Credit constraints, off-farm participation and productivity; case of Kenyan rural sector

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Abstract:

Credit constraints among smallholder farmers remain one of the impediments to the much-needed increase in agricultural productivity in sub-Saharan Africa. Applying the direct elicitation approach and using representative data from rural Kenya, we identify credit constrained farmers and assess the effect of being constrained on maize yields. Access to credit affects various variables that affect maize yields, although we do not find significant yield differences. Participation in group activities, access to financial and extension services, more education increases the likelihood of being credit unconstrained. Similarly, participating in off-farm activities reduces the likelihood of being credit constrained. Hence, policies that facilitate human capital development, such as households' education, access to information, or engagement in off-farm activities- either self-employment or salaried employment, are relevant.

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Key words: Credit constraint, maize yields, off-farm income, Kenya

1.0 Introduction

Improving productivity among smallholder farmers in sub-Saharan Africa (SSA) remains a top priority since demand for food and farm commodities continues to grow, while land and other natural resources are becoming increasingly scarce. This is primarily due to high population pressure, land degradation, climate change extremes among other pressures. Proper use of agricultural inputs will, therefore, be vital in attaining the increase in productivity. However, most smallholder farmers do not use the required amount of inputs, when needed, most especially chemical fertilizers – application rates in SSA lag the rest of the world (Morris, 2007). This may be attributed to financial constraints because smallholder farmers are mostly credit constrained.

There is a consensus that credit plays a crucial role in supporting agriculture by helping households in handling risk and purchasing inputs/technologies to improve their agricultural

productivity (Foltz, 2004; Khandker and Koolwal, 2014). Beyond agricultural productivity, credit constraints also affect rural development more broadly by preventing households from taking up non-agricultural activities, core for structural transformation and households' ability to move out of poverty (Ellis, 2000). For credit constrained households, productivity and capacity to participate in off-farm self-employment depend entirely on their wealth and liquidity.

Several studies have assessed determinants and impact of access to credit on the welfare of farmers in developing countries (e.g. Reyes et al., 2012; Njeru et al., 2016). Most of these studies have shown positive effects on productivity, efficiency or incomes of farmers. However, some of these studies do not capture credit constraint adequately, for example, some define access to credit to whether farmers received credit or otherwise. This may not adequately capture if farmers are credit constrained. We use the direct elicitation approach (World Bank, 2011; Ali et al., 2014). This method has been suggested to identify credit constrained households by considering both supply- and demand-side factors. On the demand side, farmers are often unable to obtain credit because they lack collateral or because they are reluctant to seek credit due to the risk of losing assets pledged as collateral. On the supply side, lenders may be hesitant to lend to some farmers who they do not have enough information to assess their creditworthiness or because financial institutions consider agriculture to be too risky, hence a high risk of default.

This approach identifies farmers who cannot access credit either because they are quantity, transaction cost, price or even risk constrained. First, it distinguishes applicants from non-applicants in the credit markets. This is done by directly establishing whether they applied for loans or not within a given reference period. For the applicants, if they received the amount they had sought and did not want to borrow more, they are categorized as unconstrained, while the others are categorized either as either quantity, price or risk constrained depending on the situation. Non-applicants are asked to specify the reasons for not applying for loans, and the response is used to identify them as credit constrained or unconstrained households. Those who expressed no interest in additional funds because they have sufficient resources are classified as unconstrained. Depending on the nature of their response, the remaining group of farmers that did not seek credit are categorized as quantity, transaction costs, or risk rationed.

However, for this particular study information on reasons why non-applicants did not apply for loans was missing. Therefore, to classify this category as either constrained or unconstrained, we

compare applicants (both those who applied and received and those who applied but did not receive credit) with non-applicants on some key socioeconomic and institutional characteristics. We argue that if on average the non-applicants belong to the lower side (based on empowerment and access to vital services), then they most likely did not apply for credit because they could not afford collateral or could not access the credit market. Hence we categorize them as credit constrained. On the other hand, if non-applicants belong on the higher side, they most likely did not apply for a loan because they did not need one, and hence we classify them as credit unconstrained. Using this approach we identify credit constrained farmers and assess the effect of being constrained on maize productivity.

In addition, due to uncertainties in agriculture and missing credit markets which characterize most rural economies in developing countries, smallholder farmers in SSA may diversify their sources of incomes to off-farm activities as one of the ways to overcome their credit constraints (Oseni and Winters, 2009). The off-farm activities may either be in the form of salaried employment or self-employment. Lenders, particularly formal ones, prefer to give loans to households with diversified asset portfolios and more diversified incomes (Diagne and Zeller, 2001) since they may have a low risk of default. However, empirical evidence to support this argument particularly for sub-Saharan Africa farmers is limited. Thus using representative data from rural Kenya, we assess whether households participating in off-farm activities are indeed less credit constrained.

The rest of the paper is organized as follows: Section 2 presents a brief description of the credit situation in rural Kenya, while section 3 presents the data and methods used in the study. Findings and their discussion are presented in section 4, and finally, section 5 concludes the study while outlining policy recommendations.

2.0 Credit situation in rural Kenya

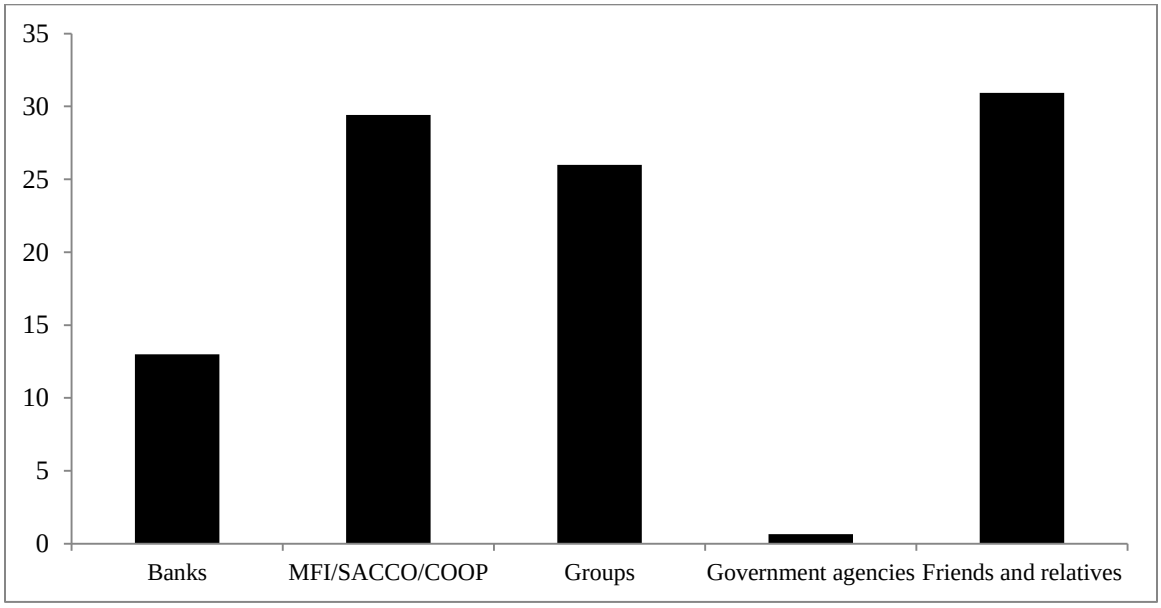
A common feature of rural credit markets in developing countries is the coexistence of formal and informal credit markets (Boucher and Guirkinger, 2007). Formal financial service providers are registered companies licensed to offer financial services by a central monetary authority. Informal services, on the other hand, refer to all transactions, loans, and deposits that take place

outside the regulated financial system and this includes the activities of intermediaries such as relatives and friends, traders, and money lenders.

Kenya continues to register improvements in the development of the financial sector. However, according to Fin Access 2009 survey data, 60% of the adult population do not have access to credit markets. Combined with those that have access to micro finance institutions (MFIs) and Savings and Credit Cooperative Organizations (SACCOs), more than half are excluded from formal bank credit. The situation is worse in rural areas where one in every two adults has never had credit (Fin Access, 2009). A report by the Central Bank of Kenya indicates that agriculture is the most underfinanced sector, receiving only an average of 3.3% of the total credit extended to the economy (RoK, 2012). Although there have been efforts by the government through schemes such as Women Enterprise Fund (WEF) and the Youth Enterprise Fund (YEF), many households in rural areas still face credit constraints (Owuor, 2009). In trying to overcome obstacles to credit financial services access, many smallholder farmers resort to forming credit groups through which they mobilize funds to loan to each other. Hence informal credit sources such as merry go rounds are becoming more popular in the Kenyan rural setting.

This is also supported by data from our survey conducted in the rural areas of Kenya. Figure 1 shows the data sources from the farmers who obtained credit. A greater proportion (31%) received credit from informal sources (friends and relatives). An almost equal proportion also got credit either MFIs or SACCOs or from farmers' cooperatives. Borrowing from groups, both registered and unregistered such as merry-go-rounds, is also popular. However, proportionately fewer people borrow from banks and government agencies.

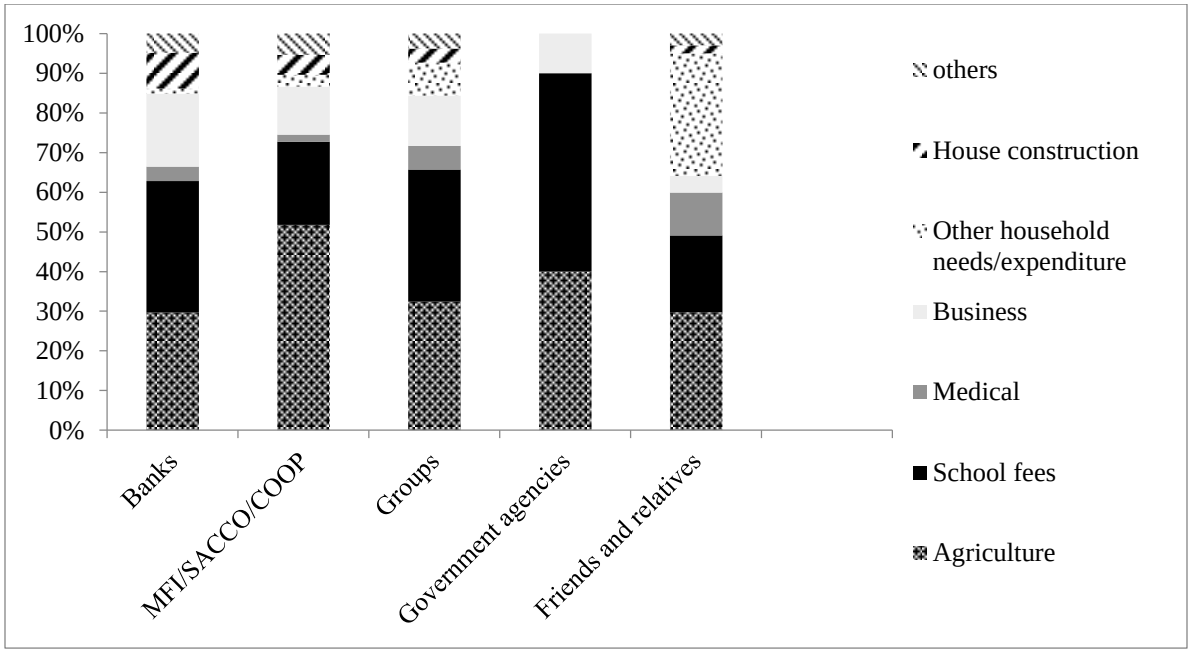
Figure 1: Proportion of credit sources among households that received credit (n=1516)



Source (own survey data)

Farmers obtain credit from these sources to meet different purposes including agriculture, household consumption expenditures, business, medical and so on. Figure 2 presents a summary of the reasons why farmers borrow credit by sources of credit.

Figure 2: Reasons for borrowing credit by credit source (n=1659)



Source (own survey data)

Reasons for borrowing credit vary substantially across the credit sources. Almost half of the farmers who borrowed either from MFIs, SACCOs or cooperatives used the credit for agricultural purposes. This was substantially higher compared to those who borrowed from banks or groups or from informal sources where only approximately 30% was used in agriculture. Compared to other credit sources, a greater proportion of farmers who borrowed from friends and relatives (31%) used the credit to meet households' needs and expenditures. However, compared to borrowing from these informal sources, borrowing from banks, MFIs and cooperatives was common for purposes of meeting school fees needs as well as for business.

3.0 Data and methods

3.1 Data and sampling

The study uses household survey data collected in 2014 by Tegemeo Institute in collaboration with Michigan State University (MSU) under the Tegemeo Agricultural Policy Research and Analysis (TAPRA II) project. Sampling was done using two-stage stratified cluster sampling technique. In the first stage, 350 rural clusters were selected from the Kenya National Bureau of Statistics (KNBS) household-based sampling frame using equal probability selection method (EPSEM). The second stage, a uniform sample of 20 households in each cluster was randomly selected from a list of households in the cluster using systematic random sampling method.

The sample size was calculated to provide representative estimates for seven Agro-Ecological Zones (AEZs): Upper Highlands (UH), Lower Highlands (LH), Upper Midlands (UM) – two zones, Lower Midlands (LM) – two zones, and Coastal Lowlands (CL). The allocation of the sample to the AEZs was done using the square root allocation method to ensure that the smaller AEZs got an adequate sample. It was distributed in the rural strata across all the counties. During data collection, there was no allowance for replacement of non-responding households. In total, 7000 households were targeted in the survey. The survey was implemented between July and September 2014 and contains data for the 2013/2014 cropping year. The survey attained a response rate of 93% and in total 6512 households responded to the survey. These households, drawn from 38 out of the 47 counties in Kenya across the seven agroecological zones were interviewed using semi-structured questionnaires.

3.2 Empirical methods

3.2.1 Endogenous switching regression

To assess the effect of being credit constrained on yield, we apply endogenous switching regression method. Whether a household is credit constrained or not, is not assigned randomly. Instead, credit constrained and unconstrained farmers differ regarding their socioeconomic, institutional and other characteristics, and we cannot simply interpret observed yield disparities as impacts of accessing credit without controlling for confounding factors. Several methods exist in literature to deal with endogeneity depending on the nature of the outcome variable.

We account for the endogeneity of being credit constrained by estimating a simultaneous equations model with endogenous switching by full information maximum likelihood (FIML) due to (Lokshin and Sajaia, 2004). The FIML method estimates both selection and outcome equations simultaneously, generating consistent standard errors. The FIML is characterized as the most efficient estimation strategy to estimate models with endogenous switching provided there are no specification errors (Greene, 2008; Wooldridge, 2010). FIML estimates of the parameters of the endogenous switching regression model can be obtained using the movestay command in STATA (Lokshin and Sajaia 2004).

The selection equation on credit constrained is specified as follows:

$$A_i^* = Z_i\,\alpha + W_i\,\theta + \eta_i \qquad A_i = \begin{cases} 1\ if A_i^* > 0 \\ 0\ otherwise \end{cases} \qquad (1)$$

Farmers are credit unconstrained, (A_i = 1) if A* > 0, 0 otherwise, where A* represents the expected benefits of being credit unconstrained. Z_i is a vector of variables influencing if a household is credit constrained including socioeconomic, institutional among other variables.

To account for selection biases we adopt an endogenous switching regression model where households face two regimes (1) credit unconstrained, and (2) credit constrained defined as follows:

Regime 1: $Y_{1i} = X_{1i}\beta_i + \varepsilon_{1i} \qquad if A_i = 1$ (2)

Regime 2: $Y_{2i} = X_{2i}\beta_i + \varepsilon_{2i} \qquad if A_i = 0$ (3)

Where Y_{1i} and Y_{2i} represent the yields of maize in Kgs per acre for each of the regimes. By definition Y_{1i} and Y_{2i} are never observed simultaneously for a given household *i*. X_i is a vector of variables which have an effect on yield including inputs (seed and fertilizers), socioeconomic variables, institutional variables, climatic shocks (frequency of drought, floods and high temperatures) as well as agro ecological zones. W_i is a vector of identifying instruments in the selection equation (1). The instruments do not have a direct impact on the dependent variable in the regime equations other than through selection in one or the other group.

3.2.2 Bivariate probit

To assess the relationship between off-farm participation and being credit constrained we apply the bivariate probit model. The specification of this model based on Greene (2003) is as follows:

$$Y_{i1}^* = X_{i1}'\beta_1 + \varepsilon_{i1} \qquad Y_{i1} = 1 \; if \; Y_{i1}^* > 0 \text{ and 0, otherwise} \tag{4}$$

$$Y_{i2}^* = X_{i2}'\beta_2 + \varepsilon_{i2} \qquad Y_{i2} = 1 \; if \; Y_{i2}^* > 0 \text{ and 0, otherwise} \tag{5}$$

$$\begin{bmatrix}\varepsilon_{i1}\\ \varepsilon_{i2}\end{bmatrix} \sim N\left[\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}1 & \rho\\ \rho & 1\end{pmatrix}\right] \tag{6}$$

Where Y_{i1} and Y_{i2} are the two dependent variables; in this case being credit constrained and participation in off-farm activities. X_{i1} and X_{i2} are the explanatory variables influencing if a household is credit constraint as well as households' participation in off-farm activities. Parameters are $\varepsilon_{i1,}$ and ε_{i2} are the error terms for the equations and ρ is the tetrachoric correlation between the Y_{i1} and Y_{i2}.

4.0 Results and discussion

4.1 Descriptive statistics

Based on relevant literature (e.g. Guirkinger and Boucher, 2008; Dong et.al, 2010; Ali and Deininger, 2012; Reyes et al., 2012; Woutersen and Khandker, 2013; Ali et.al, 2014; Tilahun, 2015; Njeru et al., 2016), Table 1 presents a summary of various variables hypothesized to influence whether or not a household is credit constrained. The characteristics are compared across three categories of households; those that did not apply for credit, those that applied but

did not receive credit or received a less amount and those that received the entire amount they had sought.

Table 1: Comparison of key characteristic among applicants and non-applicants

Variable	Description	Did not apply (n=4654)		Applied but did not receive any or received less (n=555)		Applied and received the entire amount (n=1303)	
		Mean	Std dev	Mean	Std dev	Mean	Std dev
Household characteristics							
Total income	Total HH income for the last 1 year in US dollars	2522.55	5732.25	4901.27	22618.32	2845.51	3543.91
Off farm	=1 if HH is involved in off farm activities, 0 otherwise	0.790	0.407	0.836	0.371	0.874	0.332
Salaried	=1 if HH has salaried activities, 0 otherwise	0.367	0.482	0.404	0.491	0.436	0.496
Self-employment	=1 if HH is involved in off-farm self-employment, 0 otherwise	0.583	0.493	0.631	0.483	0.693	0.461
Asset value	Total asset value in US dollars	1897.50	5588.69	3387.12	6939.45	3072.51	7420.85
Land	Total land owned in acres	4.645	21.557	4.096	25.715	3.003	9.389
TLU	Total livestock units	3.550	8.869	2.546	3.969	2.862	8.849
Gender	=1 if HH head is female, 0 if male	0.237	0.425	0.227	0.419	0.229	0.420
No education	=1 if HH head has no formal education, 0 otherwise	0.219	0.414	0.094	0.292	0.095	0.294
Primary education	=1 if HH head has primary education, 0 otherwise	0.546	0.498	0.537	0.499	0.575	0.495
Secondary education	=1 if HH head has secondary education, 0 otherwise	0.182	0.386	0.281	0.450	0.256	0.437
College/ University	=1if HH head has college/university education, 0 otherwise	0.052	0.223	0.088	0.284	0.074	0.261
Single	=1 if HH head is single, 0 otherwise	0.034	0.180	0.040	0.195	0.027	0.162
Monogamous	=1 if HH head is monogamously married, 0 otherwise	0.632	0.482	0.695	0.461	0.714	0.452
Polygamous	= 1if HH head is in polygamous marriage, 0 otherwise	0.101	0.301	0.065	0.247	0.064	0.244
divorced, separated or widowed	=1 if HH head is divorced, separated or widowed, 0 otherwise	0.233	0.423	0.200	0.400	0.196	0.397
Age	Age of HH head	50.727	17.369	50.723	15.819	48.589	14.458

Adult equivalent	HH adult equivalent	4.178	2.134	4.190	1.967	4.350	1.950
Extension	=1 if HH received extension advice, 0 otherwise	0.164	0.370	0.353	0.478	0.303	0.460
Institutional variables							
Group member	=1 if HH has group membership, 0 otherwise	0.485	0.500	0.719	0.450	0.769	0.422
Group non-agricultural	=1 if HH has membership in non-agricultural groups, 0 otherwise	0.434	0.496	0.652	0.477	0.685	0.465
Savings Account	=1 if HH has a savings account, 0 otherwise	0.389	0.488	0.760	0.427	0.668	0.471
Distance	Distance to nearest town in KMs	15.616	20.926	10.694	13.440	13.040	17.152

1 US dollar was equivalent to 87.859 KES as of July 2014 (time of data collection).

From this comparison, non-applicants have substantially lower income levels and asset value compared to applicants. Similarly, a substantially lower proportion of non-applicants does not participate in off-farm activities (both salaried and self-employment). Further still, non-applicants are less educated, 22% do not have any formal education compared to 9% of the applicants. Also, compared to the applicants, non-applicants have substantially lower access to services; fewer received extension advice, participate in groups, and even fewer own a savings account. Moreover, the average distance to the road among the non-applicants is higher than that of applicants. Based on these characteristics, it is evident that the non-applicants belong to the lower side- they are disadvantaged regarding empowerment and access to services- thus we classify them as credit constrained together with the applicants who did not receive loans or received less than amounts applied.

Table 2 presents t-tests of differences in means of these variables by if a household is credit constrained. Credit constrained households have on average significantly lower asset value but have considerably more land acreage and livestock units compared to the unconstrained ones. Participation in off- farm activities is significantly higher among the unconstrained households (87%) compared to the constrained ones (80%). This also holds for both salaried and self-employment, where, significantly more unconstrained households are involved compared to the constrained ones. In comparison with credit constrained households, a significantly larger proportion of the unconstrained households receive extension services, participates more in groups, own a savings account, have more educated heads and are considerably nearer to the nearest town.

Table 2: T-test of differences in mean on the main variables by access to credit

Variable	**Description**	**Constrained n=5209**		**Unconstrained n=1303**	
		Mean	Std Dev	Mean	Std Dev
Household characteristics					
Total income	Total HH income for the last 1 year in US dollars	2775.99	9182.37	2845.51	3543.91
Off farm	=1 if HH is involved in off farm activities, 0 otherwise	0.795***	0.404	0.874	0.332
Salaried	=1 if HH has salaried activities, 0 otherwise	0.371***	0.483	0.436	0.496
Self-employment	=1 if HH is involved in off-farm self-employment, 0 otherwise	0.588***	0.492	0.693	0.461

Asset value	Total asset value in US dollars	2056.22***	5765.32	3072.51	7420.85
Land	Total land owned in acres	4.587**	22.035	3.003	9.389
TLU	Total livestock units	3.443**	8.489	2.862	8.849
Gender	=1 if HH head is female, 0 if male	0.236	0.425	0.229	0.42
No education	=1 if HH head has no formal education, 0 otherwise	0.206***	0.404	0.095	0.294
Primary education	=1 if HH head has primary education, 0 otherwise	0.545*	0.498	0.575	0.495
Secondary education	=1 if HH head has secondary education, 0 otherwise	0.193***	0.394	0.256	0.437
College/ University	=1if HH head has college/university education, 0 otherwise	0.056**	0.23	0.074	0.261
Single	=1 if HH head is single, 0 otherwise	0.0304	0.182	0.027	0.162
Monogamous	=1 if HH head is monogamously married, 0 otherwise	0.639***	0.480	0.714	0.452
Polygamous	= 1if HH head is in polygamous marriage, 0 otherwise	0.097***	0.296	0.064	0.244
divorced, separated or widowed	=1 if HH head is divorced, separated or widowed, 0 otherwise	0.230***	0.421	0.196	0.397
Age	Age of HH head	50.73***	17.21	48.59	14.46
Adult equivalent	HH adult equivalent	4.179***	2.116	4.350	1.950
Institutional variables					
Extension	=1 if HH received extension advice, 0 otherwise	0.184***	0.388	0.303	0.460
Group member	=1 if HH has group membership, 0 otherwise	0.510***	0.500	0.769	0.422
Group non-agricultural	=1 if HH has membership in non-agricultural groups, 0 otherwise	0.457***	0.498	0.685	0.465
Savings Account	=1 if HH has a savings account, 0 otherwise	0.429***	0.495	0.668	0.471
Distance	Distance to nearest town	15.09***	20.32	13.04	17.15
Agro-ecological zones[a]					
Zone CL	=1 if HH is in CL, 0 otherwise	0.103***	0.304	0.055	0.229
Zone LH	=1 if HH is in LH, 0 otherwise	0.167**	0.373	0.195	0.396
Zone LM1-2	=1 if HH is in LM1-2, 0 otherwise	0.141	0.348	0.143	0.350
Zone LM3-6	=1 if HH is in LM3-6, 0 otherwise	0.165	0.372	0.169	0.375
Zone UH	=1 if HH is in UH, 0 otherwise	0.116***	0.3202	0.072	0.259
Zone UM0-1	=1 if HH is in UM0-1, 0 otherwise	0.116***	0.32	0.191	0.393
Zone UM2-6	=1 if HH is in UM2-6, 0 otherwise	0.191	0.393	0.175	0.380

***, **,* significance at 1%, 5% and 10% respectively [a] zone CL stands for Coastal Lowlands , LH is Lower Highlands, LM 1-2 and LM 3-6 is Lower Midland 1-2 and 3-6 respectively, UH is Upper Highland, and UM 0-1 and 2-6 is Upper Midland 0-1 and 2-6 respectively. 1 US dollar is equivalent to 87.859 KES as of July 2014.

Table 3 presents differences in means of maize yields and input use per acre by credit constraint. There are no significant yield differences between credit constrained and unconstrained households. However, fertilizer use is significantly higher among the unconstrained farmers. However, we cannot take these differences in means to represent the impact of being credit constrained due to the presence of bias arising from the fact that being credit constrained is not randomly distributed instead farmers self-select themselves based on various attributes.

Table 3: Maize yield and input use by credit constraint

Variable	**Description**	**Constrained (N=4689)**		**Unconstrained (N=1195)**	
		Mean	*Std Dev*	*Mean*	*std Dev*
Yield	Yield (kgs per acre)	606.92	590.42	585.07	635.34
Land	Total land under maize in acres	1.25	1.66	1.01	1.26
Fertilizer	Fertilizer in Kgs per acre	427.74***	1344.76	549.78	1403.39
Seeds	Seed quantity in kgs per acre	9.02	5.20	8.85	5.13

***, **,* significance at 1%, 5% and 10% respectively

4.2 Effect of credit constraint on productivity

Table 4 presents results of the endogenous switching regression highlighting the effect of being credit constrained on maize productivity. The dependent variable is maize yield in kgs per acre. The selection equation is defined as to whether a household is credit unconstrained (1) or is credit constrained (0). To instrument for being credit unconstrained, we use owning a savings account, membership in non-agricultural groups and distance to the nearest town. Earlier studies have found households' ability to save to have a positive influence on being credit unconstrained, but we do not expect it to affect yield directly. Similarly, membership in non-agricultural groups (a proxy for social capital as well as access to information) is expected to influence if a household is credit constrained but will not affect yield directly. We also do not expect distance to town to have a direct effect on yield, but it is hypothesized to influence whether or not a household is credit constrained.

Table 4: Effect of credit constraint on maize yields (kgs per acre)

Variables	Constrained		Unconstrained		Select Unconstrained=1, constrained=0	
	Coefficient	Std error	Coefficient	Std error	Coefficient	Std error
Inputs						
Land under maize (acres)	-0.520	5.355	-32.47**	16.050		
Seed (Kgs per acre)	56.43***	2.967	34.71***	6.485		
Seed squared	-0.624***	0.068	-0.092	0.124		
Fertilizer (Kgs per acre)	0.021***	0.006	0.038***	0.013		
AEZ dummies[a]						
Zone LH	376.7***	33.220	226.0**	90.310		
Zone LM1_2	166.4***	33.690	313.9***	89.430		
Zone LM3_6	59.53*	31.240	13.35	85.190		
Zone UH	343.0***	35.840	226.4**	104.800		
Zone UM0_1	75.70**	36.590	254.2***	90.770		
Zone UM2_6	260.8***	32.070	243.4***	87.370		
Climatic shocks						
Drought frequency	-18.49***	4.202	-16.70	10.240		
Flooding frequency	-1.572	9.206	7.809	19.630		
High temperature frequency	-24.11***	4.420	-6.419	10.850		
Socioeconomic variables						
Primary education[b]	-14.60	23.490	-70.73	64.410	0.194***	0.068
Secondary education	32.04	29.400	-4.086	72.310	0.177**	0.080
College/ University	109.7***	39.630	-21.09	92.830	0.057	0.107
Age	-1.944	1.223	11.33***	2.895	-0.002	0.003
Age squared	-0.009	0.012	-0.131***	0.029	-1.22e-05	0.000
Female	-45.01**	19.200	-15.34	42.560	0.138***	0.050
Adult equivalent	9.330**	3.711	-12.74	9.258	0.016	0.010
Log asset value	16.61***	5.353	-4.468	12.230	0.032**	0.014
Land owned in acres	-0.697	1.251	30.95***	3.637	-0.009**	0.004
TLU	3.050**	1.314	8.942***	2.068	-0.002	0.003
Off-farm	-67.99***	20.420	55.23	53.660	0.208***	0.057
Institutional variables						
Extension advice	15.86	22.300	-14.87	38.680	0.234***	0.045
Distance to town					-0.002	0.001
Group membership					0.476***	0.044
Savings account					0.390***	0.046

Constant	-44.12	69.670	-13.59	215.300	-2.017***	0.185
Rho	-0.0418	0.174	-0.104	0.099		
Sigma	6.196***	0.011	6.352***	0.022		
Log likelihood						

N=5816. [a] base category is zone CL; [b]base category is no education. ***, **, * show significance levels at 1%, 5% and 10% respectively.

There are notable significant differences between determinants of maize yield among the credit constrained and unconstrained households indicating that credit constraints affect yield. For the credit constrained farmers, amount of seeds used per acre has a positive effect on yield. However, this effect is at a decreasing rate as indicated by the square term. A similar effect is however not observed among the unconstrained farmers. On the influence of climatic shocks on yields, among the constrained farmers, higher frequencies of high temperatures and drought over the last 10 years have a significantly adverse effect on yields. However, this effect is not significant among the unconstrained farmers probably because they can adapt measures to cope with these climatic shocks. Most of the climate adaptation and mitigation measures to deal with climatic shocks are usually input or capital intensive. Hence being able to access credit is necessary for assisting farmers to adapt to the climatic shocks.

Still, among the credit constrained households, having a female household head has a significant adverse effect on yield. This effect is however not observed for the unconstrained households indicating that credit unconstrained female-headed households can produce just as optimally as male-headed households. Among the unconstrained households, ownership of more land is associated with significantly higher yields- this is not observed among the constrained households. However, for both, ownership of more livestock units has a positive and significant effect on yields. Among the unconstrained farmers, older farmers have significantly more yield up to a certain point where much older farmers produce considerably less. For the constrained households, participating in off-farm activities has a significantly adverse effect on yields. This is probably because of the competing use of labour between off-farm activities and agricultural activities resulting in lower yields when labour is diverted.

In the selection equation, participation in non-agricultural groups has a significantly positive influence on being credit unconstrained. This may be because social capital enhances financial

inclusion through increased access to informal loans. Similarly, owning a savings account is positively associated with being unconstrained confirming that households who save are less likely to be credit constrained since they may already have collateral or may face less difficulty in securing loans. Similarly, receiving extension advice is associated with being less credit constrained pointing out the positive role of information in overcoming credit constraints. Also, farmers with higher levels of education are less likely to be credit constrained. Again, this is because educated farmers are more likely to have more information necessary in overcoming some credit constraints.

High asset ownership is also associated with being less likely to be credit constrained since this may help farmers overcome credit constraints associated with collateral thus making the borrower more credit worthy. Participating in off-farm activities also reduces the likelihood of being credit constrained. This is mainly because diversifying to other sources of incomes makes the borrower more credit worthy from the lenders perspective since the risk of default reduces. Dependence on agricultural incomes only is associated with high risk of default due to the volatility of agricultural returns linked with unpredictable events such as weather, pests, diseases and so on.

However, the rho values though negative for both constrained and unconstrained farmers, are not statistically significant. This implies that these farmers do not have significant yield differences from any random farmer in the group.

4.3 Off-farm participation and credit constraint

Table 5 presents results of the bivariate probit model showing determinants of being credit constrained and off-farm participation. The model fits the data well with ($\chi 2$ =1122.59; P value=0.000). However, we fail to reject the LR test of rho=0 ($\chi 2$=2.465) suggesting that the two disturbances are not significantly correlated. Therefore, being credit constrained and participation in off-farm activities may not be jointly determined to imply that endogeneity may not be present.

Table 5: Results of bivariate probit showing relationship between off-farm participation on credit constraint

	Credit unconstrained		**Off farm**	
	Coefficient	Std Dev	Coefficient	Std Dev
Socio economic characteristics				
Female	0.201***	0.074	0.032	0.071
Age	-3.05e-04	0.003	-0.002	0.002
Age squared	-2.49e-05	0.000	-9.69e-05***	0.000
Adult equivalent	0.017*	0.010	0.027***	0.010
Primary Education[a]	0.182***	0.065	0.135**	0.056
Sec Education	0.154**	0.077	0.171**	0.071
College/University	0.071	0.104	0.872***	0.136
Monogamous[b]	0.206	0.126	0.194*	0.114
Polygamous	0.122	0.142	0.190	0.130
Divorced/widowed	0.132	0.121	0.074	0.111
Log asset value	0.032**	0.014	0.009	0.012
TLU	-0.001	0.003	-0.012***	0.004
Land acres	-0.002	0.002	-0.002*	0.001
Institutional characteristics				
Group member	0.462***	0.042	0.275***	0.040
Extension advice	0.224***	0.044	-0.111**	0.048
Distance town	-4.65e-04	0.001	-0.003***	0.001
Savings Account	0.397***	0.043	0.132***	0.043
Climatic shocks				
Drought frequency	-0.005	0.011	0.005	0.011
Flooding frequency	0.018	0.022	0.011	0.023
High temperature frequency	-0.010	0.012	0.002	0.011
AEZs				
Zone LH[c]	0.182**	0.086	-0.229***	0.081
Zone LM1_2	0.086	0.089	0.049	0.086
Zone LM3_6	0.209**	0.085	-0.039	0.079
Zone UH	-0.123	0.097	-0.367***	0.085
ZoneUM0_1	0.435***	0.091	0.003	0.089
ZoneUM2_6	0.057	0.085	0.093	0.080
Salaried employment	0.157***	0.051		
Self -employment	0.277***	0.061		
Constant	-2.465***	0.217	0.757***	0.183
Atrho	-0.072	0.047		
Rho	-0.072	0.047		

[a] base category is no education; b base category is single; [c] base category is zone CL. ***, **, * show significance levels at 1%, 5% and 10% respectively. ($\chi 2$ = 1122.59; P value=0.000): Wald test of rho=0; $\chi 2$=2.365 p value= 0.124.

The credit unconstrained variable is equal to 1 if the household is credit unconstrained and 0 if it is constrained. The off-farm participation variable is equal to 1 if the household participates in any off- farm activities (either salaried employment or self-employment activities) and 0, if not. Participation in off-farm activities- both salaried and self-employment- has a positive and significant relationship with being credit unconstrained. This solidifies the argument that farmers in the rural areas are still credit constrained and having another source of income is important for them to be able to overcome these constraints. Female-headed households are also more likely to credit unconstrained compared to the male headed households. This the reason that informal borrowing is more common in the Kenyan rural areas and women are more likely to participate in borrowing from informal credit sources compared to men (Fin Access, 2016).

Being nearer to the town is also positively associated with participation in off-farm activities. Similarly, membership in a group is also positively and significantly associated with involvement in off-farm activities as well as being credit unconstrained. This highlights the positive role of social networks in the agricultural households. As expected, households whose heads have higher levels of education are more likely to participate in off-farm activities and are also more likely to be credit unconstrained. This is because, with higher levels of education, farmers will have more information as well as more skills which may be necessary for participation in the off-farm activities. Being much older is however negatively associated with participation in off-farm activities.

5.0 Conclusion and policy recommendation

Credit constraint is still one of the impediments to increasing agricultural productivity in rural sub-Saharan African, and consequently to poverty alleviation and achieving food security. Rural households tend to diversify to off-farm activities to overcome credit constraints. While this is the case, empirical evidence supporting the link between participation in off-farm activities and credit constraint among households in SSA is limited. Similarly, although there are studies assessing the impact of access to credit on farmers' welfare, the definition of credit access across most studies still raises questions. Applying the direct elicitation approach, which considers both demand and supply of credit, we distinguish between credit constrained and unconstrained

households. After which, we assess the effect of being credit constrained on farmers' productivity. We also assess the relationship between off-farm participation and being credit constrained.

To assess the effect of being credit constrained on productivity (maize yield per acre), we applied the endogenous switching regression to correct for endogeneity that may arise from the fact that being credit constrained was not randomly distributed and farmers differed significantly in their attributes. To instrument for being credit constrained, we use whether or not a household owns a savings accounts, participates in groups and distance to the main road. Although we do not find significant yield differences from being credit unconstrained, there are notable and significant differences in the determinants of yield between credit constrained and unconstrained households. This highlights that being credit constrained does affect farmers' yields. For example, climatic shocks (mainly droughts and high temperatures) have significant negative effect on yields among the credit constrained households but not the unconstrained ones. This could be because unconstrained households are able to cope with these shocks.

To assess the relationship between participating in off-farm activities and being credit constrained we apply bivariate probit model. There is a positive and significant relationship between participating in off-farm activities- both salaried and self-employment- and being credit unconstrained. This solidifies the argument that rural households are still credit constrained and by diversifying to off-farm activities, they are able to minimize the credit constraints. We also find the role of information to be important in explaining credit constraints- those who received extension services are less likely to be constrained. Participation in group activities also has the same effect pointing out the role of social networks either through making information or credit accessible to the members.

Therefore, relaxing credit constraints is still relevant among rural households and off-farm participation is one avenue of relaxing these constraints. Hence, policies that facilitate households' engagement in off-farm activities- either self-employment or salaried employment will be relevant. Similarly, information plays an important for farmers in participating in off-farm activities and also in relaxing credit constraints. Therefore policies strengthening extension services among rural households as well as social networks among farmers are necessary.

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