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Master's Project in Social Statistics

# Modeling Determinants of Household Access to Credit in Rural Kenya

Research Report in Social Statistics, Number 11, 2020

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# **Modeling Determinants of Household Access to Credit in Rural Kenya**

**Research Report in Social Statistics, Number 11, 2020**

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Master Thesis

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## Abstract

Most developing countries work towards poverty reduction. In order to realize this, they put in place various measures. Reduction in poverty levels leads to improved standards of living within the populous. Countries in Sub Saharan Africa recorded extreme poverty levels of 41 per cent in 2015, a reduction from 54 per cent recorded in 1990, a result of deliberate efforts by African countries working on reducing poverty levels.

The provision of credit has been considered as a stimulus to economic growth in the global economy. The improvement in access to credit services to households is seen as a method to alleviate poverty and better the well-being of rural households around the country. Financial services are mostly used by households to expand or start new businesses and cushion themselves from various income shocks. Evidently, there is a huge demand for commercial services at a small-scale level in both savings and credit from households with small income. The high demand in credit accords policy makers the push to develop policy frameworks that go towards improving of access to credit to households.

The investigator aimed to explore the various determinants of rural household access to credit through a multinomial probit, probit and tobit models, given the robustness of the data. The study also established how these determinants affect the access of credit by rural households.

The study determined that those who have attained some level of education have a higher likelihood to access credit through a formal source as compared to individuals with no education in rural areas. It was also established that persons with low levels of education tend to access informal sources of credit more than the formal ones. The study additionally established that married couples borrowed more than un-married individuals. Income was also seen to be a major factor in the access for credit in rural areas as individuals with higher income ended to go for credit from formal sources. In terms of financial health, individuals with some level of education, those who were married, those with mobile phones and those with a higher income level reported to be financially healthy.



## Declaration and Approval

I the undersigned declare that this dissertation is my original work and to the best of my knowledge, it has not been submitted in support of an award of a degree in any other university or institution of learning.

---

Signature

Date

**COLLINS KAMIRE**

Reg No. I56/12401/2018

In my capacity as a supervisor of the candidate's dissertation, I certify that this dissertation has my approval for submission.

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Signature

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## Dedication

This paper is dedicated to my parents Mr and Mrs. Paul Obunde who have always pushed me to achieve the best that I can in life. Most importantly, I dedicate this to the almighty God for seeing me through this project.

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## List of Abbreviations

- *AIC* - Akaike Information Criterion
- *BIC* - Bayesian Information Criterion
- *Fin Access* - Financial Access
- *MTP III* - Third Medium Term Plan
- *MFIs* - Micro Finance banks
- *GoK* - Government of Kenya
- *AFC* - Africa Finance Corporation
- *HELB* - Higher Education Loans Board
- *ICDC* - Industrial and Commercial Development Corporation
- *BRICS* - Brazil, Russia, India, China and South Africa
- *SAARC* - Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan and Sri Lanka
- *CGAP* - Consultative Group to Assist the Poor
- *KNBS* - Kenya National Bureau of Statistics
- *CBK* - Central Bank of Kenya
- *FSD* - Financial Sector Deepening Trust Kenya
- *Chama* - Informal group
- *KISH* - Sampling method used for randomly selecting an respondents within a household

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Collins Kamire

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Nairobi, 2020.

# 1 Introduction

## 1.1 Background of the study

Most developing countries work towards poverty reduction. In order to realize this, they put in place various measures. Reduction in poverty levels leads to improved standards of living within the populous. According to Beegle et al. (2016), countries in Sub Saharan Africa recorded extreme poverty levels of 41 per cent in 2015, a reduction from 54 per cent recorded in 1990, a result of deliberate efforts by African countries working on reducing poverty levels.

Kenya's poverty level is at 29.2 per cent according to Silas et al. (2018) which is equivalent to 14.2 million people. The government has been concerned about this high level of poverty and has been working towards its reduction. The third Medium Term Plan (MTP III, 2018-2022) is one of the government's blueprints whose major aim is to alleviate poverty, improve gender equality. Access to finance refers to the ability of an individual or enterprise to access financial services according to (Demirguc-Kunt et al., 2013). Measuring financial access is essential for creating a nexus between theory and empirical evidence. There has been an upsurge of financial institutions in Kenya over the past two decades. The advent of mobile technology has also played a key role in this as the number of online and mobile financial institutions has increased dramatically. As such, there are more options than ever before for consumers regarding accessing financial services. This means that in addition to the traditional financial institutions, one can access financial services via tapping of their phone.

The provision of credit has been considered as a stimulus to economic growth in the global economy. The improvement in access to credit services to households is seen as a way to alleviate poverty and improve the livelihood of households around the country. Financial services are mostly used by households to expand or start new businesses and cushion themselves from various income shocks. It is evident that there is a strong demand for small-scale commercial services in both savings and credit from low income households (Robinson, 2001). The high demand in credit accords policy makers the push to develop policy frameworks that go towards improving of access to credit to households.

### 1.1.1 Formal Financial Sector

The development of the monetary system in Kenya brought about the aspect of use of currency as a medium of exchange. Traditional banking involves the collection of deposits

and lending of the same to those who need it. However, the formal financial sector has expanded beyond the traditional banking system. This can be classified into Formal Prudential Financial Product and service providers such as commercial banks, deposit taking SACCOs, capital market intermediaries, Micro Finance banks and insurance providers. The other category is the non-Prudential Financial Providers that includes mobile wallet financial services services such as Airtel Money and M-Pesa, National Social Security Fund (NSSF), Post bank and National Hospital Insurance Fund(NHIF). Other formal registered financial services that provided by legally registered institutions or individuals and may operate through direct government intervention. These services include Mobile Money Apps/Digital Apps, Development Financial Institutions such as AFC, HELB, ICDC and JLB, hire purchase companies, non-deposit taking SACCOs and credit only Micro-finance Institutions (MFIs)

### **1.1.2 Informal and Excluded Financial Sector**

Informal services are offered through different forms that are largely unregulated but usually have a well-defined and working organization structure. Informal financial services can be provided by groups such as chamas, shopkeepers and supply chain credit, employers and shylocks. Excluded financial services involves persons who reported utilizing financial and credit facilities exclusively through family members, friends and neighbors or keep cash in secret hide outs.

## **1.2 Problem Statement**

According to Silas et al. (2018), financial access has been experiencing a global increase over the past few decades. This rise could be attributed to the increase in number of mobile phones and access to internet. Households can easily access financial services at a click of a button for as long as there is internet connection and mobile phone network. In Kenya, financial inclusion in households has gone up from 26.7 per cent in 2006 to 82.9 per cent in 2018, according to the Financial Access Household Survey (2019). Additionally, the report also indicated that financial exclusion decreased from 41.3 per cent in 2006 to 11.0 per cent in 2018.

The 2019 FinAccess household survey also indicated that there was a decline in financial health from 39.4 per cent in 2016 to 21.7 per cent in 2019. The decline may be attributed to the continued rise of mobile app loan facilities that have increased access to financial services to households but are largely unregulated. The result is an increase in bad debts that have seen many households default on loans.

This study shall therefore explore the different factors affecting borrowing in rural Kenya and additionally assess household's borrowing behavior. The results may be of policy



interest to government, private sector and any other stakeholder as the nation works towards strengthening financial inclusion.

### **1.3 Objectives**

#### **1.3.1 The overall objective:**

The primary objective is to explore factors affecting access to credit in rural Kenya

#### **1.3.2 The Specific objectives:**

- (i) To identify the determinants of access to credit in rural Kenya
- (ii) To deduce the determinants of household financial health in rural Kenya
- (iii) To study the association between credit source and access to credit in rural Kenya

### **1.4 Significance of the Study**

Access to credit and banking services can help rural households better manage financial decisions. According to Beck et al. (2007), financial access is associated with lower poverty rates and inequality in income. Additionally, formal banking is linked with an surge in individual monthly earnings according to (Honohan & King, 2012). The study may help policy makers reach evidence based decisions which shall be geared towards poverty reduction through easier access to credit. Financial institutions and mobile based lending apps will also be able to make more tailor made financial services for their clients and potential clients. This study will also be used by researchers seeking knowledge in the financial access field for further input.

## 2 Literature Review

### 2.1 Introduction

Availability of credit to households has been hypothesized to be a key driver in many economies. As a result, there has been interest from researchers in the same or similar field. This chapter will mainly discuss literature on the study that are done by other authors in areas closely related to the present study. Throughout this chapter, there will be comprehensive discussion on theoretical and practical views of previous studies done on access to credit in households. .

### 2.2 Empirical Literature

Quach et al. (2005) investigated the determinants of household borrowing from the formal financial sector, the determinants of credit rationing by the formal sector and the impact of credit on household welfare in rural Vietnam. The study found that education, savings, the area devoted to farming and the availability of formal credit are important determinants of both household borrowing and credit rationing by the formal sector. They also found that credit has a positive (albeit small) effect on household welfare in rural Vietnam. The findings of the study have policy implications for land and banking sector reform. (Quach et al., 2005) employed the use of tobit regression to estimate the determinants of credit model rather than having demand and supply modeled separately.

Duy et al. (2012) investigated the factors affecting the access of rural individual and group-based households to formal credit in the Mekong Delta (MD), Vietnam. They noted that Poverty levels in the Mekong Delta have reduced significantly over the last decades, but in the rural areas they remain significant. They assumed that access to credit is a vehicle for poverty alleviation, it is necessary to assess how households decide on borrowing. The paper identified the determinants of the decision to borrow and of the amount that is borrowed by using the double hurdle model and Heckman selection model. Data used in the paper was obtained from a survey of 325 rural households, conducted between May and October 2009. The results indicate that household's capital endowments, marital status, family size, distance to the market center, and locations affect the probability to ask for and amount of credit.

Sekyi et al. (2017) did a study that focused on the determinants of rural households' access to credit and loan amount. Multistage sampling procedure was used to select a sample of 120 households from the Wa Municipality in rural Ghana. Data was collected

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using a questionnaire. Due to the lack of a bias during sample collection, the researcher estimated an ordinary least squares regression and a probit model. The observed findings showed that sex, farming activities, age, trading activities, credit history, and income of the household were the most outstanding determinants of credit access in rural households. Additionally, education, sex, trading, marital status, workers in formal sector, the distance from credit source were identified to be significant in regards to loan amount. The study suggested that applicable educational programmes be created via marketing of self-paid adult literacy classes and active use of local media to raise knowledge and awareness of households on credit access. Additionally, the study suggested that process for getting credit should be simplified. Finally, it was also established that to make it easier for the rural folk to access credit, informal financial institutions should intensify their showing in rural areas.

Quach et al. (2005) developed an econometric structure to examine the impact of credit on the socio-economic well-being of households. The study employed sampled data obtained from two household based surveys conducted in 1992-1993 and 1997-1998 to come up with empirical conclusions. The study findings confirmed that access to credit in the household contributes significantly and positively to the economic health of households with regards expenditure on both food and non-food items. The beneficial impact of credit on household economic health was regardless of their economic standing, that is rich or poor. Additionally, those considered to be poor experienced a positive effect on their economic well-being when they had access to credit. According to the study, the key factors that affected household borrowing included the household head's age, land ownership, amount of savings, land ownership, size of the household and the accessibility of credit facilities at village level.

Lotto (2019) examined how the borrowing behavior of households in the East African region are influenced by their demographic characteristics:- gender, age, income and education using Tobit regression. The paper employed survey data acquired from the World Bank's 2017 Global Findex. Results showed that households headed by men borrowed more often than households headed by females. Additionally, older head of households were more likely to participate in borrowing activities than their younger counterparts. Generally, the results revealed that the households whose age is relatively small will be more indebted and will have a lower level of income, and consequently fewer physical assets. The study revealed that this is due to the life-cycle theory which suggests that younger households have expectations of their income to rise in the future as opposed to the older households, who are headed for retirement. Consequently, the study showed that they are more willing to borrow and acquire durables and other assets due to their hopes and expectation of getting more income in the future. The findings also revealed that the education level of the household head was the enabling factor for the household to borrow due to the financial literacy awareness one can derive from education. The income level of the household was also considered as the determining factor of the

household's borrowing likely-hood. Despite household's level of education, income and age the results also showed that the gender of the households influences the borrowing behavior of the households and that women may not have the borrowing power and ability as compared to men.

Amendola et al. (2016) evaluated the effect of access to credit from commercial banks and other financial institutions on household socio-economic health in Mauritania. The study used unit-level data from a 2014 household survey to investigate the association between credit access, various household characteristics, and household welfare indicators. The paper intended to address potential endogeneity issues by performing isolation at household level to instrument access to credit services. The outcome of the study showed that households headed by people who were older and had a high level of education were more likely to access financial services. This also applied to households who were located in urban areas since most financial institutions are found in urban areas. Additionally, an increased level of financial health was found to be correlated with a reduced dependence on household production but influenced an increased investment in human capital.

Demirguc-Kunt et al. (2015) identified the role of the financial service sector to economic growth. Access to more and better credit by households and firms gives the ability to start and expand businesses, increase Marginal Prosperity to Save, boost investments, increase the purchasing power, acquire quality education, manage shock and risk emanated by external shocks. Hence, increased access to financial services may be used as a driver of reducing inequalities and accelerating growth and development in the economy.

Zins & Weill (2016) focused on the determinants of financial access in Africa. The study used the World Bank's Global Findex database of 37 countries in Africa. A probit model was employed to estimate accessibility of financial services of a formal nature on various regressors. The results revealed that being a man, attaining higher education, older, richer, favors access to credit with a higher influence of training and employment status. In addition, Mobile and digital banking has led to more individuals to access credits than usual banking. The study also found that being a woman has a negative correlation with formal account ownership, savings and credit. Being woman increased the likelihood of using informal saving compared to formal financial institution. The results illustrated how women in Africa have resorted more to informal finance which has however seemed not to bridge gender gap in formal credit.

Fungáčová & Weill (2015) selected China to analyze determinants of access to financial products and services in the nation. This analysis incorporated comparisons to other BRICS Countries as well. The study found out that gender influenced the type of financial service provider between formal and informal sources. Women borrowed and saved more from the informal sources compared to men, this means that females are not that likely to borrow from formal credit to off-set their disadvantage in informal credit. According

to the paper, other factors that influenced credit access included: individuals' level of income, education, and age. More emphasis was given to individual income and their level of education explaining that lack of money dictates the choice of source of financial goods and services especially loans.

Lenka & Barik (2018) analyzed the relationship between increase in the access to financial products and services and the adoption of internet and mobile phones in SAARC countries. Results revealed that there is a positive link where more use of mobile phone and internet leads to expansion of financial services. Similarly, (Kabakova & Plaksenkov, 2018) identified three factors that affect the access of financial products and services, they include economic, technological and social factors. Hence, increase in use of digital and mobile phone to access credit had a notable positive influence on the overall financial inclusion. In addition, (Ouma et al., 2017) also revealed that a rise in use of mobile phones in accessing credit, increases income and savings among persons living in poverty especially in Sub-Saharan Africa.

Francis et al. (2017) established that digital credit has significantly accelerated access to financial services. However, this is two fold, on one way is increase in financial health while the other way being that the target individuals do have minimal or no financial literacy on digital platforms. According to focus groups run by Consultative Group to Assist the Poor (CGAP) in 2015, showed that most of the respondents had minimal awareness of the products, terms and condition of the loans and fee charged. Individuals end up over borrowing loans especially when the only thing required is dialing to request via a mobile phones, and thereafter, it becomes difficult to repay the loan. In addition, digital credit products have raised a host of privacy issues. Most borrowers do not have proper understanding on how private information is being used as data to determine loan eligibility by loan providers.

## 3 Methodology

### 3.1 Determinants of Household Credit

The study worked on a dataset of respondents who have loans and those who do not. This kind of selection minimized any type of bias that may arise since households with no loans may have a demand for it but may be left out from accessing it. The amount of credit given to a household that an investigator can discern is the result of the forces of demand and supply. For instance, the ownership of assets can boost a household's chance of obtain a loan. The same assets may be used by credit offering facilities as possible collateral hence increasing supply of the service.

### 3.2 Probit and Tobit Models

The basic form for of these models is given by;

$$Y_i^* = \beta_0 + \beta_1 X_i + \varepsilon_i \quad (1)$$

A utility model developed by Walker & Ben-Akiva (2002) can therefore be deduced. We assume that a consumer seeks to maximize their utility given the budget that they have. They may have limited funds within their budget. It is also assumed that households will seek to pick alternatives that give them the highest utility. This is evidenced by the various sources of credit at the disposal of the consumer and they at liberty to choose which ever they want. The preference of the consumer determines which option they will take. If the utility index is high enough, the consumer will apply for the loan. This could be given by;

$$Y_i = 1 \text{ if } Y_i^* \geq 0 \quad (2)$$

If the utility index given is not high enough according to the consumer, then he or she is less likely to take up the credit;

$$Y_i = 0 \text{ if } Y_i^* < 0 \quad (3)$$

$$P_i = P(Y_i = 1) \quad (4)$$

$$= P(Y_i^* \geq 0) \quad (5)$$

$$= P(\beta_0 + \beta_1 X_i + \varepsilon_i \geq 0) \quad (6)$$

$$= P(\varepsilon_i \geq -\beta_0 - \beta_1 X_i) \quad (7)$$

$$= 1 - F(-\beta_0 - \beta_1 X_i) \text{ where } F \text{ is the c.d.f for } \varepsilon \quad (8)$$

$$= F(\beta_0 + \beta_1 X_{1i}) \text{ if } F \text{ is symmetric} \quad (9)$$

The two models differ in the selection of the cumulative density function

### 3.3 Probit Model

Variable  $y_i$ , which is the outcome variable, is a random variable of Bernoulli distribution that is discrete in nature taking either value 1 or 0. We have

$$P(y_i = 1|x_i) = F(x_i\beta)$$

$$P(y_i = 0|x_i) = 1-F(x_i\beta)$$

In this case, we have  $F$  being the cumulative distribution function obtained from the standard normal distribution and coefficient  $\beta$  is the  $k \times 1$  vector of coefficients. Assuming we have a sample of identically and independently distributed input outcome variables  $(x_i, y_i)$  for observations  $i, \dots, N$  that is used to estimate vector  $\beta$

Additionally, assuming that the error in the utility index is normally distributed with mean being 0 and its standard deviation being  $\sigma^2$

$$Prob(Y_i = 1) = F\left(\frac{\beta_0 + \beta_1 X_{1i}}{\sigma}\right) \quad (10)$$

We can also express the equation as;

$$Prob(Y_i = 1) = F\left(\frac{\beta_0 + \beta_1 X_{1i}}{\sigma}\right) = \int_{-\infty}^{\frac{\beta_0 + \beta_1 X_{1i}}{\sigma}} \quad (11)$$

### 3.4 Model Estimation

Probit regression model is based on an inferred model:

$$P(y_i = 1|x) = P(y_i^* > 0|x) \quad (12)$$

$$= P(x_i\beta + \varepsilon_i > 0|x) \quad (13)$$

$$= P(\varepsilon > -x_i'\beta|x) \quad (14)$$

$$= 1 - F(-x_i'\beta) \quad (15)$$

Assuming that the residuals are normally independently distributed:

$$P(y_i = 1|x) = 1 - \Phi\left(-\frac{x_i'\beta}{\sigma}\right), \sigma = 1 \quad (16)$$

$$= \Theta(x_i' \beta)$$

The joint density of the probit model is given by;

$$\begin{aligned} f(y|x, \beta) &= \prod_i F(x_i' \beta)^{y_i} [1 - F(x_i' \beta)]^{(1-y_i)} \\ &= \prod_i F_i^{y_i} (1 - F_i)^{(1-y_i)} \end{aligned} \quad (17)$$

The model's log likelihood function can written as;

$$\ln L = \sum_i y_i \ln F_i + (1 - y_i) \ln(1 - F_i) \quad (18)$$

The equation can also be written as

$$\ln L = \sum_{n=1}^N \ln(F(y_i x_i \beta)) \quad (19)$$

With respect to parameter  $\beta$ , the vector of the first derivatives of the log-likelihood is given by;

$$\nabla \ln L = \sum_{n=1}^N \frac{f(x_i \beta)}{F(x_i \beta)[1 - F(x_i \beta)]} [y_i - F(x_i \beta)] x_i \quad (20)$$

The equation can also be written as;

$$\nabla \ln L = \sum_{n=1}^N \lambda_i x_i \quad (21)$$

where;

$$\lambda = \frac{f(y_i x_i) y_i}{F(y_i x_i \beta)} \quad (22)$$

The matrix of the second derivative is given by;

$$\nabla \ln L = - \sum_{n=1}^N \lambda(x_i \beta + \lambda_i) x_i^T x_i \quad (23)$$



We now look for the value of  $\beta$  that maximizes the probability of observing the sample;

$$\begin{aligned}\frac{\partial \ln L}{\partial \beta} &= \sum_i \left[ \frac{y_i f_i}{F_i} + \frac{(1-y_i)(-f_i)}{1-F_i} \right] x_i \\ &= \sum_i \left[ \frac{y_i - F_i}{F_i(1-F_i)} f_i \right] x_i \\ &= 0\end{aligned}\tag{24}$$

### 3.5 Censored Regression Models

In most statistical analyses of household and individual data, the dependant variable is censored. If the dependent variable is censored to zero as is in our study, for significant fraction of the observations, parameters estimates obtained by conventional regression models may be biased. Consequently, consistent estimates can be obtained by the method obtained by the method proposed by (Tobin, 1958). This particular approach is known as Tobit model and is a special case of the more general censored regression model.

#### 3.5.1 Tobit Regression

The tobit regression model is a regression model that is censored in nature. The model estimates linear relationships between variables when there is either left or right censoring in the dependent variable. Right censoring or censoring from the right happens when there are desired values at or above some threshold. Left or below censoring refers to censoring whereby value that fall at or below a determined threshold are censored. For our study, censoring is done at the lower limit of zero as this is where amount of household savings and borrowing tend to be. The model can also have latent variable models that do not involve binary dependent variables.

$$y_i^* = x_i \beta + \varepsilon\tag{25}$$

$$y_i^* = \begin{cases} y_i & \text{if } y_i > 0 \\ 0 & \text{if } y_i \leq 0 \end{cases}\tag{26}$$

where we have:

$y_i$  being the observed amount of borrowed credit

$Y_i^*$  refers to an unobserved variable

$\beta$  is a vector of an unknown parameter

$X_i$  is the vector of independent variable influencing the dependent variable  $y_i$

The probability model can be written as;

$$\begin{aligned} P(y = 0|x) &= P(y^* \leq 0|x) = P[(y^* - X\beta)/\sigma \leq (0 - X\beta)/\sigma|x] \\ &= P[z \leq -X\beta/\sigma|x] = \Theta(-X\beta/\sigma) = 1 - \Theta(X\beta/\sigma) \end{aligned} \quad (27)$$

$$P(y > 0|x) = P(y^* > 0|x) = 1 - \Theta(-X\beta/\sigma) = \Theta(X\beta/\sigma) \quad (28)$$

The unconditional expectation of the model can be given as;

$$\begin{aligned} E[y|x] &= Prob(y > 0|x) * E[y|y > 0, x] + Prob(y = 0|x) * 0 \\ &= P(y > 0|x) * E[y|y > 0, x] \\ &= \Theta(X\beta/\sigma) * E[y^*|y > 0, x] \end{aligned}$$

The conditional expectation could be stated as;

$$E[y|y > 0, x] = x'_i\beta + \sigma\lambda(x'_i\beta)$$

We can generate ols of the estimated model with  $y > 0$  for left censored data. We have;

$$y_i = x'_i\beta + \vartheta_i$$

We now look at the density of  $\vartheta_i f_\vartheta(\cdot)$  and integrate it to 1 as follows;

$$\int_{-x'_i\beta}^{\infty} f_\vartheta(\eta) d\eta = 1$$

The  $\varepsilon_i$ 's density, which is assumed to be normal in the model is given by;

$$\int_{-x'_i\beta}^{\infty} f_\vartheta d\eta = F_i = \int_{-\infty}^{x'_i\beta} f_\varepsilon(\eta) d\eta = \int_{-\infty}^{x'_i\beta} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{1}{2}(\frac{\eta}{\sigma})^2} \quad (29)$$

Then,  $f_\vartheta(\cdot)$  can be written as:

$$f_\vartheta = F_i^{-1} f_\varepsilon = F_i^{-1} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{1}{2}(\frac{\eta}{\sigma})^2} \quad (30)$$

The pdf of  $\vartheta_i$  can be given by;

$$E[\vartheta_i] = \int_{-x'_i\beta}^{\infty} \eta f_{\vartheta}(\eta) d\eta = F_i^{-1} \int_{-x'_i\beta}^{\infty} \eta f_{\varepsilon}(\eta) d\eta \quad (31)$$

$$= F_i^{-1} \int_{-x'_i\beta}^{\infty} \eta \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{1}{2}\left(\frac{\eta}{\sigma}\right)^2} d\eta \quad (32)$$

$$= F_i^{-1} [-\sigma f_{\varepsilon}(\eta)]_{-x'_i\beta}^{\infty} \quad (33)$$

$$= \sigma F_i^{-1} f_i \neq 0 \quad \text{given}(f_i = f_{\varepsilon}(x'_i\beta)) \quad (34)$$

Then,  $E[\vartheta|x] = \sigma F_i^{-1} f_i = \sigma \lambda(x'_i\beta) \neq 0$  which depends on  $x'_i\beta$ .

$$E[y_i|y_i > 0, x'_i\beta] = x'_i\beta + \sigma \lambda(x'_i\beta)$$

The model employed in this paper is made up one dependent and several independent variables as follows;

$$Y_i^* = \lambda + \zeta_1 X_1 + \zeta_2 X_2 + \zeta_3 X_3 + \zeta_4 X_4 + \zeta_5 X_5 + \zeta_6 X_6 + \dots + \zeta_n X_n + \varepsilon \quad (35)$$

Where:

$Y_i^*$  refers to the dependent variable

$\lambda$  refers to the coefficient of the constant

$\zeta_1$  to  $\zeta_n$  refer to the coefficients of the independent variables outlining the magnitude and direction by which they influence the dependent variable.

$\varepsilon$  is the error term

Variables  $X_1$  to  $X_n$  refers to the explanatory variables used in the model

### 3.5.2 Model Estimation

Censored regression model tend to be estimated by the Maximum Likelihood estimation method. In this case, we assume that we have an error term  $\varepsilon$  that is distributed normally with a mean 0 and variance being  $\sigma^2$ , the log-likelihood function is;

$$\log L = \sum_{n=1}^N \left[ I_i^a \log \Phi \left( \frac{a - x_i' \beta}{\sigma} \right) + I_i^b \log \Phi \left( \frac{x_i' \beta - b}{\sigma} \right) + \left( 1 - I_i^a - I_i^b \right) \left( \log \phi \left( \frac{y_i - x_i' \beta}{\sigma} \right) - \log \sigma \right) \right] \quad (36)$$

Where  $\Phi$  denotes the probability density function while  $\phi$  denotes the cumulative distribution function from the standard normal distribution. Additionally,  $I_i^a$  and  $I_i^b$  are represent indicator functions as below;

$$I_i^a = \begin{cases} 1 & \text{if } y_i = a \\ 0 & \text{if } y_i > a \end{cases} \quad (37)$$

Standard non-linear optimization algorithms can be used to maximize parameter vector  $(\beta', \sigma)'$  for the likelihood function of the censored regression model.

### 3.6 Model Specification

In our study, we will be looking at different sources of credit as outlined in the FinAccess Report, 2019. An individual is free to choose from any of the below;

- Formal; commercial banks including mobile banking, microfinance banks, insurance providers, capital markets, deposit taking SACCOs
- Formal others; mobile money, NSSF, NHIF, Postbank, mobile money Apps, Hire Purchase, Development financial Institutions such as HELB, Non- deposit taking SACCOs, and credit only microfinance (MFIs)
- Informal; groups such as chamas, employer, shopkeepers, shylocks
- Excluded; friends, family, neighbors or not using any alternative of financial products and services.

Assuming that a household chooses a credit source with the highest utility, we can now form a utility function.

The utility function can be given by;

$$A_{ij}(O_{ij}; U_{ij}) = B_j(O_{ij}; \beta) + \varepsilon_j$$

where;

$i = 1, 2, 3, \dots, M$   $j = 1, 2, 3, \dots, N$

$O_{ij}$  refers to the detected characteristics of individual  $i$  and credit choice from option  $j$

$A_{ij}(C_{ij}; U_{ij})$  represents individual  $i$ 's derived utility from a credit choice from option  $j$

$U_{ij}$  represents unobserved characteristics of individual  $i$  and credit choice of option  $j$

$B_j(O_{ij} : \beta)$  represents the relationship between the variables in the utility.

$\varepsilon_j$  is the error term

Our model seeks to test the relationship among the probabilities of the credit choice options. The estimated coefficients will be used to generate the probabilities of individual choosing any of the given options. The probability of individual  $i$  selecting alternative  $j$  is given as;

$P(y_i = j)$  given  $j = 1, 2, 3, \dots, n$  and  $i = 1, 2, 3, \dots, n$

$j$  represents the different options while  $i$  denotes the particular individuals from individual 1 to  $n$ .

We derive an econometric model below;

$$\text{CreditSource} = \beta_0 + \beta_1 \text{Sex} + \beta_2 \text{Age} + \beta_3 \text{Education} + \beta_4 \text{MaritalStatus} + \beta_5 \text{income} + \dots + \mu \quad (38)$$

### 3.7 Description of the Data

The FinAccess data set is made up of various data types depending on the variable. It can be classified as a mixed data type. The data set has a total of 884 variables based on the questionnaire that was administered to respondents. Out of this, the researcher picked the most applicable variables that achieve the desired objectives. This data set contains different data types such as binary, count and categorical. Based on the models employed, the researcher picked the most appropriate data types as well. Table 2 outlines the characteristics of the specific variables used in this study.

Variable	Description
Apply and denied loan	this variable is binary and was assigned dummy variable 1 for those who have been denied and 0 elsewhere
Financial health	This variable is also binary, being assigned dummy variable 1 for one who is financially healthy and 0 otherwise
sex	sex was assigned dummy variable 1 for males and 0 for females
Age	Depicts the respondents age
Age Squared	Squares the age of the respondents
Education	Depicts the different levels of education with no education selected as the base, 0 for primary education, 1 depicting secondary education, 2 for tertiary education
Marital status	Dummy variable created 1 for married and 0 otherwise
Mobile Ownership	Dummy variable created 1 for individuals who own a mobile phone and 0 elsewhere
Income	Amount of monies received by the respondent with high income as the base

Table 1. Variable definitions and characteristics

### 3.8 Model Selection

In this study, to determine the goodness of, will use Akaike Information Criterion(AIC) and Bayesian Information Criterion(BIC).

#### 3.8.1 Akaike information criterion

AIC was first developed by Akaike (1973) as an estimator of the relative quality of statistical models for a given set of data. The selection of the best model is determined by an AIC score.

$$AIC = 2K - 2\log(\hat{L}) \quad (39)$$

---

where the estimated number of parameters in the model is denoted by  $k$  while the maximum value of the likelihood function in the model is denoted by  $\hat{L}$ .

AIC deals with both the risk of not fitting the right model. The model with the least AIC value is considered to be the best model fit.

### 3.8.2 Bayesian information criterion

The Gideon E. Schwarz developed the BIC in 1978. Similar to the AIC, it is used to do a comparison among a set of models with the one with the lowest value of BIC being preferred. The BIC is given as below;

$$BIC = \ln(n)k - 2\ln(\hat{L}) \quad (40)$$

where:

- $\hat{L}$  represents the maximum value of the likelihood function.
- $x$  refers to the data observed.
- $k$  in the model denotes the number estimated parameters.

## 4 Analysis

### 4.1 Introducing the Data

This study employed data from the FinAccess survey conducted in 2018 by the Kenya National Bureau of Statistics (KNBS), the Central Bank of Kenya (CBK) and Financial Sector Deepening Trust Kenya (FSD). The survey was household based, targeting household individuals aged 16 years and above and designed to provide national, regional and residence (rural and urban areas) level estimates. Sampling for the 2019 Survey utilized a two-stage stratified cluster sampling design. This was geared towards providing valid and reliable estimates at national level, regional levels and rural and urban areas separately. The first stage entailed selecting 1000 clusters. The second stage involved random selection of a uniform sample of 11 households (434 in urban and 566 in rural areas) in each cluster from a roster of households in the cluster using systematic random sampling method. The third stage involved selection of the individual at the household level using an inbuilt Computer Aided Personal Interview (CAPI) KISH grid to select one eligible individual (16+ years) from a roster of all eligible individuals in the household. All the selections were done without replacement. The data has been weighted back to the population to be representative at both the national level as well as at the regional levels. Table 2 outlines the distribution of the sample.



**Table 2. Sample Allocation in the 2019 finaccess household survey**

<b>Region</b>	<b>Rural</b>	<b>Urban</b>	<b>Total</b>
Nairobi	N/A	814	814
NorthRift	396	154	550
Central Rift	770	506	1,276
South Rift	572	341	913
Nyanza	781	451	1,232
Western	704	341	1,045
Central	770	517	1,287
Lower Eastern	572	352	924
Upper Eastern	198	143	341
Mid-Eastern	561	242	803
Coastal Region	495	275	770
North Eastern	407	209	616
Mombasa	N/A	429	429
Total	6,226	4,774	11,000

Source: FinAccess 2018 data

## 4.2 Descriptive Analysis

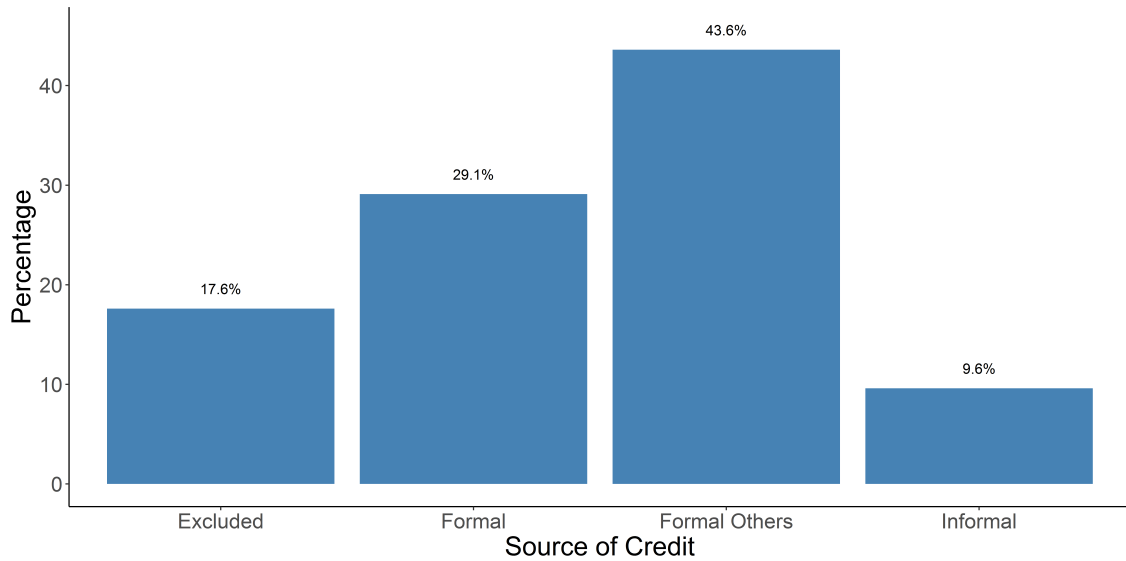
The study uses the FinAccess data set which had sampled 11,000 households. Of this, the survey received 8,669, a 78.9 per cent response rate. Rural households represented 58.3 per cent of the sample while urban represented 41.7 per cent. The sampled respondents were all aged above 16 years with 41.4 per cent of them being male while 58.6 per cent of them were female. The mean age of respondents was 42 years while the modal age was 30 years. The survey also showed that 27.6 per cent of individuals in rural households did not complete primary education. The highest level of education was university education with 1.7 per cent of individuals having completed. The survey also revealed that 57.3 per cent of individuals in rural households have no one to help them during harsh financial times. We also note that household heads make key financial decisions 48.9 per cent of the times as compared to 22.3 per cent who do it jointly with their spouses. Additionally, 17.9 per cent of individuals in rural households sell livestock for emergency funds, 16.9 per cent receive assistance from friends and family, 15.7 per cent of individuals get funds from their savings held at banks and saccos, 5.0 per cent take loans from banks while 1.2 per cent take loans from mobile banking services. 0.4 per cent of individuals from rural

households take loans from mobile app-based lenders while 9.8 per cent use savings from their mobile banking devices.

**Table 3. Descriptive Statistics**

<b>Variable</b>	<b>Mean</b>	<b>standard deviation</b>	<b>minimum</b>	<b>maximum</b>
Age	47.57	18.03	16.00	95.00
Age Squared	2052.80	1740.16	256.00	9025.00
Sex	0.42	0.49	0.00	1.00
Borrowing	0.03	0.17	0.00	1.00
Marital Status	0.60	0.49	0.00	1.00
Phone Ownership	0.26	0.44	0.00	1.00
No Education	0.20	0.40	0.00	1.00
Primary Education	0.48	0.50	0.00	1.00
Secondary Education	0.50	0.87	0.00	1.00
Tertiary Education	0.19	0.74	0.00	1.00
Excluded	0.18	0.38	0.00	1.00
Formal	0.29	0.45	0.00	1.00
Formal Others	0.87	0.99	0.00	1.00
Informal	0.29	0.89	0.00	1.00
Low income	0.61	0.49	0.00	1.00
High income	0.42	0.82	0.00	1.00
Middle Income	0.17	0.38	0.00	1.00
Wealth	1.21	0.41	0.00	1.00
Financial Health	0.12	0.32	0.00	1.00
N	4,992	4,992	4,992	4,992

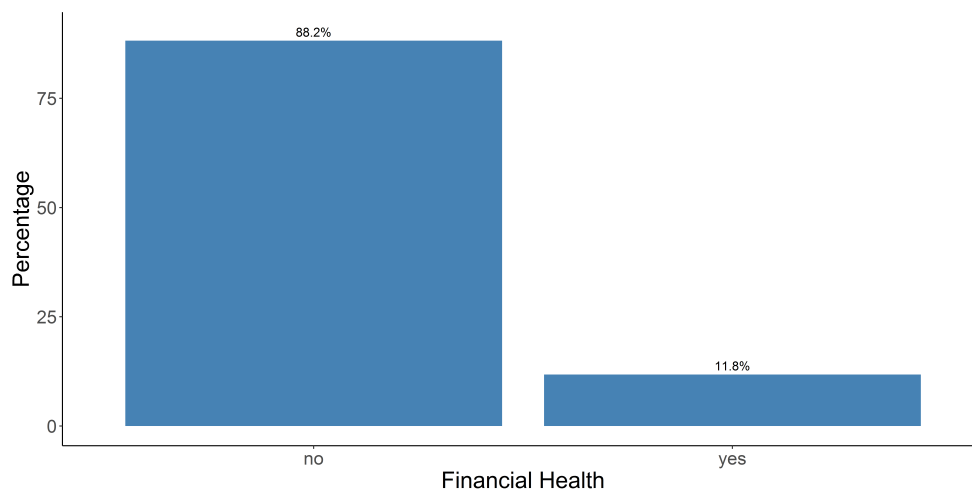
Source: FinAccess 2018 Data



**Figure 1. Sources of Credit in Rural Kenya**

Source: FinAccess 2018 data

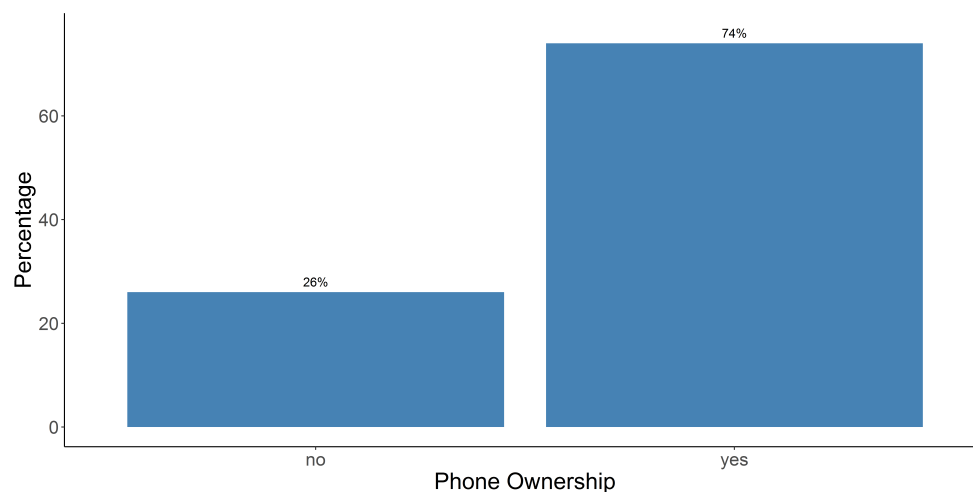
Figure 1 is a chart showing the percentage distribution among the four credit sources. We can deduce that 17.57 per cent of individuals in rural areas are excluded from access to credit. These could be individuals who reported utilizing financial products and services purely through friends, family, neighbours or may have opted to keep money in secret hideouts. 29.15 per cent of individuals in rural areas access credit through formal sources that include commercial banks, micro finance co-operations and saccos. Additionally, 43.65 of people in rural areas access credit through other formal sources that include mobile money, postbank, non credit taking saccos and mobile money apps. Finally, 9.64 per cent of individuals in rural areas access informal sources of credit which includes chamas, shopkeepers, money lenders and from employers.



**Figure 2. Financial health**

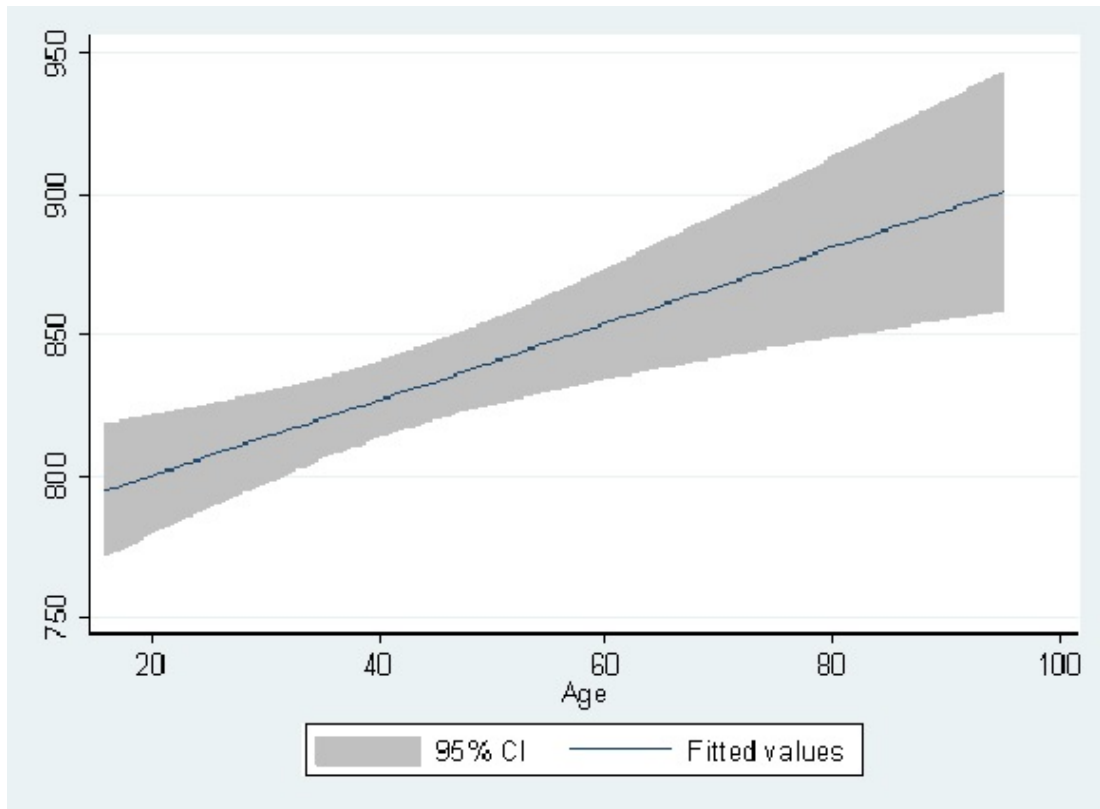
Source: FinAccess 2018 data

Figure 2 displays the perception of people on whether they are financially healthy or not. It shows that 88.22 per cent of individuals are not financially healthy while 11.78 per cent reported that they were financially healthy.



**Figure 3. Phone Ownership**  
Source: FinAccess 2018 data

Figure 3 displays a bar chart for percentage of those who own phones and those who do not own phones in rural areas. 73.96 per cent of individuals reported that they do own phones while 26.04 per cent reported to not having phones.



**Figure 4. Graph of income against Age**

Source: FinAccess 2018 data

Figure 4 displays linear prediction plot with confidence intervals for Age against income. From the graph we can deduce that income increases with age in the rural areas.

### 4.3 Exploratory Analysis

The researcher needed to determine if any of the independent variables was correlated to the other in any way. High levels of correlation among variables would imply that we would need to drop one or more variables from our equation. Removing these correlated variables enables the researcher achieve statistical significance of the independent variables. In this paper, we shall use the variance inflation factor (VIF) which identifies correlation between independent independent variables and the strength of that correlation. The lowest VIF level is one and the highest has no upper limit. VIFs between 1 and 5 suggest that there is moderate correlation. This correlation is not that significant hence can be ignored. VIF values greater than 5 represent critical levels of multicollinearity where the coefficients are poorly estimated. These variables should be removed from the equation. The lower the VIF value, the more suitable the variable.

**Table 4. VIF Coefficients table when Taking a Loan as the dependent Variable**

<b>Variable</b>	<b>Collinearity Tolerance</b>	<b>Statistics VIF</b>
Sex	0.966	1.035
Age	0.034	29.719
Marital Status	0.850	1.176
Phone Ownership	0.814	1.228
Primary Education	0.492	2.034
Secondary School	0.442	2.261
Tertiary Education	0.650	1.538
Low income	0.534	1.873
Middle Income	0.646	1.549

#### **4.4 Probit for Application of loan**

Table 4 displays the probit regression model of results where the dependent variable is whether or not one has ever attempted to borrow a loan but was denied. The variable is categorical in nature with 1 for those who did borrow but were denied while 2 indicating those who borrowed but were given a loan. Dummy variables were then created for these two binary outcomes. The variables are 1 for those who applied but were denied and 0 for those who applied but were not denied. The number of observations recorded was 4,992.

Those who have attained Primary Education are 1.4 per cent more likely to apply for be denied credit compared to those who have no education. Individuals with tertiary education also 1.4 percent more likely to apply and be denied loan compared to those who have no education.

Table 5. Marginal effects table for Probit model where being denied a loan is the dependent variable

Variable	Marginal Effects	std Err	z	P> z
Sex	0.0019107	0.00441	0.43	0.665
Age	0.0007105	0.00073	0.97	0.331
Agesquared	7.95E-06	-0.0001	-1.02	0.309
Primary Education	0.0138188*	0.00878	1.75	0.080
Secondary Education	0.0132035***	0.00408	3.23	0.001
Tertiary Education	0.0131834***	0.0033	3.99	0.000
Marital Status	0.0084296*	0.00467	1.8	0.071
Phone Ownership	0.0086125	0.00539	-1.6	0.110
Low income	-0.0060201	0.00587	-1.03	0.305
Middle income	0.0026288	0.00587	-1.03	0.305

Signf codes at : 0'\*\*\*'0.001'\*\*'0.01' \*'0.05'.'0.1'1

The model deduced from the above table is given below to four decimal points;

$$Y = -2.629 + 0.0019X_1 + 0.0007X_2 + 0.0000X_3 + 0.0138X_4 + 0.0138X_5 + 0.0138X_6 + 0.0084X_7 + 0.0086X_8 - 0.0060X_9 + 0.0026X_{10} \quad (41)$$

The Akaike's information criterion value for the above model is 1285.655 while the bayesian information criterion value is 1357.327. These values are lower than the value obtained when one includes all variables in the data set. Therefore, the study restricted the model to a few specific models as opposed to having an unrestricted model with many variables.

#### 4.4.1 Multinomial Probit

Table five displays the marginal effects of the multinomial probit model where the dependent variable is the source of credit. We have for categories in this variable which are formal credit, formal others, informal credit and those who are excluded. In this case, our reference category is those who are excluded. In this case, the reference category is being denied a loan when one applied for it. The model is associated with a log likelihood value of -4336.3 and p value of 0.000 which is less than 0.05 hence the model as a whole is significant.

Males are more likely to access credit from a formal source compared to females by 7.4 per cent. At the same time, Males are less likely to get credit from other formal sources

by 6.0 per cent compared to females. Finally, males are 3.8 per cent less likely to be get credit from informal sources compared to females. These results outlines the disparity of access to credit between men and women in rural regions. Men have easier access to credit from formal sources as compared to females.

Persons with primary education are 9.7 per cent more likely to be select credit from formal sources compared to those who have not attained primary education. Persons with primary education are 2.0 per cent more likely to acquire credit from other formal sources compared to those with no primary education. Additionally, those who have primary education are 6.0 per cent less likely to secure credit from informal sources compared to those who have not attained primary education. Persons with secondary education are more likely by 10.6 per cent to acquire credit from formal sources compared to those with no secondary education. The result also shows that individuals with secondary education are 3.4 per cent more likely to gain credit from other formal sources compared to those with no secondary education. Individuals with secondary education are 5.2 per cent less likely to be access credit from informal sources compared to those who have not attained secondary education. Individuals with tertiary education are 17.9 per cent more likely to take credit from formal sources when compared to those with no tertiary education. Comparatively, individuals with tertiary education are 4.4 per cent more likely to obtain credit from other formal sources compared with those who have not achieved tertiary education.

The marital status of an individual is significant for those accessing all sources of credit in rural areas. The model showed that individuals who are married are 2.5 per cent more likely to gain credit from formal sources compared to those who are not married. Individuals who are married are 2.7 per cent more likely to secure credit from other formal sources compared to those who are not married. Additionally, those who are married are 0.3 per cent more likely to get credit from through informal sources compared to those who are not married.

Ownership of a mobile phone is significant for all sources of credit. Individuals with mobile phones are more likely by 23.0 per cent to get credit through formal sources compared to persons with no phones. Individuals with phones are 48.3 per cent more likely to access credit through other formal sources compared to those without phones. Individuals with phones are 23.7 per cent more likely to acquire credit services via informal sources compared to those without phones. This result outlines the importance of phones in the access of credit.

Income is significant for some sources of credit. Individuals who have low income are less likely by 30.9 per cent to access credit through formal sources as compared to individuals with high income. Individuals who have low income are 26.7 per cent more likely to access credit from other formal sources compared to those with high income. Individ-



uals with low income are 4.0 per cent more likely to get credit from an informal source compared to those who have high income. Persons with middle income are less likely by 12.5 per cent to acquire credit through a formal source compared to those with high income. Additionally, those with receive middle income are 16.4 per cent more likely to receive credit from other formal sources compared to those with high income.

**Table 6. Marginal Effects table for Multinomial Probit model where credit source is the dependent variable**

Variable	Formal Source	Formal Others	Informal Source
Sex	0.0743513(0.0827)	-0.060426*** (0.0786)	-0.0379116*** (0.0916)
Age	0.0082008*** (0.0114)	0.002135*** (0.0106)	0.0020874*** (0.0121)
Agesquared	-0.0000326*** (0.000116)	-0.0000349*** (0.000109)	-0.0000388*** (0.000125)
Primary Education	0.0977036*** (0.114)	0.0202262 (0.0710)	-0.0596303*** (0.106)
Secondary Education	0.1085727*** (0.0713)	0.0342613 (0.0659)	-0.0527575*** (0.0762)
Tertiary Education	0.1786165*** (0.138)	0.0444359*** (0.138)	-0.0561626 (0.196)
Marital Status	0.0248836*** (0.0873)	0.0265836*** (0.0826)	0.003425*** (0.0934)
Phoneownership	0.230317*** (0.100)	0.483471*** (0.0876)	0.2367396*** (0.0937)
Middleincome	-0.1248405 (0.141)	0.1637537*** (0.142)	-0.0074236 (0.191)
Lowincome	-0.3095218*** (0.116)	0.2663952*** (0.116)	0.0390624** (0.154)
Observations	4,992	4,992	4,992

*standard errors in parantheses Signif. codes : 0' \*\*\*' 0.001' \*\*' 0.01' \*' 0.05' .0.1' 1*

The first model deduced from the table 6 is given below to four decimal points;

$$Y = -3.8577 + 0.0743X_1 + 0.0082X_2 - 0.0000X_3 + 0.0098X_4 + 0.1086X_5 + 0.1786X_6 + 0.0249X_7 + 0.2303X_8 - 0.309X_9 + 0.1248X_{10} \quad (42)$$

The second model deduced from table 6 is given below to four decimal points;

$$Y = -3.3954 - 0.060426X_1 + 0.002135X_2 - 0.0000X_3 + 0.0202X_4 + 0.0343X_5 + 0.0444X_6 + 0.0266X_7 + 0.4837X_8 + 0.2664X_9 + 0.1638X_{10} \quad (43)$$

The third model deduced from table 6 is given below to four decimal points;

$$Y = -2.1198 - 0.0379X_1 + 0.0021X_2 - 0.0000X_3 - 0.0596X_4 - 0.0527X_5 - 0.0528X_6 + 0.0034X_7 + 0.2367X_8 + 0.0391X_9 - 0.0074X_{10} \quad (44)$$

#### 4.4.2 Tobit regression

Table six displays the results of tobit analysis where the amount of borrowing from shop keepers is the dependent variable. The number of observations is 1,942 which represents the number of people who responded to have taken a loan from a shop keeper. The data is censored to the left for those who did not borrow any amount. The predicted values for sex, marital status, phone ownership and various levels of education are significant.

A male is likely to borrow 864.89 shillings more than a female from a shopkeeper. A married individual was found to likely borrow 1,239.34 shillings more than an individual who is not married. Individuals that own phones were found to likely borrow 1,683 more than individuals with mobile phones. The study also found that persons who have attained primary education were likely to borrow 5,932.32 shillings less than individuals with no education. Additionally, those with secondary education were found to borrow 3,057.71 shillings less than those with no secondary education. People with tertiary education borrowed 1,729.30 shillings less than those with no secondary education.

**Table 7. Tobit regression model where amount of credit borrowed is the dependent variable**

Variable	Model mfx
Sex	864.8924***(315.74)
Age	-55.57381(49.017)
Agesquared	0.07259(0.51402)
Marital Status	1230.344***(332.79)
Phone Ownership	1683.461**(375.85)
Primary Education	-5,932.319***(371.85)
Secondary Education	-3,057.714***(247.46)
Tertiary Education	-1,729.229***(229.25)
Low income	753.8713(460.12)
Middle income	-578.9275(550.29)

*Standard errors in parentheses*

\*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$

The model deduced from table 7 is given below to two decimal points;

$$Y = 640.23 + 864.89X_1 - 55.57X_2 + 0.07X_3 - 5,932.32X_4 - 3,057.71X_5 - 1,729.23X_6 + 1230.34X_7 + 1,683.46X_8 + 753.87X_9 - 578.93X_{10} \quad (45)$$

#### 4.4.3 Probit estimation for financial health

Table seven displays the probit results for financial health as the dependent variable against various explanatory variables. Financial health looks at the monetary affairs of an individual. It can be described the ability of Individuals to use financial products and services for running their daily needs, helping to achieve their life goals and protecting themselves from possible shocks that may occur. One's ability to run their daily financial obligations, risks and investment can also important aspects of financial health..

People who have attained primary education are 3.3 per cent more likely to be financially healthy compared to those with no education. Individuals with secondary education are 2.9 per cent more likely to be financially healthy compared to those with no secondary education. Additionally, persons who have tertiary education are 4.3 per cent more likely to be financially healthy compared to those with no tertiary education.

Married people are more likely by 3.3 per cent to be healthy financially compared to those with who are single. In addition to that, individuals with phones are 5.0 per cent more likely to be financially healthy compared with those who have no phones. Individuals with low income are 19.9 per cent less likely to be of sound financial health compared with those with high income. Persons with middle income are 6.1 per cent less likely to be financially healthy in comparison with to people with high income.

**Table 8. Marginal Effects table for Probit model where financial health is the dependent variable**

Variable	Marginal Effects	std. Err.	z	P> z
Sex	0.0046185	0.00734	0.63	0.529
Age	-0.000538	0.00117	-0.46	0.645
Agesquared	7.25e-06	0.00001	0.59	0.554
Primary Education	0.0332332**	0.01415	2.35	0.019
Secondary Education	0.0292093***	0.00735	3.97	0.000
Tertiary Education	0.0430183***	0.00578	7.44	0.000
Marital Status	0.0331591***	0.00766	4.33	0.000
Phone Ownership	0.050153***	0.00869	-5.77	0.000
Low income	-0.1998951***	0.01344	-14.87	0.000
Middle income	-0.0611292***	0.00593	-10.30	0.000

*Signif. codes : 0' \*\*\*' 0.001' \*\*' 0.01' \*' 0.05' .0.1' 1*

The model deduced from table 8 is given below to four decimal points;

$$Y = -1.3610 + 0.0046X_1 - 0.0005X_2 + 0.0000X_3 + 0.0332X_4 + 0.0292X_5 + 0.0430X_6 + 0.0331X_7 + 0.0501X_8 - 0.1999X_9 - 0.061X_{10} \quad (46)$$

## 5 Conclusion and Recommendations

### 5.1 Conclusion

The study revealed the main determinants of credit access in rural areas are age, sex, education level, marital status, phone ownership and income. The study further revealed that age is not a significant factor in determining whether one is denied a loan or not. It also revealed that education is a key factor in determining whether one is denied a loan or not. This underpins the importance of education in rural areas. Additionally, the study revealed that education is also quite significant in the determination of a credit source. More educated individuals tend to go for formal sources of credit. Therefore, education plays a key role in the choice one makes when determining their preferred source of credit. The findings also showed that more men than women preferred accessing credit from formal sources. Married couples are also more inclined to take loans from all sources compared to single people. In addition to that, individuals with high income in rural areas were established to access credit from formal sources compared to those with low and middle income. The study also revealed that younger people in rural areas access credit from other formal sources which include mobile money and digital lending loans. The ownership of phones is a major determinant of the kind of credit one prefers, according to the study. It was revealed that persons with phones in rural areas preferred taking loans from other formal sources which under pins the importance of mobile phones in credit access.

### 5.2 Recommendation

It is the recommendation of the researcher that more focus should be put on impediments of credit access in rural areas based on the determinants identified in this paper.

### 5.3 Future Research

The study can be expanded to have a comparison among various counties inline with the 2010 constitutional dispensation. This will give a more personalised picture on the key determinants of access to credit within specific counties. It will also show which counties are lagging behind inters of credit access. Additionally, research can also be taken to investigate other socio-economic and demographic factors such access to roads and electricity.

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## Appendix 1

Appendix I, Detailed descriptions of the different credit sources as used in the study

Credit Source	Definition	Type of Institution
Formal	Financial services and products used through prudentially regulated and supervised financial Government Agency including CBK, CMA, IRA, RBA and SASRA	Commercial banks including mobile phone bank products offered by banks in partnership with MNOs such as KCB M-PESA MCo-op Cash, M-Shwari, Eazzy loan, Timiza and HF Whizz Microfinance banks including mobile banking products offered by microfinance banks Insurance service providers Deposit Taking SACCOs Capital markets intermediaries
Formal Others	Financial services and products offered through service providers that are subject to non-prudential regulation and supervision (oversight) by Government Ministries/Departments with focused legislations. Financial services and products offered through providers that are legally registered legal persons and/ or operate through direct Government interventions	Mobile Money, Postbank, NSSF, NHIF, Credit only microfinance institutions (MFIs), Non-deposit taking SACCOs, Hire purchase companies, Development financial institutions (DFIs) e.g. AFC, HELB, ICDC & JLB, Mobile Money Apps/ Digital Apps
Informal	Financial services offered through different forms not subject to regulation, but have a relatively well-defined organizational structure	Groups e.g. ASCAs, chamas & ROSCAs, Shopkeepers/supply chain credit, Employers, Moneylenders/shylocks
Excluded	Individuals who reported using financial services and products only through family, friends, neighbours or keep money in secret, places or not using any form of financial service	Social networks and individual arrangements (e.g. secret hiding place)

**Figure 5. Classification and Description of Access to Credit**



## Appendix 2

Appendix II, Outlines the names of variables used in this paper

**Table 9. Variable descriptions**

<b>Variable Symbol</b>	<b>Variable Name</b>
$X_1$	Sex
$X_2$	Age
$X_3$	Age Squared
$X_4$	Primary Education
$X_5$	Secondary Education
$X_6$	Tertiary Education
$X_7$	Marital Status
$X_8$	Phone Ownership
$X_9$	Low income
$X_{10}$	Middle income