit goes only to 5 percent of the borrowers in many developing countries (Bali Swain, 2001; Antwi and Antwi, 2010). The condition is not much different in rural Ethiopia. For example, during the period 1951 – 1969, smallholder farmers received only 7.5 percent of the total loan disbursed by the Development Bank of Ethiopia. The rest was going to wrong groups of the society such as “absentee landlords”, merchants, and government officials, and it did not reach poor farmers (Admassie, 1987). Only 4.7 percent of the domestic credit went to the private sector during the period from 1986 to 1991 (World Bank, 1991) and more than 89 percent of the banks' agricultural credit went to state farms during that period (Admassie *et al.*, 2005). This created binding credit constraints on farm households over the decades.

Hence, promoting an inclusive credit market and ensuring farm households' access to financial services in developing countries is a re-emerging and pressing development agenda, and the recent policy emphasis has shifted to "Finance for All" (Lamberte *et al.*, 2006; World Bank, 2007).

In line with this policy shift, Ethiopia has done much in reforming its financial sector in recent years. Although there is an improvement in access to credit following these reforms, smallholder farmers still face credit constraints. Commercial banks in Ethiopia hesitate to lend to farmers due to the inherent risk in agricultural production and lack of the required loan collateral, and

hence, farm households are excluded from the formal banking market. Microfinance institutions and financial cooperatives are the alternative credit providers to these households. However, despite the rapid growth of these institutions in recent years, they reach only about 20 percent of the rural poor (AEMFI, 2011; EEA, 2011), implying the existence of binding credit constraints.

Studies confirm that such binding constraints have significant adverse impacts on farm investment (Carter and Olinto, 2003; Karlan *et al.*, 2014), agricultural output (Petrick, 2005), and efficiency of intra-household resource allocation (Fletschner, 2008). It also reduces farm profit (Foltz, 2004) and technical and financial efficiency in agriculture (Hamda and Öhlmer, 2006; Fletschner *et al.*, 2010). Credit constraints, coupled with exposure to climatic shocks, may also force farmers to shift away from high-income and high-risk economic activities to low-risk and low-income activities, leaving them in unsustainable livelihoods and the vicious circle of poverty (Humphreys and Verschoor, 2004; Charles, 2011).

Thus, identifying the nature of credit constraints and borrowing behavior of households is crucial both from empirical and policy perspectives, since it is a central welfare and development issue. But empirical evidence on this topic is rare in the context of rural areas in the sub-Saharan Africa in general, and particularly in rural Ethiopia. In filling this gap, the current study set out to: (1) identify the types of households who are credit constrained; (2) investigate the demand and supply side factors affecting credit constraint status; and (3) examine how such constraints affect the borrowing behavior of farm households. Hence, this study contributes to the existing literature in three ways. First, there are only few studies on credit constraints and borrowing behavior in rural Ethiopia and, to the knowledge of the author, there is no rigorous prior work on this topic in the context of the study area. Second, the existing few studies categorize households into two regimes as either credit constrained or unconstrained². This is a crude measure and does not provide

² See, for example, Hamda and Öhlmer (2006); and Kedir and Ibrahim (2007) for recent studies. Though these studies recognize that using a dummy does not entangle between borrowing status and credit constraint condition, they classify the households only into two categories in their final econometric analysis.

adequate information about the real causes and multiple manifestations of credit constraints. Guirkinger and Boucher (2008) and Reyes and Lensink (2011) argue that existence of the credit market may not guarantee participation of households in the credit market; or getting some amount of loan may not automatically solve the credit constraint problems of farmers. Hence, this study extends the binary categorization into five, using the direct elicitation approach. These are: (i) unconstrained non-borrowers, (ii) unconstrained borrowers, (iii) quantity constrained borrowers, (iv) transaction cost constrained borrowers, and (v) risk rationed borrowers. Such detailed categorization is expected to provide a clear understanding about both the demand and supply side causes of credit constraints in the rural credit market. Section 3 provides further details about the classification strategy. Third, prior comparable studies mentioned above rely on cross-sectional data which show only a one-period picture of the credit constraint situation and may not provide precise estimates due to omitted variables. This study is based on a unique panel data collected from randomly selected rural households, and this is expected to show possible changes in the credit constraint status of farm households over time. Moreover, a multinomial logit model with random effects was estimated to control for unobserved heterogeneity, and this has an added advantage of providing more efficient and unbiased results. Fourth, using zone dummies, this study also shows to what extent the rural credit market is segmented and how credit constraints vary across the study sites.

The rest of the paper is organized as follows. Section 2 briefly discusses the theoretical and empirical literature related to credit constraints and borrowing behavior. Section 3 gives a description of the data and method of analysis. Section 4 presents a discussion on the results and section 5 concludes the paper.

2. Credit constraints and borrowing behavior: A brief review of the theoretical and empirical literature

The concept of credit constraints and borrowing behavior of households is linked with the permanent income or the life-cycle hypothesis (Friedman, 1957; Modigliani, 1986). This theory states that households try to maximize their utility by smoothing the marginal utility over the life cycle. It assumes

existence of a perfect and complete capital market where households can borrow the amount of credit they want when they face liquidity problems and repay it in a period of high income. Thus, with standard convex preferences, and in the absence of borrowing constraints, transitory income shocks will not affect consumption, since it depends only on permanent income.

However, the credit market literature provides three competing theories about the structure of rural credit market in developing countries, namely: the monopoly market theory, the perfectly competitive market theory, and the imperfect information theory (Stiglitz and Weiss, 1981; Hoff and Stiglitz, 1996; Bardhan and Udry, 1999; and Ho, 2004). The monopoly market theory argues that informal credit dominates in the rural credit market where village money lenders have a monopoly power and can charge the maximum possible interest rate to maximize their profits. This market is highly complicated because money lenders use various strategies to control their clients. This theory, however, does not capture the full image of the rural credit market in developing countries. It does not explain why formal and informal lenders co-exist despite the fact that formal loan interest rates are much lower than that charged by informal lenders. Moreover, it fails to explain the tricks and reasons for the inter-linkages between the formal and informal credit transactions in rural areas. The perfectly competitive market theory, on the other hand, predicts that the rural credit market clears with a market-clearing single equilibrium where the lending interest rate serves as the main screening device. It means that lenders increase the interest rate when the loan applicant is a high-risk borrower and they reduce it for low-risk borrowers. But this theory is based on unrealistic assumptions, and it fails to describe the real world condition, where a pervasive credit-rationing is observed in the rural credit market even when there is equilibrium in the market. Compared to the above two theories, the imperfect information theory provides a more advanced and realistic explanation of the nature of rural credit markets in developing countries. According to this theory, the rural credit market is characterized by market imperfections such as: uncertainty, the problems of incentive compatibility and information asymmetry, which lead to the problems of adverse selection, moral hazard, higher transaction cost and higher risk in borrowing and lending transactions. This leaves many households credit constrained.

Prior empirical studies also confirm that most households in developing countries are credit constrained due to market imperfections (See, for example, Kochar, 1997; Foltz, 2004; Khandker, 2005; Chen & Chivakul, 2008). However, in sub-Saharan Africa, and particularly in rural Ethiopia, quantitative evidence on the causes of credit constraints and borrowing behavior of households is thin (Hamda and Öhlmer, 2006; Aterido *et al.*, 2011; and Ayalew and Deininger, 2014). This calls for further studies aiming at explicitly addressing the demand and supply side causes of credit constraints and borrowing behavior of households in the context of imperfect credit markets.

3. Data and Method of Analysis

3.1. Data description

Data used in this study were collected in two rounds (in 2011 and 2013) from 1,200 randomly selected households living in four zones of the Amhara National Regional State located in the northern and central highlands of Ethiopia. About 33 percent of these households reside in north Shewa, 31 percent in west Gojjam, 23 percent in south Wollo, and the remaining 13 percent in north Wollo zones (Table 1). The surveys were conducted by the Ethiopian Economics Association in collaboration with the University of California, University of Athens, FAO, and the European Commission Joint Research Center. The two surveys provided information on livestock and crop production, marketing, farm and non-farm income, household consumption expenditure, ownership of assets, participation in non-agricultural enterprises, exposure to various climatic shocks and coping strategies, attitude towards risk, demand for crop insurance, and credit constraints.

The analysis in this paper is based on a balanced panel data of 1,189 households who were interviewed in both rounds.

Socio-economic and demographic characteristics of these households is presented in Table A1 in the appendix. As indicated in that table, the average age of household heads in the sampled zones was about 50 years, and heads in west Gojjam zone are relatively younger than those in the other three zones.

Table 1: Sample Households, by Zone (2011 and 2013)

Region	Percent
north Shewa	33.22
west Gojjam	31.12
south Wollo	23.13
north Wollo	12.53
Total	100

The average household size was about 5 and the number of female-headed households has increased from about 9 percent in 2011 to 12 percent in 2013. The survey instrument gathered information on years of schooling of the heads, and on average, 51 percent of the heads have no education while about 22 percent have about 5 years of formal education, and 27 percent have attended some informal education.

3.1.1 Dependent variables

The dependent variables of this study are the probability that a household will fall in one of the credit constraint categories, and the probability of participating or getting credit from formal, semi-formal, or informal sources. Unlike prior studies, which mainly focused on supply-side factors, the current study considers both demand- and supply-side causes of credit constraints and borrowing behavior of households. From the supply side, prior studies suggest that potential borrowers may be constrained due to creditworthiness issues, and/or due to liquidity constraints of lending institutions. When lenders face shortage of loanable fund, they may ration credit, leading to quantity constraints. The creditworthiness factors include: (i) households' socio-economic characteristics; (ii) endowment of livelihood assets; and (iii) institutional constraints (Kon and Storey, 2003; Mpuga, 2008; Cheng, 2009; Reyes and Lensink, 2011).

The theory of discouraged borrowers (Kon and Storey, 2003) suggests that demand-side factors affect households' decision to participate in the credit market. The imperfect credit screening mechanisms used by lenders usually force potential borrowers not to apply for credit. Following this theory, the

demand-side factors can be conceived as households' rational reaction to institutional rigidities of lending institutions. Thus, in this study, it is hypothesized that farm households may shy away from formal lenders due to such factors as: (i) high transaction cost of borrowing; (ii) high risk costs of loan contracts or due to risk aversion behavior of households; and (iii) cognitive and behavioral biases created due to previous borrowing experiences. However, these factors, which create barriers on credit market participation and hinder investment on profitable activities, have not been studied thoroughly in the context of rural Ethiopia. Thus, this study tries to investigate the types of households who are discouraged, rejected or systematically excluded from the rural credit market in the context of rural Ethiopia.

3.1.2 Explanatory variables

Although there are a host of variables that determine the credit constraint condition and participation in the rural credit market, the choice of variables for this study is guided by the review of related literature and context of the study area. Accordingly, demographic variables (such as sex, age and marital status of the head, and household size), education, farm size, livestock ownership, membership in a primary credit cooperative, location dummies and exposure to climatic shocks are included in the regression analysis as explanatory variables.

Moreover, the different credit constraint categories (such as being risk rationed, discouraged due to high transaction cost of borrowing and quantity constrained) are included as additional variables in the credit market participation equation. A detailed discussion about each variable is provided in section 4 below.

Identifying credit constraint categories using the Direct Elicitation strategy

Identifying credit constrained households is an empirical challenge since credit rationing cannot be observed directly. The literature suggests the direct and the indirect elicitation strategies as two possible solutions to this challenge (see Boucher *et al.*, 2009; Cheng, 2009; Ayalew and Deininger, 2014). The indirect strategy is based on the life-cycle or the permanent income hypothesis,

which is discussed in section 2 above³ while the direct approach is based on household survey data. Using the direct elicitation strategy, this study identified five credit constraint categories as shown in Table 2. First, the unconstrained borrowers are those who are willing to participate in the credit market and have full access to credit facilities from a given lending institution. The credit limit set by lenders to overcome the information asymmetry problem will not be binding for such borrowers. Second, the unconstrained non-borrowers are those who do not borrow from credit institutions because they do not have an urgent need for external finance or they do not have a profitable project that would require a loan. The production and consumption (resource allocation) decisions of such households is not affected by the prevailing credit market imperfections.

Classification Criteria Based on the Responses of HHs	Credit Constraint Category
I prefer working with my own funds.	Discouraged HH (risk-rationed)
My productive activities do not give me enough to repay debt.	Discouraged HH (risk-rationed)
I do not want to put my land and other assets at risk.	Discouraged HH (risk-rationed)
I do not want to be worried; I am afraid.	Discouraged HH (risk-rationed)
Group loan is risky.	Discouraged HH (risk-rationed)
My religion doesn't allow me to borrow.	Discouraged HH (risk-rationed)
Formal lenders do not offer refinancing.	Quantity constrained borrowers
The collateral asked is too large.	Quantity constrained borrowers
The interest rate is too high.	Quantity constrained borrowers
Formal lenders are too strict and inflexible.	Discouraged HH (tran. cost-rationed)
The bank branch is too far away.	Discouraged HH (tran. cost-rationed)
It is too time consuming to deal with commercial or other banks.	Discouraged HH (tran. cost-rationed)
I do not need a loan.	Unconstrained non borrowers

Third, the quantity constrained borrowers have an excess effective demand for credit but face a binding credit limit due to supply-side limitations. These households stated that they applied for credit and received the loan, but the

³ Further discussion about the strengths and weaknesses of this strategy is given in Diagne *et al.* (2000).

loan amount is less than their effective demand given the available contract terms. Fourth, from the demand side, the 'transaction-cost rationed' households are identified as those who have a positive effective demand but do not apply for credit. These households confirmed that they do not want to incur the additional costs associated with the loan application process, including the extra paper work and the time they waste dealing with lenders. Further, from their past experience or from their knowledge about lenders' credit procedures, they are sure that their application will be rejected. Such households may have profitable agricultural projects but they do not participate in the credit market because their projects become unprofitable once these costs are accounted for. Fifth, lenders normally want borrowers to bear a certain amount of risk to overcome the moral hazard problem in the borrowers' effort or choice of investment projects. One mechanism to do so is to ask for collateral. However, from the questionnaire, it was identified that risk-averse households prefer working with their own funds not to put their land and other assets at risk. These farmers do not want to incur debt even if they qualify for the loan and have a profitable project after accounting for transaction costs.

3.2 Econometric Model

3.2.1 *The Generalized Linear Latent and Mixed Model (gllamm)*

A unique feature of longitudinal categorical data is the existence of unobserved heterogeneity among the repeated observations for a single individual (Train, 2009; Haan and Uhlendorff, 2006). This heterogeneity may occur because each household can make several choices which may not be independent, and hence, the probabilities of each category for the same household will share the same unobservable random effects (Reyes and Lensink, 2011). If these 'unobservables' are not handled properly, the parameter estimates will be biased. This calls for a more advanced estimation strategy beyond the traditional pooled multinomial model without the random effects. Hence, the generalized linear latent and mixed model (gllamm) is employed to fit a multinomial logit model with correlated random intercepts, which accounts for any spurious dependence between individuals or categories.

Consider an individual i who is faced with J different alternatives at time t . The probability that this individual falls in a specific category j conditional on observed characteristics x_{it} , which vary between individuals and over time and also conditional on unobserved individual effects, α_i which are time constant, can be specified as:

$$prob(j|x_{it}, \alpha_i) = \frac{\exp(x'_{it}\beta_j + \alpha_{ij})}{\sum_{k=1}^J \exp(x'_{it}\beta_k + \alpha_{ik})} \quad (3.1)$$

It is assumed that α is identically and independently distributed over individuals and it follows a multivariate normal distribution with mean μ and variance-covariance matrix (Ω), i.e. $\alpha \sim iid(\mu, \Omega)$ (Haan and Uhlenborff, 2006; Train, 2009).

The likelihood function for equation (3.1) can be specified as:

$$L = \prod_{i=1}^N \int_{-\infty}^{\infty} \prod_{t=1}^T \prod_{j=1}^J \left(\frac{\exp(x'_{it}\beta_j + \alpha_j)}{\sum_{k=1}^J \exp(x'_{it}\beta_k + \alpha_k)} \right)^{d_{ijt}} f(\alpha) d\alpha \quad (3.2)$$

This is so because the choice probabilities given in equation (3.1) are conditioned on α_i , and hence, it must be integrated over the distribution of α to get the sample likelihood for the multinomial Logit with the random intercepts. This model will be identified if the coefficient vector (β) and the unobserved heterogeneity term (α) of one category are set to zero. Hence, $d_{ijt} = 1$ when individual i falls in category j at time t and zero otherwise.

The key problem in solving equation (3.2) is that an analytical solution cannot be found for the integral part of the model. This is because the random effects are assumed to have a multivariate normal distribution and the marginal

distribution can be found only after integrating out these random effects. This calls for some form of numerical integration. The literature suggests various simulation and Quadrature techniques including: the Adaptive Gaussian Quadrature (AGQ), Monte Carlo Simulation, Laplace Approximation, Taylor series approximation, and Gauss Hermite Quadrature to solve this problem (Rabe-Hesketh *et al.*, 2004; Haan and Uhlenborff, 2006; Train, 2009; Cameron and Trivedi, 2009). Among these simulation and Quadrature techniques, the AGQ approach is preferred for a longitudinal categorical data because it is computationally more efficient than the ordinary Quadrature in performing the numerical integration of equation (3.2) above. Another advantage of using the AGQ is that the number of Quadrature points required to approximate the integral are much fewer than that of the ordinary Quadrature and prior studies used this technique to evaluate similar integrals (examples include: Hartzel *et al.*, 2001; Rabe-Hesketh *et al.*, 2004; and Haynes *et al.*, 2006).

Inclusion of the AGQ technique is a recent development in statistical software. For instance, STATA software has a procedure called the generalized linear, latent and mixed model (gllamm), which is designed to model categorical dependent variables with repeated observations (Rabe-Hesketh *et al.*, 2004; Haan and Uhlenborff, 2006). It is an extension of the generalized linear model because it incorporates both the fixed and random effects, and hence, the response distribution is defined conditionally on the random effects. This model takes care of individual unobservable heterogeneity by capturing them through the alternative-specific random intercepts or coefficients (ASC), and it accounts for the possible correlation of choices made by individuals.

4. Results and Discussion

4.1 Credit constraints and borrowing behavior: An econometric assessment

Initially, a conventional, robust panel data multinomial logit (MNL) model without random effects was estimated on the determinants of credit constraints and borrowing behavior of farm households in the study area (Tables A4 and A5 in the appendix). However, given the type of problem at hand and the panel nature of the data, it is suspected that an unobserved heterogeneity may

exist between individuals and across different constraint categories. Therefore, an MNL model with random effects is also estimated using the generalized linear latent and mixed model (gllamm) (Tables 3 and 4). To select one of these two sets of specifications, the Likelihood Ratio (LR) test, the Bayesian Information Criterion (BIC), and Akaike's Information Criterion (AIC) tests were conducted. The test results support the gllamm more than the MNL model without random effects. Therefore, the discussion that follows is based on the results given in Tables 3 and 4. The unexplained variance in the first two categories and the correlation between all the three categories is captured by the random effects at the individual level (Table 3). These values statistically differ from zero and this implies that the individual effect captured by the MNL model with random effects explains a considerable portion of the total heterogeneity.

The null hypothesis of the Wald test that all coefficients except for the intercept term are equal to zero is rejected at a one percent level of statistical significance, and this confirms the theoretical predictions of the model. Variables explaining credit constraint and borrowing behavior are categorized into: (i) household demographic characteristics; (ii) ownership of livelihood assets; (iii) risk preference behavior; (iv) institutional constraints; and (v) control variables such as location and exposure to shocks. A descriptive statistics of the variables used in the analysis is given in Table A3 in the appendix.

Table 3: Determinants of different credit constraint categories of borrowers compared with unconstrained borrowers - generalized linear latent and mixed model (gllamm)§

Variable	Unconstrained non-borrowers	Constrained - Quantity rationed borrowers	Discouraged - Tran. Cost and risk rationed borrowers
age	.0231*** (0.00694)	.0127* (0.00652)	.0276*** (0.00706)
female	-1.4*** (0.454)	-0.553 (0.44)	-1.08** (0.461)
married	-.745* (0.422)	-0.424 (0.423)	-.735* (0.431)
Household size	-0.0772 (0.05)	-0.0245 (0.0476)	-0.0545 (0.0509)
No educ.	.459** (0.228)	-0.2 (0.213)	.497** (0.237)
formal educ.	-0.106 (0.239)	0.107 (0.223)	0.178 (0.247)
Land hect.	.466*** (0.12)	0.00962 (0.123)	0.134 (0.125)
Own livestock	-1.28** (0.568)	-0.795 (0.574)	-1.11* (0.579)
Coop member	0.0732 (0.302)	0.137 (0.308)	-0.11 (0.307)
Year dummy	-0.148 (0.183)	.613*** (0.189)	0.159 (0.19)
ln(food exp)	0.191 (0.121)	0.035 (0.119)	.274** (0.126)
Drought shock	0.18 (0.187)	.459** (0.181)	0.279 (0.192)
west Gojjam	-1.65*** (0.228)	-0.136 (0.209)	-1.32*** (0.229)
south Wollo	1.56*** (0.279)	1.63*** (0.288)	1.38*** (0.284)
north Wollo	-.493* (0.297)	.93*** (0.271)	-.909*** (0.314)
_Constant	0.944 (0.95)	-0.22 (0.947)	-0.283 (0.982)

Variance - Covariance Matrix of the Random Effects

	ucnb	qcb	Disc
ucnb	1.49***(0.158)	0.567***(0.206)	1.36***(0.164)
qcb	0.567***(0.206)	0.463*(0.239)	-0.314(0.200)
disc	1.36***(0.164)	-0.314(0.200)	0.001(0.412)
Statistics			
Log likelihood	-2794.11		
N	2294		
AIC	5696		
BIC	6081		

Note: * $p < .1$; ** $p < 0.05$; *** $p < 0.01$

BIC and AIC are Bayesian Information Criteria and Akaike's Information Criteria, respectively.

Ucnb, qcb and disc stand for unconstrained non-borr., quantity constrained borr., and discouraged borr.

§ All reported coefficient estimates are marginal effects after *gllamm*.

i) Household demographic characteristics

The age of the household head is used in this study as a proxy for maturity and the potential for careful handling of bank loans and repayment capability of the borrower. It is assumed that lenders discourage individuals who are above 40 years of age given the health risks and shorter life expectancy in developing countries such as the sub-Saharan Africa (SSA). Table 3 shows that age has a positive and statistically significant effect on the probability of being discouraged, and this is as expected since the average age of the heads in the study area was 49. Moreover, the result in Table 4 reveals that older individuals do not want to borrow both from formal and informal lenders. This is so, probably, because they are already discouraged by lenders or because they do not want to take the risk related to borrowing. These results are consistent with the findings by Crook (2001) and Mpuga (2008) that the demand for credit becomes negative for individuals who age above 40s.

Table 4: Determinants of farm HHs' choice of lenders compared to non-borrowers-generalized linear latent and mixed model (gllamm) §

Variable	HHs who prefer formal lenders	HHs who prefer informal lenders	HHs who prefer semi-formal lenders
Risk averse	-2.01*** (0.224)	-1.02*** (0.226)	.655* 0.339
Discouraged borrower	-1.83*** (0.449)	.652* (0.379)	-0.212 (0.575)
Quantity constrained borr.	-.287* (0.174)	-0.0258 (0.192)	0.0251 (0.329)
Age	-.0154*** (0.00573)	-.0192*** (0.00592)	0.00489 (0.00966)
Female	.698* (0.383)	0.0463 (0.391)	0.0603 (0.6)
Married	0.191 (0.36)	-0.176 (0.359)	-0.42 (0.544)
Household size	.0771* (0.0414)	0.0167 (0.0457)	-0.0377 (0.0706)
No educ.	-.316* (0.19)	-0.128 (0.199)	-.529* (0.319)
Formal educ.	0.0766 (0.201)	-0.00907 (0.221)	-.81** (0.365)
Land hectare	-.215** (0.102)	-0.19 (0.117)	0.0985 (0.196)
Own livestock	1.11** (0.508)	0.322 (0.438)	-0.169 (0.61)
Coop. member	-0.0416 (0.26)	0.165 (0.298)	-0.111 (0.415)
Year dummy	.56*** (0.166)	.377** (0.185)	-2.22*** (0.38)
ln(food exp.)	-0.169 (0.103)	-0.1 (0.116)	-0.101 (0.177)
Drought shock	-0.215 (0.163)	0.00795 (0.18)	0.239 (0.3)
West Gojjam	1.07*** (0.177)	-.729*** (0.204)	-0.228 (0.317)
South Wollo	-1.47*** (0.239)	-0.234 (0.228)	-3.06*** (0.653)
North Wollo	-0.123 (0.25)	0.371 (0.263)	.629* (0.354)
Constant	-0.867 (0.818)	-0.691 (0.822)	-0.653 (1.24)

Variance-Covariance Matrix of the Random Effects of HH Lender Choice			
	formal	informal	semi-formal
formal	.992***(0.155)	0.219(0.201)	0.459***(0.384)
informal	0.219(0.201)	0.127(0.305)	-0.966(0.73)
semi-formal	0.459***(0.384)	-0.966(0.73)	0.863(0.696)
Statistics			
Log likelihood	-2002.87		
N	2294		
AIC	4132		
BIC	4580		

Note: * p < .1; ** p < 0.05; *** p < 0.01

BIC and AIC are Bayesian Information Criteria and Akaike's Information Criteria, respectively.

§ All reported coefficient estimates are marginal effects after gllamm.

The gender of the household head is captured as a dummy variable with a value of one for female and zero for male. The result shows that gender has a negative and significant effect on the probability of being credit constrained (Table 3), and females prefer borrowing from the formal sector (Table 4). This implies that female-headed households have higher probability of access to rural credit, compared to their male counterparts. This may be due to the recent micro credit revolution which focuses more on empowering women. It agrees with the actual case in rural Ethiopia where 54 percent of the clients of micro finance institutions are females (EEA, 2011). Ashraf *et al.* (2003) also showed that credit schemes which favor female borrowers have gained popularity in recent years and become successful. Hansen and Rand (2011), using micro-level data from eight sub-Saharan African countries, found that there is female favoritism rather than discrimination in the African credit markets since women are considered as more loyal to their groups and have better repayment performance. Aterido *et al.* (2011) also reached a similar conclusion.

Marital status: Married individuals have a higher probability of access to rural credit as revealed by the negative and statistically significant coefficient on the probability of being discouraged (Table 3), and this is in line with the results of prior studies. For instance, according to Mpuga (2008), married heads are more likely to be stable, trustworthy and abide by rules and regulations compared to the unmarried or separated heads, and financial institutions view them as more reliable and allow them to have better access to credit.

Household size: The result shows that having a larger household increases the probability of demanding credit from formal lenders. In developing countries where the rural labor market is usually imperfect or missing, family labor is an important source of agricultural labor supply. Hence, it is possible to argue that larger a household may mean more labor supply in agriculture, which can lead to higher agricultural production, higher household income, and better capacity to accumulate productive assets. Some members of the household may also migrate to nearby towns or bigger cities for off-farm employment and may send remittances back to their families. This, in turn, may help farm households to build assets which can serve as loan collateral.

ii) Ownership of livelihood assets

The literature on rural livelihoods argues that household income and participation in the credit market is determined by the portfolio of assets owned (Ellis, 2000). In relation to this, size of land owned, ownership of livestock asset, level of education, and membership in primary multi-purpose cooperatives are included in this study as indicators for natural, physical, human, and social capital of households, in that order.

Farm size: As presented in Table 3, ownership of farm land has a significant positive effect on the probability of being an unconstrained non-borrower. This may be because households who own relatively larger sizes of land asset are expected to have more potential for equity financing and thus may not go for credit. Mpuga (2008) also finds that households having larger sizes of land do not have demand for credit in rural Uganda.

Ownership of livestock asset has a significant negative effect on the probability of being discouraged (Table 3), and those who own livestock asset prefer borrowing from formal lenders (Table 4). The probable reason for this result is that households who own livestock have higher probability of obtaining credit from formal sources because of its positive influence on lenders' valuation of the creditworthiness of the loan applicant since livestock can easily be converted into cash in cases of default.

Human capital: In this study, household heads are classified as having no education, some informal education, and some formal education. Compared to those who have some level of education, uneducated heads are highly discouraged, and hence, do not want to borrow from the rural credit market. This finding is consistent with the results of Gropp *et al.* (1997), who showed the positive effect of education on access to credit. This suggests the importance of education in access and participation in the rural credit market. Some level of education is expected to increase technical knowledge, know-how and farming skills, better credit information and familiarity with credit procedures of lending institutions. It is also expected that educated individuals will be engaged in non-farm business activities and are more likely to use the loans more wisely than the uneducated ones.

iii) Borrower's risk aversion behavior

The result shows a significant negative effect of risk aversion on the probability of borrowing from formal and informal sources of credit (Table 4). This can be explained by the fact that lenders require their clients to bear some amount of risk in the form of collateral. However, risk averse farmers do not want to put their assets at risk, and hence, prefer working with their own funds (Table 2). This implies that these farmers choose less risky but low-value crops or projects which require no credit. Choosing such less risky but low-value crops, in turn, means that these farmers are less efficient in agricultural production and are generating lower incomes for their households. Thus, following Boucher *et al.* (2009), it is possible to note that credit constraint can occur even when there is an excess supply of credit and this arises when the effective demand for credit is lower than the supply due to risk aversion.

iv) Institutional constraints

Table (2) presents institutional constraints in the credit market of the study area and these include: (a) long and strict credit procedures such as collateral requirements or group formation, fixed repayment schedules which do not fit with harvest seasons; (b) high transaction costs of borrowing associated with the loan application process, paper works, distance, and the number of times an applicant should visit a lender's office to secure the loan; (c) cost of

negotiation with lenders; and (d) institutional mistakes made in selecting applicants. The result also shows a significant negative effect of these constraints on the demand for credit. Household heads who are discouraged due to these constraints do not prefer borrowing from formal lenders. This can be explained by the fact that lenders usually make their credit procedures very strict to solve the screening, monitoring, and moral hazard problems which are common in the credit market of developing countries (Stiglitz and Weiss, 1981; Hoff *et al.*, 1996; Antwi and Antwi, 2010). These strict and lengthy credit procedures make the transaction cost of borrowing very high, and hence, discourage genuine applicants who want to have access to rural finance.

v) Control variables

Year dummy is used as a control variable to capture the change in credit constraints and borrowing behavior of farm households between 2011 and 2013. The result shows that demand for credit both from formal and informal sources has increased by 56 percent and 38 percent, respectively (Table 4). However, the probability of being quantity constrained has also increased by 61 percent, which implies that farm households do not get the amount of credit they applied for. Possible reasons for this gap between the demand for and supply of rural credit include: lack of adequate ‘loanable’ fund in the hands of lenders; strict refinancing policy of lenders; lack of loan collateral in the hands of borrowers; and lack of loan track record or long-term relationships between borrowers and lenders.

Exposure to climatic shocks: Exposure to drought shocks increases the probability of being quantity constrained by 46 percent (Table 3). In a rain-fed smallholder agriculture (as is the case in Ethiopia), good harvest is possible only if it rains and other shocks do not occur. In such a fragile environment, access to external sources of finance is very difficult because lenders do not want to take the risk of default in case crops fail.

Location: Households living in drought- and disease-prone zones such as south Wollo are highly discouraged and also quantity constrained, relative to households residing in the other three zones of the country. According to World Bank (2004), 45 percent of the south Wollo zone is exposed to Malaria.

Households residing in west Gojjam have relatively better access to formal credit and this may be because west Gojjam is a more fertile region known for its Teff production (a crop used to make a staple food called “INJERA” in Ethiopia).

5. Conclusion and Implications

Using household-level panel data from four zones of the Amhara region in Ethiopia, this paper examined the constraints to farmers’ access to rural credit. An attempt has been made to explore the extent to which credit constraints stem from demand- or supply-side factors. An in-depth analysis is also made on key variables explaining the probability of a household to fall into one of the listed credit constraint categories and their respective borrowing behavior.

A generalized linear latent and mixed model (gllamm) was estimated, and the result showed that credit constraint status and borrowing behavior are significantly affected by: (1) a borrower’s perceived probability of rejection due to institutional rigidities; (2) location, a borrower’s exposure to climatic shocks and risk preference behavior; (3) availability of mortgage-able livelihood assets; (4) the transaction cost of borrowing; and (5) household demographic characteristics such as gender, age, education, family size, and marital status.

Understanding household socio-economic conditions is essential in designing credit market policies. For instance, gender-credit constraint gap is of central policy importance as many micro credit institutions in sub-Saharan Africa target females to enhance their asset-building capacity and to pull them out of abject poverty. This story is largely supported by the data used in this study as evidenced by the result that the probability of being credit constrained decreases for female-headed households in rural Ethiopia (Table 3).

The result also shows that education is an important determinant of credit constraint status and of the demand for credit in rural areas. Mobilizing and sensitizing literate people about the need for and importance of credit would be easier and this suggests that more investment on primary education in rural

areas would reduce credit constraints and improve participation of farm households in the rural credit market. In addition, the demand for credit is higher for households who own livestock and they are also less discouraged in the credit market. It is therefore important to devise policies that aim at increasing household income and asset holdings to promote their participation in the credit market.

Demand factors such as risk aversion behavior of farm households play important roles to have access to rural credit as confirmed by the results discussed in the above section. The key lesson from this result is that increasing the supply of credit alone is not the solution for the credit constraint problem of farm households. It is crucial to understand farmers' attitude towards risk and to follow a bottom-up approach in designing credit market policies that encourage farm households to take risk. In Ethiopia, the credit market is basically supply-driven in the sense that borrowers take only what the lender offers and do not ask too many questions. The type of loan products, prices (interest rate), quality and reliability of the services are determined by the supplier, and innovative loan products are not very common in this market. This implies that institutional issues of the credit market need more attention of the macro-, meso- and micro-level policy makers and practitioners to make the market demand-driven, inclusive, and more competitive.

As discussed above, lenders require their borrowers to bear some amount of risk in the form of collateral. However, risk averse farmers are not willing to take such risks, and this necessitates designing innovative collateral-substitutes such as contract farming, using supply contracts as collateral, reputation-based lending, directly monitoring borrowers, lending according to crop cycle, and providing group loans. The sign and significance on the location and drought shock dummies also call for credit market policies which consider location-specific key variables and not simply make blanket recommendations to be applied across the board. For instance, farm households in south Wollo are vulnerable to drought shocks, and hence, they are highly discouraged. Although it requires further study to identify its benefits and drawbacks, interlinking credit with insurance may also be suggested as a solution to the credit constraint problem stemming from risk aversion.

Information asymmetry is another important source of credit constraint in the study area as discussed above, and credit reference bureaus can help lenders to have credit information of loan applicants. Hence, strengthening such credit reference bureaus may help in solving the information asymmetry problem and may reduce credit constraints. As the sign and statistical significance of the year dummy reveals, there is an increased demand for formal credit and yet a serious quantity constraint over the years 2011 and 2013. This is consistent with the general situation of access to credit in Ethiopia as discussed in section 1 above. For instance, EEA (2011) and AEMFI (2011) showed that micro financing institutions, which are the major formal credit providers to rural farm households, reach only about 20 percent of the rural poor. This is, by and large, a supply-side constraint, which usually occurs due to lack of 'loanable' funds in the hands of the rural credit service providers. As Kristen (2006) argues, compared to the bigger commercial banks which have excess liquidity, the rural credit service providers possess better information and enforcement mechanisms and are typically more flexible and innovative. However, these institutions are constrained by shortage of resources and infrastructure to reach a bigger number of clients. Hence, collaboration between commercial banks and the rural credit institutions would lead to a win-win situation to both parties. This can increase the supply of credit and improve the operating environment of the rural credit institutions so that farm households will have better access to credit.

References

- Admassie, A. (1987). "A study of the factors that affect the use of agricultural credit among peasant farmers in Ethiopia: The case of two districts", MSc. Thesis, Addis Ababa University.
- Admassie, A. Ageba, G., and Demeke, M. (2005). Rural finance in Ethiopia: Assessment of the financial products of microfinance institutions. Association of Ethiopian Microfinance institutions, Occasional paper No. 12, Addis Ababa.
- Antwi, G., and J. Antwi. (2010). The analysis of the rural credit market in Ghana. *International Business & Economics Research Journal*, Volume 9, Number 8.
- Ashraf, N., N. Gons, D. Karlan, and W. Yin. (2003). "A review of commitment savings products in developing countries." Asian Development Bank.
- Association of Ethiopian Microfinance Institutions (AEMFI). (2011). Ethiopian Microfinance Institutions Performance Report, Addis Ababa.
- Aterido, R., T. Beck, and L. Iacovone. (2011). Gender and finance in sub-Saharan Africa. Are women disadvantaged?" World Bank Policy Research Working Paper 5571. World Bank, Africa Region.
- Ayalew, D., and K. Deininger. (2014). Causes and implications of credit rationing in rural Ethiopia: The importance of zonal variation. *Journal of African Economies*, Vol. 23, number 4, pp. 493–527.
- Bali Swain, Ranjula. (2001). "Demand, segmentation and rationing in the rural credit markets of Puri." Dissertation, Department of Economics, Uppsala University, 2001.
- Bardhan, Pranab K., and Christopher Udry. (1999). *Development Microeconomics*. Oxford University Press.
- Boucher, S. R., C. Guirkinger, and C. Trivelli. (2009). Direct elicitation of credit constraints: Conceptual and practical issues with an application to Peruvian agriculture. *Economic Development and Cultural Change*, 57(4), 609-640.
- Cameron, C., and P. Trivedi. (2009). *Microeconometrics*. Cambridge University Press New York.
- Carter, M. R., and P. Olinto. (2003). Getting institutions right for whom? Credit constraints and the impact of property rights on the quantity and composition of investment. *American Journal of Agricultural Economics*, 85(1), pp. 173–186.
- Charles, S. Datta. (2011). Resource allocation decisions in Malaria-prone farming households in Kagera Region of Tanzania. Washington, D.C.

- Chen, K., and M. Chivakul. (2008). What drives household borrowing and credit constraints? Evidence from Bosnia and Herzegovina. IMF Working Paper WP/08/202. Washington, DC: International Monetary Fund.
- Cheng, Yu. (2009). Credit Constraints under Interaction of Supply Rationing and Demand Depression: Evidence from Rural Households in China, Paper presented at GLOBELICS 2009, 7th International Conference, 6-8 October, Dakar, Senegal
- Crook, J. (2001). The demand for household debt in the USA: Evidence from the 1995 survey of consumer finance. *Journal of Applied Financial Economics*. Vol. 11, pp. 83-91.
- Diagne, A., M. Zeller, and M. Sharma. (2000). Empirical measurements of households' access to credit and credit constraints in developing countries: Methodological issues and evidence. FCDN Discussion Paper No. 90, Washington, D.C.: International Food Policy Research Institute.
- Ellis, F. (2000). The determinants of rural livelihood diversification in developing Countries. *Journal of Agricultural Economics* 51.2: 289–302.
- Ethiopian Economics Association (EEA). (2011). Report on the Ethiopian Economy, June 2011.
- Fletschner, D. (2008). Women's access to credit: Does it matter for household efficiency? *American Journal of Agricultural Economics*, 90(3), pp. 669–683.
- Fletschner, D., C. Guirkinger, and S. Boucher. (2010). Risk, credit constraints and financial efficiency in Peruvian agriculture. *The Journal of Development Studies*, 46:6, 981-1002.
- Friedman, M. (1957). *A theory of the consumption function*. Princeton University Press: Princeton.
- Foltz, J. D. (2004). Credit market access and profitability in Tunisian agriculture. *Agricultural Economics*, 30 (3): 229–40.
- Gropp, R., J. K. Scholz, and M. J. White. (1997). Personal bankruptcy and credit supply and demand. *Quarterly Journal of Economics*. Vol. 112, pp. 217-251.
- Guirkinger, C. and S. R. Boucher. (2008). Credit constraints and productivity in Peruvian agriculture. *Agricultural Economics*, 39 (3): 295–308.
- Haan and Uhlendorff. (2006). Estimation of multinomial Logit models with unobserved heterogeneity using Maximum simulated likelihood. German Institute for Economic Research, WP 573.
- Hamda, H. and B. Öhlmer. (2006). Effect of credit constraint on production efficiency of farm households in South-eastern Ethiopia. *Ethiopian Journal of Economics*, Vol XV, No. 1

- Hansen, H. and Rand, J. (2011). Another perspective on gender specific access to credit in Africa, Danish Ministry of Foreign Affairs, to support collaborative research under the World Bank research program “Economic Development and Structural Change”
- Haynes, M., M. Western, L. Yu, and M., Spallek. (2006). Methods for categorical longitudinal survey data: Understanding employment status of Australian women. Paper prepared for the Methods for Longitudinal Surveys (MOLS2006) Conference, University of Essex, Colchester, United Kingdom, 12-14 July 2006
- Hartzel, J., A. Agresti, and B. Caffo. (2001). Multinomial logit random effects models. *Statistical Modelling*, 1, 81-102.
- Ho, Ginag. (2004). Rural credit markets in Vietnam: Theory and practice. Department of Economics, Macalester College, April 2004.
- Hoff, Karla, and Joseph E. Stiglitz. (1996). Imperfect information and rural credit markets: Puzzles and policy perspectives. *The Economics of Rural Organizations: Theory, Practice and Policy*. Ed. Karla Hoff, Avishay Braverman, and Joseph Stiglitz. Oxford University Press, 33-52.
- Humphreys, S. and A. Verschoor. (2004). Decision-making under risk among small farmers in East Uganda. *Journal of African Economies*, 13(1), 44 -101.
- Karlan, D., Robert Osei, Isaac Osei-Akoto, Christopher Udry. (2014). Agricultural decisions after relaxing credit and risk constraints. *The Quarterly Journal of Economics*, Volume 129, Issue 2, 1, Pages 597–652.
- Kedir, A. and G. Ibrahim. (2011). Household-level credit constraints in urban Ethiopia. *Ethiopian Journal of Economics*, Vol XX, No. 1.
- Khandker, S. (2005). Microfinance and poverty: Evidence using panel data from Bangladesh. *The World Bank Economic Review*, 19(2), 263-286.
- Kirsten, M. (2006). Linkages between formal and informal financial institutions in extending financial services to the poor, Agency for International Development. Paving the way forward for rural finance: An international conference on best practices.
- Kochar, A. (1997). An empirical investigation of rationing constraints in rural credit markets in India. *Journal of Development Economics*, 53(2), pp. 339–371.
- Kon, Y. and D. J. Storey. (2003). A theory of discouraged borrowers. *Small Business Economics* 21: 37–49.
- Lamberte, M. B., R. C. Vogel, R. T. Moyes, and N. A. Fernando. (Eds.). (2006). Beyond microfinance: Building inclusive rural financial markets in Central Asia., Asian Development Bank.
- Modigliani, F. (1986). Life Cycle, Individual Thrift, and the Wealth of Nations, *The American Economic Review*, Vol. 76, No. 3: 297-313

- Mpuga, P. (2008). Constraints in access to and demand for rural credit: Evidence in Uganda. A Paper for presentation during the African Economic Conference (AEC), 12-14 November, 2008, Tunis, Tunisia.
- Petrick, M. (2005). Empirical measurement of credit rationing in agriculture: A methodological survey. *Agricultural Economics*, 33(2), 191-203.
- Rabe-Hesketh, S., A. Skrondal, and A. Pickles. (2004). GLLAMM manual, technical report. U. C. Berkeley Division of Bio-statistics Working Paper Series, Working Paper 160.
- Reyes, A. and R. Lensink. (2011). The credit constraints of market-oriented farmers in Chile". *Journal of Development Studies*, Vol. 47, No. 12, 1851–1868.
- Stiglitz, Joseph E., and Andrew Weiss. (1981). Credit rationing in markets with imperfect information. *The American Economic Review* 71.3 (June 1981): 393-410.
- Train, K. (2009). *Discrete choice models using simulation*. Cambridge University Press: Cambridge, UK.
- World Bank. (1991). Ethiopia financial sector review 1991. Washington, D.C.
- _____. (2004). Investments in rural finance for agriculture. Agriculture investment sources book, chapter 7, by D. Pearce, A. Goodland, and A. Mulder. Washington, DC: World Bank.
- _____. (2007). Finance for all? Policies and pitfalls in expanding access. Policy Research Report. Washington, D.C., World Bank.

Appendix A: Tables and Figures

Table A1: Socio-economic information on the households (HHs) surveyed in 2011 and 2013 from the Amhara Region

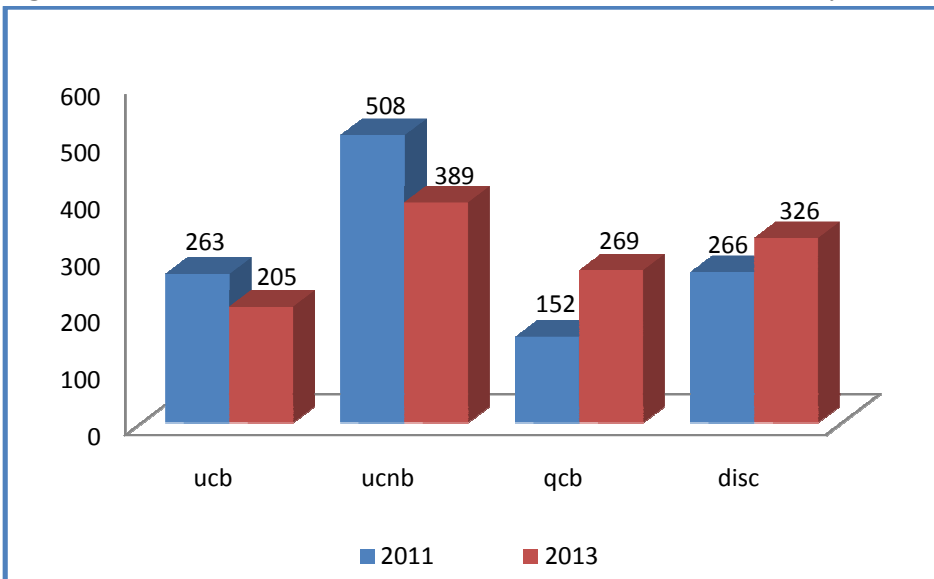
Socio-economic Info.	All		North Shewa		West Gojjam		South Wello		North Wello	
	2011	2013	2011	2013	2011	2013	2011	2013	2011	2013
Number of HHs surveyed	1189(50)	1189(50)	403(33.9)	395(33.2)	372(31.3)	370(31.1)	272(22.9)	142(11.9)		
Female-headed HHs (%)	111(9.3)	139(12)	40(10)	55(14)	25(6.7)	25(6.8)	29(10.7)	17(12)		
Average age of HH head (years)	48.9	50.5	50.8	52.6	46	47.9	49.1	50.8		
Average HH size	5.3	5.1	5.47	5.07	5.74	5.63	4.65	4.92		
HH heads who have no education	606(51)	656(55)	171(42.4)	184(46.6)	231(62.1)	243(65.7)	126(46.3)	78(54.9)		
HH heads who attended formal education	256(21.5)	243(20.4)	92(22.8)	81(20.5)	65(17.4)	56(15.1)	70(25.7)	29(20.4)		
Average years of formal education of heads	4.8	5.2	4.9	4.8	4.5	4.6	5.2	3.9		
HH heads who attended informal educ.	317(26.7)	290(24.4)	140(34.7)	130(32.9)	76(20.4)	71(19.2)	74(27.2)	27(19)		
Average area of land owned by the HH (ha)	1.07	0.73	0.99	0.96	1.4	0.17	0.9	0.77		
Average area of land cultivated by the HH (ha)	1.17	0.71	1.17	1	1.56	0.19	0.83	0.86		
Average number of parcels cultivated	3.6	3.5	3.1	3	4.4	4.5	3.6	3.3		
Households who own livestock	1158(97.4)	1130(95.2)	394(97.7)	367(93.2)	371(99.7)	363(98.1)	261(95.9)	132(92.7)		
Households whose house roof is made of iron sheets	854(72)	932(78)	287(71.2)	298(75.4)	338(91)	344(93)	169(62)	60(42.3)		
Average monthly income from a microenterprise	528.84	926.23	504	1075.1	577.3	718.9	714	317.8		
Households who benefited from PSNP	146(12.3)	136(11.4)	20(5)	0	0	0	60(22)	65(45.8)		
Households who have a bank account	164(14)	267(22.5)	60(15)	118(30)	50(13.5)	44(12)	25(9.2)	29(21.2)		

Table A2: Credit constraint status of HHs in the study area (%)

Credit Constraint Category	2011	2013	Full Sample
Unconstrained:			
borrowers	263(22.1)	205(17.2)	468(19.7)
non-borrowers	508(42.7)	389(32.7)	897(37.7)
Total unconstrained households	771(64.8)	594(49.9)	1365(57.4)
Constrained households:			
quantity constrained borrowers	152(12.8)	269(22.6)	421(17.7)
discouraged borrowers	266(22.4)	326(27.4)	592(25)
Total constrained households	418(35.2)	595(50.1)	1013(42.7)

Source: Calculation based on EIIPICA's 2011 and 2013 survey data

Figure A1: Credit constraint status of farm households in the study area



NB. ucb, ucnb, qcb, and disc stand for: unconstrained borrowers, unconstrained non-borrowers, quantity constrained borrowers, and discouraged borrowers, respectively.

Table A3: Descriptive statistics of variables used in the data analysis

Variable name	Variable definition and unit of measurement	N	mean	St. dev.
Dependent variables:				
Constraint cat.	Credit constraint category of the household (multinomial response)	2,378	2.478	1.068
Sector choice	Households' choice of loan sector (formal, semi-formal, or informal sector)	2378	1.54	.73
Explanatory variables:				
Age	age of the household head (years)	2377	49.725	14.118
Female	gender of the HH head (dummy = 1 if female, 0 for male)	2378	0.105	0.307
Married	marital status of the HH head (dummy = 1 if married, 0 otherwise)	2378	0.866	0.341
Household size	household size (number of members of the household)	2298	5.209	1.913
Educational Status of the HH head (Informal education is the reference group)				
No education	level of education of the HH head (dummy = 1 if uneducated, 0 otherwise)	2378	0.531	0.499
Informal education	level of educ. of HH head (dummy = 1 if attended informal educ., 0 otherwise)	2378	0.255	0.436
Formal education	level of educ. of HH head (dummy = 1 if attended formal educ., 0 otherwise)	2378	0.210	0.407
Land hectares	area of land owned by the HH (ha)	2378	0.902	0.697
Own livestock	Livestock ownership of the HH (dummy = 1 if HH owns, 0 otherwise)	2376	0.963	0.189
Coop. member	membership in a cooperative association (dummy = 1 if member, 0 otherwise)	2378	0.925	0.264
Food expenditure	amount of money spent on HH consumption items	2377	309.766	225.346
Drought shock	exposure to drought shock (dummy = 1 if the HH experienced drought shock, 0 otherwise)	2378	0.391	0.488
Agro-ecological zones (North Shoa is the reference zone)				
North Shoa	zone in which the HH resides (dummy = 1 if HH is in N. Shoa, 0 otherwise)	2378	0.336	0.472
West Gojjam	zone in which the HH lives (dummy = 1 if HH is in W. Gojjam, 0 otherwise)	2378	0.312	0.463
South Wollo	zone in which the HH lives (dummy = 1 if HH is in S. Wollo, 0 otherwise)	2378	0.230	0.421
North Wollo	zone in which the HH resides (dummy = 1 if HH is in N. Wollo, 0 otherwise)	2378	0.122	0.328

Table A4: Determinants of credit constraint status of farm HHs compared with unconstrained borrowers - Multinomial Logit model with standard errors adjusted for cluster effects (Robust Model)§

Variable	Unconstrained non-borrowers	Constrained quantity rationed borrowers	Discouraged tran. cost and risk rationed borrowers
Age	.0167*** (0.00529)	.0101* (0.00584)	.0215*** (0.00557)
Female	-1.21*** (0.35)	-0.445 (0.391)	-.897** (0.379)
Married	-.684** (0.335)	-0.394 (0.363)	-.674* (0.361)
Household size	-0.065 (0.0398)	-0.0172 (0.0435)	-0.0428 (0.0424)
No education	.346* (0.177)	-0.198 (0.196)	.391** (0.198)
Formal education	-0.125 (0.19)	0.124 (0.201)	0.157 (0.207)
Land (hectares)	.417*** (0.104)	-0.00162 (0.126)	0.0875 (0.111)
Own livestock	-1.08** (0.486)	-0.747 (0.529)	-.92* (0.505)
Coop member	0.00636 (0.257)	0.0882 (0.29)	-0.172 (0.273)
Year dummy	-0.0681 (0.147)	.611*** (0.182)	0.238 (0.159)
Ln(food exp.)	.158* (0.0933)	0.0494 (0.108)	.246** (0.101)
Drought shock	0.13 (0.159)	.425** (0.18)	0.236 (0.17)

Hailu Elias: Multiple Credit Constraints and Borrowing Behavior ...

West Gojjam	-1.26*** (0.166)	-0.0616 (0.191)	-.947*** (0.177)
South Wollo	1.38*** (0.252)	1.54*** (0.278)	1.22*** (0.248)
North Wollo	-0.271 (0.251)	.911*** (0.259)	-.682** (0.275)
_Constant	0.818 (0.75)	-0.477 (0.81)	-0.452 (0.801)
<hr/>			
Statistics			
Wald chi2(45)	367		
Prob > chi2	0.000		
Number of obs	2289		
AIC	5746		
BIC	6022		

Note: Robust standard errors in brackets; * $p < .1$; ** $p < 0.05$; *** $p < 0.01$; the Wald test clearly shows the joint significance of all regressors. The variables are estimated using robust standard errors based on the White's heteroscedasticity consistent estimators of variance. The AIC and BIC stand for the Akaike's information criteria and the Bayesian information criteria, respectively, which are used to choose the appropriate model. The gllamm model (Table 3) is found to be more appropriate based on the values of BIC and AIC.

§ All reported coefficient estimates are marginal effects after mlogit.

Table A5: Determinants of farm HHs' choice of lenders compared to non-borrowers - Multi-nomial Logit model with standard errors adjusted for cluster effects (Robust Model)

Variable	HHs who prefer formal lenders	HHs who prefer informal lenders	HHs who prefer semi-formal lenders
Risk averse	-1.85*** (0.194)	-.979*** (0.229)	-.555* (0.289)
Discouraged borrower	-1.68*** (0.438)	-0.612 (0.386)	-0.117 (0.468)
Quantity constrained	-0.227 (0.151)	-0.0131 (0.199)	0.0425 (0.274)
Age	-.0128*** (0.00489)	-.019*** (0.0057)	0.00377 (0.00813)
Female	.651* (0.336)	0.0347 (0.368)	0.0141 (0.397)
Married	0.207 (0.317)	-0.172 (0.348)	-0.375 (0.367)
Household size	.0721** (0.0342)	0.0136 (0.0447)	-0.0386 (0.0658)
No education	-.281* (0.167)	-0.118 (0.193)	-.459* (0.264)
Formal education	0.0782 (0.175)	-0.00129 (0.216)	-.674** (0.301)
Land (hectar)	-.198** (0.0945)	-0.188 (0.125)	0.11 (0.149)
Own livestock	1.04* (0.534)	0.308 (0.413)	-0.172 (0.445)
Coop member	-0.0177 (0.24)	0.16 (0.291)	-0.054 (0.358)
Year dummy	.497*** (0.136)	.361* (0.191)	-.2*** (0.334)
Ln(food exp.)	-.17** (0.0843)	-0.102 (0.124)	-0.106 (0.144)
Drought shock	-0.194 (0.14)	0.0145 (0.18)	0.217 (0.271)
West Gojjam	.937*** (0.147)	.694*** (0.195)	-0.197 (0.268)

Hailu Elias: Multiple Credit Constraints and Borrowing Behavior ...

South Wollo	-1.33***	-0.208	-2.8***
	(0.218)	(0.229)	(0.614)
North Wollo	-0.0968	0.377	.589*
	(0.225)	(0.258)	(0.305)
_constant	-0.76	-0.689	-0.225
	(0.755)	(0.769)	(0.923)

Statistics

Wald chi2(54)	455
Prob > chi2	0.000
Number of obs.	2289
AIC	4138
BIC	4465
