Financial and Digital Inclusion: Determining Factors Influencing Use of Financial Products with Regression

MSc Research Project
FinTech

Similoluwa Kenku
Student ID: X18113079

School of Computing
National College of Ireland

Supervisor: Noel Cosgrave

National College of Ireland
Project Submission Sheet
School of Computing

Student Name:	Similoluwa Kenku
Student ID:	X18113079
Programme:	FinTech
Year:	2019
Module:	MSc Research Project
Supervisor:	Noel Cosgrave
Submission Due Date:	12/08/2019
Project Title:	Financial and Digital Inclusion: Determining Factors Influencing Use of Financial Products with Regression
Word Count:	7000
Page Count:	21

I hereby certify that the information contained in this (my submission) is information pertaining to research I conducted for this project. All information other than my own contribution will be fully referenced and listed in the relevant bibliography section at the rear of the project.

ALL internet material must be referenced in the bibliography section. Students are required to use the Referencing Standard specified in the report template. To use other author's written or electronic work is illegal (plagiarism) and may result in disciplinary action.

Signature:	
Date:	16th September 2019

PLEASE READ THE FOLLOWING INSTRUCTIONS AND CHECKLIST:

Attach a completed copy of this sheet to each project (including multiple copies).	☐
Attach a Moodle submission receipt of the online project submission, to each project (including multiple copies).	☐
You must ensure that you retain a HARD COPY of the project, both for your own reference and in case a project is lost or mislaid. It is not sufficient to keep a copy on computer.	☐

Assignments that are submitted to the Programme Coordinator office must be placed into the assignment box located outside the office.

Office Use Only	
Signature:	
Date:	
Penalty Applied (if applicable):	

Financial and Digital Inclusion: Determining Factors Influencing Use of Financial Products with Regression

Similoluwa Kenku
X18113079

Abstract

This study aims to analyse what factors influence men and womens decision to use financial products and services. For this paper, we decide to select indicators of financial inclusion based on the review of extensive literature and recommendations of researchers. The motivation behind the selection of this research is due to the unchanging gender gap in access to finance. Since the release of first Findex Database in 2011, the gender gap has remained stagnant. Women are less included than men and this gender gap is more concentrated in low-income economies as well as lower middle-income economies. The data used for this analysis is the Global Findex Database prepared by the World Bank in conjunction with Gallup World Poll which contains over 100 indicators on peoples perspective and use of financial products and services. The data is disaggregated by gender and it measures how men and women use financial products and services. The methodology followed the KDD technique and we applied the Multivariate Linear Regression Model to the data. The findings from the data revealed certain similarities in the factors influencing men and womens decision to use financial products such as Savings and saving for farm and business. These are important factors men and women consider when they decide to use a bank account or a mobile banking service (mobile money). Keywords: Financial Inclusion, Mobile money, Accounts, Multiple linear regression

1 Introduction

Financial Inclusion has been researched theoretically by Government agencies, World Bank, International Monetary Fund (IMF) and other organisations invested in expanding equal access to formal finance across the world for all adults, especially in low-income economies (Yorulmaz; 2018). Financial inclusion can be described as banking the unbanked or serving the underserved. It entails efforts made or carried out to expand access to financial products and services to disadvantaged groups at affordable rates to improve their economic and financial freedom (Vivek and Maheswari; 2016). Statistics and empirical studies have shown and proven that a gender gap exists in financial inclusion especially after the release of the Findex database by the World Bank. Globally, 72 percent of men have access to bank accounts while just 65 percent of women have access to bank accounts, the gender gap has remained unchanged since the first data was released in 2011. The disparity is pronounced in low-income or developing economies where 67 percent of men and 58 percent of women have access to bank accounts (Demirguc-Kunt et al.; 2017). Furthermore, recent research carried out on 18 countries show that men represent 65 percent of customers, they have access to 80 percent of loans and 75 percent of deposits (Robino et al.; 2018). Access to financial institution accounts and mobile money services can help families manage and prevent economic crises which may push them into poverty (Evans; 2018). The factors influencing the gender gap include but are not limited to gender discrimination, distance to financial institutions, lack of identification, cultural and societal norms, illiteracy, lack of funds, voluntary exclusion and use of a family members account etc. Furthermore, Banks are not willing to relax on their account ownership requirements and transaction charges to help formally include the unbanked into the system and this is detrimental because many of these women live in poverty with no solid means of income. A lot of banks want to make a profit and developing products and services that target these group of people means lessening the expectations of making a substantial amount of profit (Gabor and Brooks; 2017). In Nigeria as of July 2018, 51 percent of men were banked and 27 percent of women were banked while 49 percent of men were unbanked and 73 percent of women were unbanked. These figures show a staggering gender gap which was reported by the world bank as a 14 percent gap between men and womens use of bank accounts (Lewis and West; 2017). Digital Financial services through Mobile Money (MM) has emerged to include the disadvantaged, they can use MM to save, make transactions and own accounts without going through the rigorous process of traditional financial institutions. Greater inclusion of women demands addressing the specific barriers women face in access to the demand (customer side) and supply-side (financial services providers) of finance. Financial inclusion is crucial because it helps people save money for emergencies and events that could push them into poverty, get loans to start up a business which ultimately leads to their overall wellbeing, economic development and growth Ramakrishna and Trivedi (2018). It is imperative for Financial Institutions and Mobile money agents to understand the factors that motivate individuals to own a bank account in order for them to tailor products that serve unbanked customers.

1.1 Research Question and Objectives

Can the factors influencing decision to use financial products be identified by machine learning?

- To highlight the factors influencing women and mens decision to own mobile bank accounts.
- To highlight the factors influencing women and mens decision to own a bank account.

2 Related Work

Financial Inclusion of women means ensuring that equal access to formal finance is available for each gender without discrimination or barriers hindering female inclusion in the financial system (Demirguc-Kunt et al.; 2013). Previous literature has highlighted the importance of creating an inclusive formal financial system for women. Due to the rise of Financial Technology (FinTech), alternative means of providing financial products and services to the unbanked have been embraced, initially, Microfinance institutions (MFIs) were used by Governments to curb financial inclusion which led to the decrease in unbanked adults, but the efforts were not enough to include women due to distance, banking requirements, illiteracy and other factors such as cultural norms, social norms and discrimination against women specifically in low-income economies etc (Sahay et al.; 2015). This gave rise to mobile money which has succeeded to an extent in curbing financial exclusion in countries such as Kenya with the M-PESA mobile money service and the efforts of the Indian Government to include adults through the introduction of the Biometric identification (Aadhar), but the policy introduced by the Indian Government was not without issues because after opening the accounts with the ID, the accounts still lay dormant and unused. Researchers have highlighted the significant macroeconomic benefits of financial inclusion, thereby motivating an in-depth analysis of the drivers of financial access. Owning bank accounts increases individual savings, empowers females, increases investment productivity and income for the poor (Zins and Weill; 2016).

2.1 Literature Review

Ghosh and Vinod (2017) applied multivariate regression model on All India Debt and Investment Survey (AIDIS) data to analyse whether gender matters for financial inclusion and assuming that is the case, what are the potential reasons that impact the relationship, they went further to analyse the link between gender and finance. Their results showed a significant gender disparity in access to and use of finance. The growing literature on financial inclusion highlighted the benefits of a financial inclusive system for all members of an economy. Financial inclusion lacks concrete data specifically the demand-side data segregated by gender which allows for an adequate measure of financial inclusion. Evans (2018) applied FMOLS approach and Granger Causality on world bank dataset to carry out analysis on 44 African countries to test the potentials and effects of digital finance on financial inclusion. The author discovered that there is a positive relationship between financial inclusion and technology (Internet and mobile phones). The authors analysed the drivers of the gender gap in financial inclusion in Nigeria using Fairlie decomposition technique and Binary Probit model on the 2011 Global Findex database. The results from the decomposition technique proved that a significant gender gap exists in financial inclusion, they went further to state that male-headed households are favoured in access to finance while education and income also contribute to the gender disparity (Abdu et al.; 2015). Taufeeque et al. (2017) examined the relationship between telecommunication on financial inclusion in rural India with Structural Equation Modelling. Data utilised was collected from a village on two dimensions: telecoms and financial inclusion. The results showed a positive impact between telecommunication and financial inclusion. Fanta (2016) analysed gender in financial inclusion for the Southern Africa Development Community (SADC) countries using survey data from the FinScope consumer surveys. The results showed that the gender gap exists in SADC countries with the highest financial inclusion with women using someones bank account and gender gap persisting in account usage compared to account ownership. In Uganda, Malawi and Chile, the impact of expanding access to financial institution account over two years is tested. The survey data results showed that average monthly deposits in the accounts were not impressive and more policies have to be developed to expand access beyond basic bank accounts (Dupas et al.; 2018).

In contrast, Fanta and Makina (2017) analysed the unplanned penalties of financial inclusion in the form of indebtedness and its link with poverty by analysing survey data on 15 African countries. T-test, Cramers V test and binary logistic regression are utilised by the author and results showed that over-indebtedness can be caused by cross-borrowing and lack of financial literacy, it can be eradicated by improved income and employment. The author also observed that indebtedness can worsen poverty. Ramakrishna and Trivedi (2018) analysed the demand side perception of respondents to classify the causes of financial inclusion and exclusion using Exploratory Factor Analysis and Confirmatory Factor Analysis. Vivek and Maheswari (2016) attempted to uncover financial inclusion with a chi-square test by analysing the barriers to womens financial inclusion. The study carried out a survey on a sample of 550 respondents in 110 villages in a rural village in India which were used as primary data and secondary data was pulled from other sources. This study by (Alfred Ouma et al.; 2017) attempted to analyse the relationship between mobile money and financial inclusion by examining if mobile money has helped increase mobile savings in selected Sub-Saharan Africa countries. Results showed a positive relationship and it also highlighted that access to mobile money increases savings at the household level. Zins and Weill (2016) studied factors that determine financial inclusion in Africa using the World Banks Global Findex data. Probit estimations were carried out on 37 selected African countries, results showed that financial inclusion favours men, the wealthy and is influenced by education and income. It was also discovered Mobile money is also influenced by the same determinants. The authors of the study used macroeconomic country characteristics and micro-level data for 140 countries to examine what drives the financial inclusion of women across numerous countries. Results showed a negative relationship between being female and financial inclusion as highlighted in previous studies. The analysis also showed legal discrimination of women, lack of protection from harassment and other gender discrimination factors contribute to the exclusion of women. They also discovered that macro-economic factors such as financial development, policies and resource richness are significantly related to financial inclusion. This study observed and assessed the financial inclusion stand of various countries by utilising the International Monetary Funds (IMF) Financial Access Survey (FAS) data to generate a new composite index of financial inclusion. The analysis was carried out because the authors believed a robust measurement of financial inclusion is still outstanding. Factor analysis is used to form a weighting methodology. Upon conclusion of the factor analysis, the composite index provided the authors as a source for ranking the countries. It is important to note that the FAS dataset is the supply side of financial inclusion i.e. the financial outreach measures of financial institutions in every country (Mialou and Amidzic; 2017).

The authors examined the influence of womens land ownership position on their financial inclusion in emerging countries. The study used data from the World Banks Global Findex data and Social Development Index. The analysis was carried out using limited information maximum likelihood to establish a relationship between the use of financial services and womens land ownership variables. The results showed that there is a substantial influence on womens land ownership on their use and demand for financial services. The authors went further to state that women are more likely to get credit (loan) if they are backed by a male member of the family and regardless of their wealth status, they are deprived of credit if they do not own land. The findings also showed that women who have a higher wealth status are more active in applying for credit (Arasu et al.; 2018). Ajide (2017)examines the determinants of financial inclusion in 18 Sub-Saharan Africa (SSA) with a focus on the influence of institutional infrastructure. The author specifically accounted for the roles of institutions in panel data using a dynamic system of Generalized Method of Moments (SYS-GMM). The results showed that institutions with GDP, inflation, bank concentration and z-score are key drivers of financial inclusion. Behl and Pal (2016) analysed the barriers towards mobile financial inclusion in India. The authors developed a relationship between users perception and the degree of usage of mobile banking and studied the barriers associated with using mobile banking. The authors used the Technology Acceptance Model (TAM), Structural Equation Modelling (SEM) and Confirmatory Factor Analysis. The results indicated that perception plays an important role in the usage of mobile financial services. In contrast, Klapper and Singer (2018) measured financial inclusion from the viewpoint of users of financial services. The authors provided the overview of sources of financial inclusion indicators and stated the importance of getting measures of users of financial services perspective. The authors used insights from the Global Findex data to support their stand. Wang'oo (2013) examined financial inclusion and economic development in Kenya. The author established a relationship between financial inclusion and economic development with United Nations Development Programme (UNDP), International Monetary Fund (IMF) and Financial Access Surveys (FAS) using a descriptive statistical approach, regression and correlation analysis. Evans and Alenoghena (2017) substantiated this by measuring Financial inclusion and GDP per capita in Africa using Bayesian VAR Model. They applied the model to 15 African countries over 2005-2014. Their findings showed that GDP per capita has a significant impact on financial inclusion, proving that an increase in GDP can be used to drive required financial inclusion in Africa.

This author, in contrast, wrote on the positive impact technology has on financial inclusion. He agreed that digital finance (mobile money) offers the chance to profile the disadvantaged in financial services, ease payments, make transaction charges cheap and generally deliver financial services to the financially excluded people (Peric; 2015). Arun and Kamath (2015) provide a global and regional perspective on the practices and guidelines of financial inclusion using macroeconomic data. The results show a diversity in the efforts towards attaining financial inclusion and the need for a progressive method in financial inclusion. Willams (2019) sought to determine the factors and combinations drive people to choose a financial service provider using factor analysis and logistic regression to the importance of factors people consider before choosing a financial service provider. The author also went further by using choice-based conjoint analysis to carry out an exploratory study to identify banking features users find most appealing. Results showed that Results from the first study suggest that a customers choice of banks, credit/debit cards, online lending, and the US Postal Service for financial services are related with a preference for convenience while trust and apparent cost drives the choice of street alternative financial service providers. In the second study, results from the choice-based conjoint analysis propose that fees are significantly more imperative than convenience and level of customer contact across all categorical variables (age, gender, race/ethnicity, employment, income, and education). Furthermore, physical customer service is considered more important than convenience. Chu (2019) employed Probit on the 2017 Global Findex data to examine what determines financial inclusion in high, middle and low-income countries. The measures of financial inclusion selected for the analysis are account, payment, savings and borrowing. The results also show that being a man, education level, employment status, wealth status (income level) and older age increases access to financial services. The results for the income level showed that education and income impact savings and borrowing specifically in high-income economies and low in disadvantaged economies. The reverse is the case for formal accounts and payments. The authors are in support of the view that the exchange of formal and informal credit depends on income level for high-income and middle-income countries. In contrast, (Kofi-Osei; 2018), examined the gender disparity in the performance of Small Medium Enterprises (SMEs) in Ghana and how the gender gap in financial inclusion contributes and affects SMEs. The analysis is conducted on 1225 SMEs captured in the 2015 Gender and Enterprise Development in Africa survey using Unconditional Quantile Decomposition Technique, the studies also reveal statistically significant gender gaps at the selected quantiles. The author concluded that being financially included improves SMEs performance across Ghana.

Alhassan (2019) also investigated the barriers and determinants to financial inclusion in the Middle East and African countries using Global Findex data for 2011, 2014 and 2017. Data were also drawn from World Governance Indicators, World Development Indicators and international telecommunication union. The author examined how political instability affects financial inclusion in the Middle East and North Africa (MENA) using Probit model and results showed that political instability positively correlates with lower degrees of financial inclusion which means that political instability can lead to financial exclusion. The results also showed that higher income and higher education relate to higher financial inclusion. The author also tested for the adoption of mobile money in relation to regulation and electricity supply by using TAM and SEM to conduct the analysis, results showed that available electricity is important for mobile phones and mobile money adoption. In addition, permitting regulation also shows a correlation with peoples intention to accept and utilise mobile money services. However rural dwelling negatively correlates with peoples intentions to accept and use mobile money due to limited network coverage and epileptic power supply. Akudugu (2013) used logit models to examine the determinants of financial inclusion in West African countries with a focus on Ghana. The author used data collected from 1000 adults and it included individuals in different locations, with different income levels occupations and gender etc. The results showed that only two out of five adults are financially included in the formal sector. In addition, the author also stipulated that age of individuals, wealth status, literacy, documentation, poverty and lack of trust in financial institutions are significant determinants of financial inclusion in Ghana. The findings in this section substantiate every research carried out on general financial inclusion and financial inclusion of women. The results have shown that a gender disparity persists in the use of and access to finance as well as poor financial inclusion strategies in low-income economies. In addition, it also substantiates that women are still discriminated and prevented from being independent and having a source of income. The outstanding factor is that machine learning has not been applied to any datasets utilised for the analysis carried out by several researchers.

3 Methodology

The proposed methodology approach is the Knowledge Discovery in Databases (KDD). KDD is a process used to obtain knowledge by applying specified measures to extract information or knowledge from a database with any required cleaning, pre-processing and transformation stages (Azevedo and Filipe Santos; 2008). The KDD comprises of five stages, how the stages will be applied in this research are listed below:

- Selection: This is the first stage in the KDD process, this will entail us selecting the dataset to be used for this research. This stage also entails getting to understand what the authors goals are for the data and what information or knowledge need to be extracted. The dataset selected is the Global Findex Database which is the Worlds most comprehensive data on financial inclusion. The data has over 778 indicators (features) on financial inclusion, it covers 3 years (2011, 2014 and 2017) with 494 observations. It is a cross-sectional panel dataset represented in percentages. The data is prepared by the World bank with survey questions which aim to understand how customers use or perceive financial products and factors that determine their use of financial products and services.

- Preprocessing: As per this thesis, this stage will entail exploratory data analysis such as checking for missing data, skewness, structure, summary etc. This stage also involves imputation strategies, decision to remove or leave outliers if appropriate. Normalization or standardization measures will be undertaken and applied to the data if not normally distributed. This stage is basically checking to see how the data looks and what kind of data it is.

- Transformation: Data transformation entails finding useful indicator (features) in the data to include in the analysis, which depends on the goal of the researcher, application of transformation methods to extract useful variables in the data which will be based on previous indexes formulated by past researchers on the measure of financial inclusion. The transformation will also entail changing the variable names because the current names for each variable are too long and this could hinder imputation and model application strategies.

- Data Mining: This stage will entail the application of a proper analytical method to achieve the stated objectives of this research. The model selected for this research is the multivariate linear model. We will choose to adopt this model based on past research on Financial inclusion and how it has been successful in analysing determinants and factors influencing financial inclusion. The difference in the approach for this thesis is that many of these researchers analysed the general gender gap and they controlled for categorical dummy variables (Gender, education, Age etc). Probit estimations would have been used but there are no dummy variables and efforts to include a dummy coded variable in the dataset had no effect. From studies carried out on past research, we discovered that the researchers carried out surveys to get information on their dummy variables, and due to time limit and limitations, it wasnt possible for us to carry out a survey to ensure that dummy coded variables are included in the dataset.

- Interpretation/Evaluation: This stage entails the interpretation and evaluation of results and knowledge gotten from the mined data. The results extracted from this analysis will be presented in a table to show a comparison between both genders.

Global Findex Database: This is the worlds most comprehensive database on financial inclusion with indicators measuring how individuals across the world use and access financial products and services. The data is collected every 3 years (2011, 2014, 2017) with surveys and questionnaire. It is a cross-sectional dataset with 448 observations and 778 features prepared by the World Bank in conjunction with World Gallup Poll. The World Gallup Poll prepares the questions included in the questionnaire to measure financial access. [1]

Multivariate Linear Regression: Also known as multiple linear regression, it is an analytical method used to explore, determine and predict the relationship between an

[1] https://globalfindex.worldbank.org/data$_{s}ec_{f}ocus$

outcome variable (target or dependent) and a number of independent variables also known as predictors or regressors. The predictors may be categorical or continuous as encoded. [2]

4 Implementation

Data cleaning and engineering were done with R studio. The Knowledge Discovery in Databases (KDD) methodology was adopted. Due to the large amounts of missing values, mere mean or median imputation would not have sufficed. Thus, the Multivariate Imputation by Chained Equation (MICE) package was used for imputing missing values. This automatic imputation by machine learning guarantees a high level of precision in completing for missing data. From the large dataset, subsets were selected and taken with respect to the desired analysis. The imputation technique mentioned above was implemented in each subset. The selection of variables for the mobile banking analysis based on the factors influencing the need for a mobile bank account for each gender: being able to make and/or receive digital payment, own a debit or credit card, make internet payments or purchases, were intuitively included as evidences in the research papers and journals strongly corroborate this (Morsy and Youssef; 2015) (Delechat et al.; 2018). Furthermore, for the analysis of the factors determining the choice of having an account at a financial institution, the same strategy adopted for mobile banking variable selection was implemented. It is normal practice in Regression to standardize or normalize the data, The summary statistics for the data showed that it is standardized between the figures of 0 and 1. Applying standardization techniques such as range and BoxCox either created NAs or made no changes at all on the variables. A correlation matrix was generated to check the strength of the relationship amongst variables with the pairs. panels plot. The matrix which was generated for each subset of the entire data gives an indication of multicollinearity, especially among regressors. It is not good practice including independent variables that are perfectly correlated (correlation value of 1) in the model without transforming them, doing this may not introduce bias but may render significant parameters insignificant. The reason is due to inflated variances which in turn produce trivial t-values or z-values [3]. The data used for this study definitely has correlated variables because its a survey data, some of the sample population live in the same household and vicinity (community) which will cause responses to be related. The selected datasets were each partitioned into training and testing datasets. The training dataset was used in determining the coefficients of the factors of the model built. The testing dataset was used to validate the output from the training dataset. The partition was on an 80:20 basis. 80 per cent training and 20 per cent testing. Following previous research and based on how successful the model was, as per (Ghosh and Vinod 2017) and (Kunt, Klapper and Singer, 2013), we employ the Multivariate Linear Regression to explore what factors determine men and womens decision to own bank accounts and mobile money accounts. This permits us to express a dependent variable as a linear combination of regressors that influence its outcome. The p-value which gives the level of significance of each regressor included in the model is attached to their level of significance. This gives us the statistic for detecting factors with more influence in a specific sex groups disposition to adopting a financial service. The R-squared (coefficient

[2] https://www.statisticssolutions.com/what-is-multiple-linear-regression/

[3] https://statisticsbyjim.com/regression/multicollinearity-in-regression-analysis/

of determination) value which reveals the proportion of the variability in the dependent variables that are explained by the regressors is another measure of efficiency or accuracy. To ensure we capture the full knowledge from the data, two models were built on each subset of the data (before and after applying stepwise). The result for determinants of mobile banking remained the same before and after testing for multicollinearity while the result for determinants of owning a financial institution changed. The stepwise rendered important parameters insignificant and the R squared as low as 0.6. A plot of the models was included to highlight normality and absence of heteroskedasticity (the deviation from constant variance). The missing values visualization is shown below in Figure 1 andix for mobile banking female variables is shown in figure 2 below and figure 3 shows the residual plots for mobile banking of male accounts.

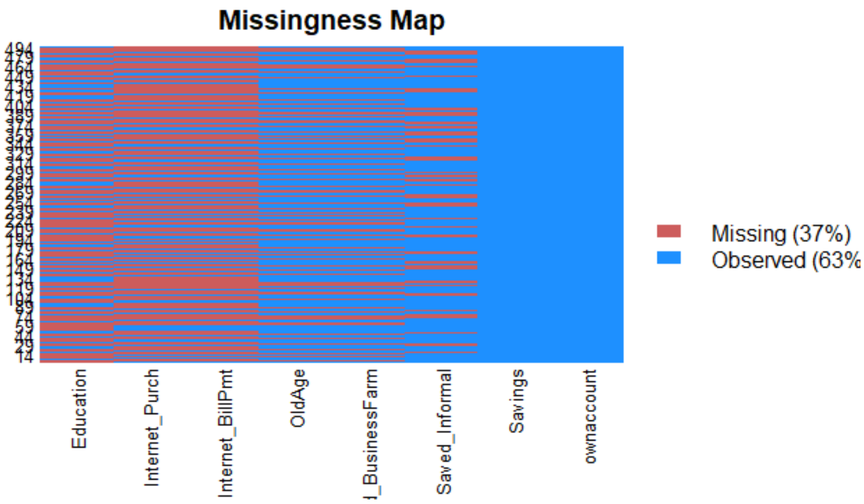

Figure 1: missingness map

5 Evaluation

Determinants of Mobile Banking

From the extensive literature review such as (Morsy and Youssef, 2017), it was discovered that the need to make and receive digital payments, own a credit or debit card, internet bill and purchase payments are important factors that influence the need to have a mobile bank account. On that premise, a linear regression accommodating the aforementioned factors was created.

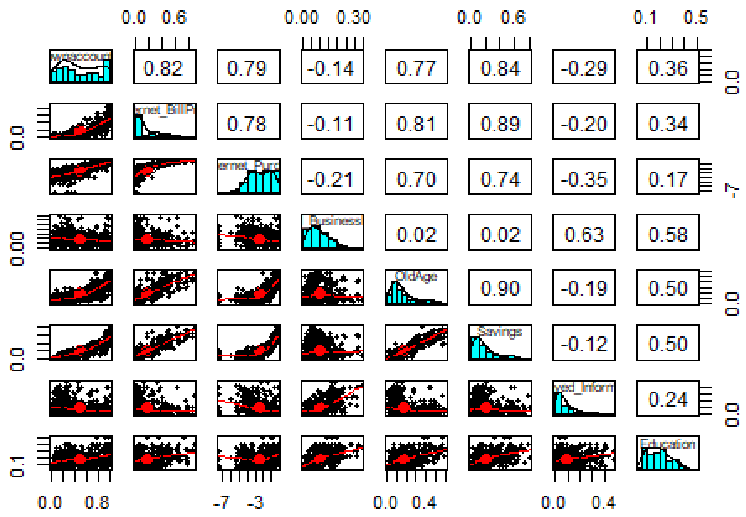

Figure 2: female mobile banking corr plot

Table 1: Linear Regressors

Variable	Description
mobileacct	proportion of females who own a mobile account
receiveddigital	proportion of females that received digital payment
madedigital	proportion of females that made digital payment
madeReceiveddig	proportion that made or received digital payments
owncreditcard	proportion that own a credit card
owndebitcard	proportion that own a debit card
internbill	proportion that made internet bill payment
internpurch	proportion that made internet purchase

5.1 Determinants of Mobile Banking for Adult Females

In attempting to understand the factors influencing people's decision in financial inclusion, with emphasis on mobile banking, the level of significance of the factors mentioned prior must be determined. The linear model is thus:

$$\hat{Y}_i = \hat{\beta}_0 + \hat{\beta}_1 X_i + \hat{\epsilon}_i \quad (1)$$

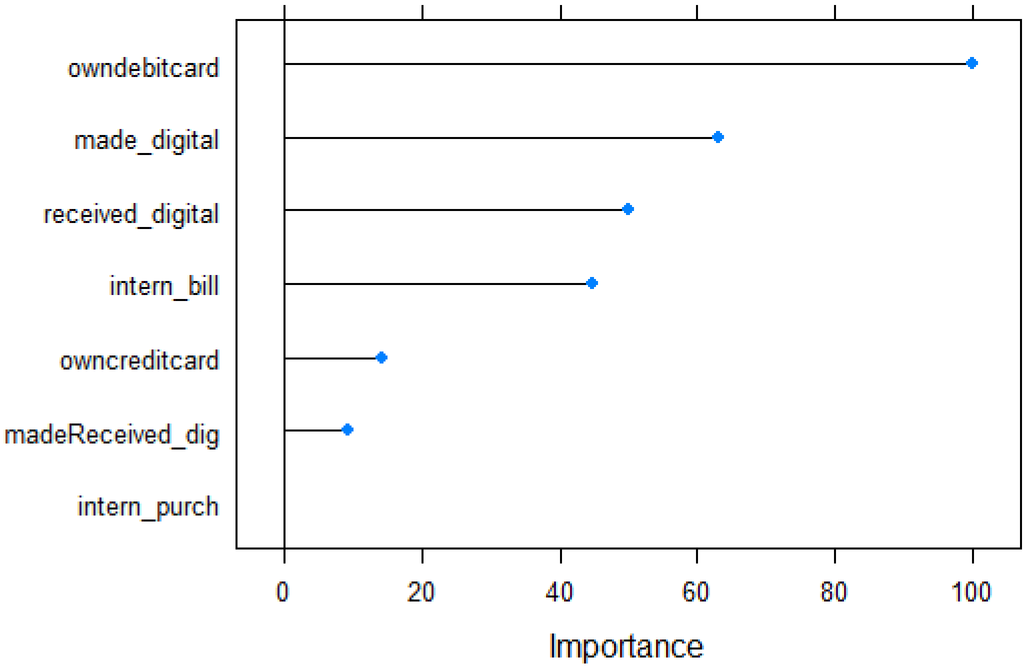

Figure 3: female importance for mobile banking

From the figure above, it can be stated that for the females, owning a debit card for easy transaction is a major factor in their decision to having a mobile bank account. In addition, the analysis from the data also shows that making internet purchase contributes nothing to womens choice of having a mobile bank account. I believe the data needs some reviewing. As expected, making and receiving digital payments are significant to having a mobile account, as well as internet bill payments. From the output above, considering the R squared value of 0.886 and Adjusted R-squared value of 0.884, we conclude that 88.40 per cent of the variability in the choice of obtaining a mobile bank account for the females is captured by the regressors in the model. Given the p-value, the model is extremely significant

5.2 Determinants of Mobile Banking for Adult Males

The linear model is given below:

$$\hat{Y}_i = \hat{\beta}_0 + \hat{\beta}_1 X_i + \hat{\epsilon}_i \tag{2}$$

The highest mean proportion indicates that 51.69 per cent of males either made or received digital payment. The lowest is the adoption rate of mobile accounts, which indicates that 15.99 per cent of males adopted mobile banking. This figure is higher than the 14.78 per cent adoption rate for females, thus the argument of gender inequality in financial inclusion.

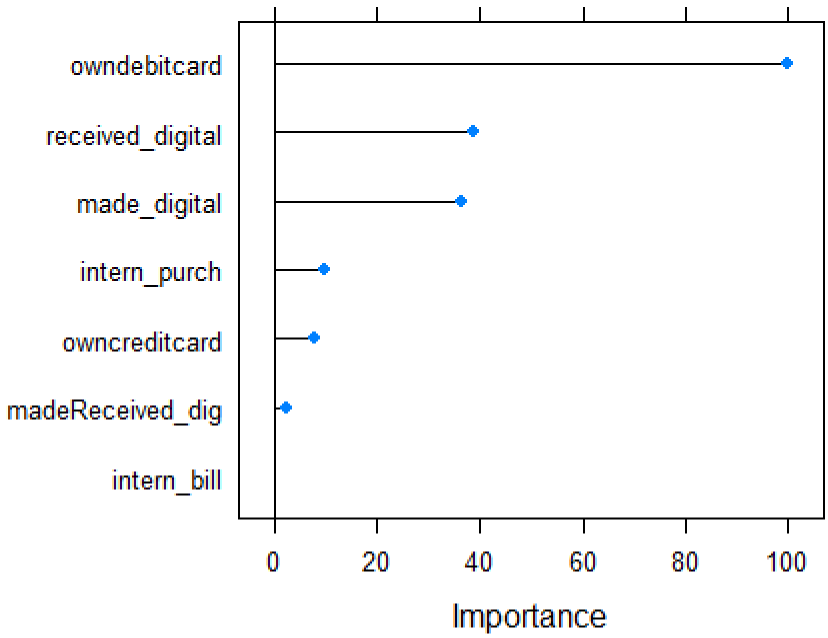

Figure 4: male importance for mobile banking

From the figure above, owning a debit card for transactions is a huge influence on the choice of adoption of mobile banking. This rate of influence for the males is proportionate to the females, thus owning a debit card has equal influence in both genders choice of the service. The second most significant factor for the males is the need to make digital payments, which has over 47 per cent influence. This figure is however low, compared to the over 60 per cent influence the need for making digital payments have in mobile banking for females. Making digital payments influences females more than males. Naturally, this is expected. Receiving digital payments, although more significant in the female model than the male, almost has a similar contribution to the decision of adoption. In a nutshell, men are more likely to adopt mobile banking than females for internet purchases and are less likely to adopt it due to owning a credit card or either making or receiving digital payments.

Table 2: R Squared Results for male and female

Mobile Banking	R Squared	Adjusted R Squared
Males	0.853	0.851
Females	0.886	0.884

From the output above, considering the R-squared value of 0.886 for the females and Adjusted R squared of 0.884, we conclude that 88.60 per cent of the variability in the choice of obtaining a mobile bank account for the females is captured by the regressors in the model, this is a relatively good result. Given the p-value, the model is extremely significant. Similarly, considering the R-squared value of 0.853 and Adjusted R squared of 0.851 for the males, we conclude that 85.30 per cent of the variability in the choice of obtaining a mobile bank account for the males is captured by the regressors in the model, this is also a relatively accurate model. Given the p-value, the model is extremely significant. Similarly, the result can be obtained by looking at the Residual Standard Errors generated from both the train and test dataset.

5.3 The decision to Own a Financial Institution Account (Adult Females)

As stated in the literature review, there are pertinent factors which influence a persons choice to have an account with a financial institution. Some factors have a greater influence on the decision-making process than others and the level of influence differ between the sexes. Here we look at some determinants and their level of significance. The analysis was carried out to test before and after carrying out forward stepwise regression to remove highly correlated variables. The figures below show before and after stepwise regression actions.

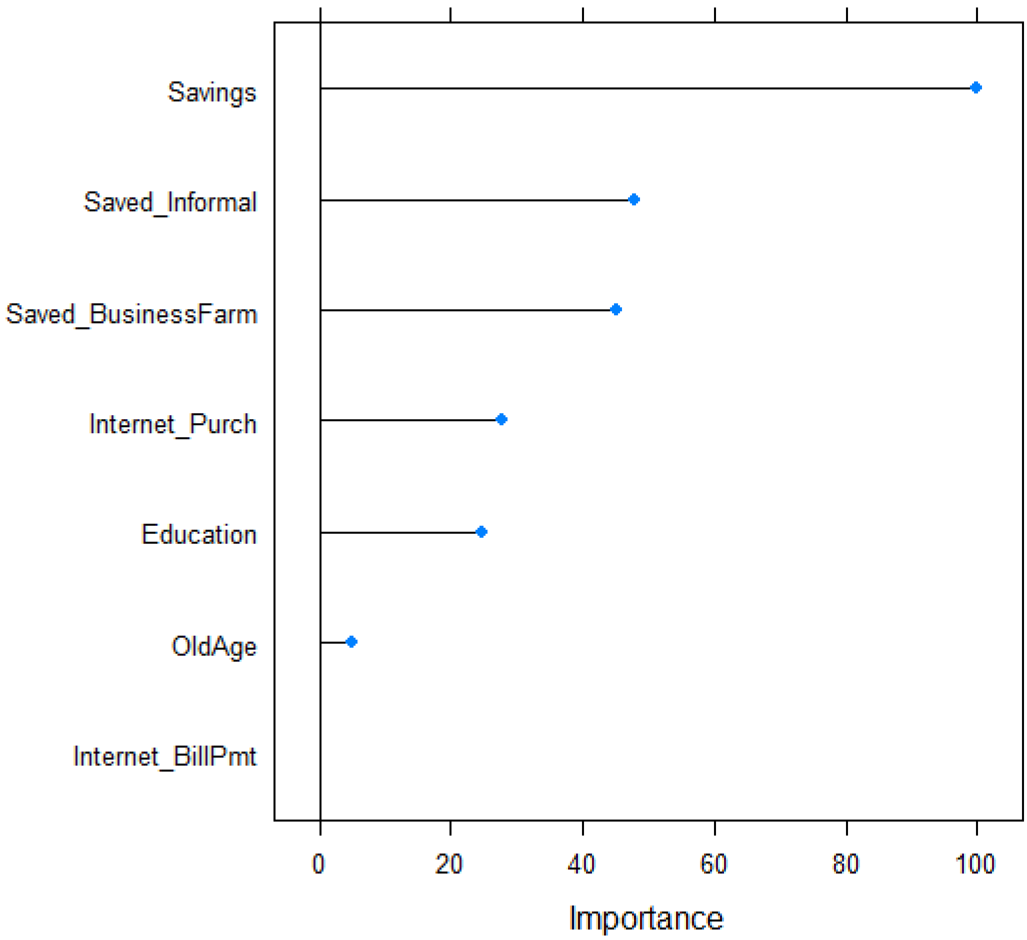

Figure 5: Female Importance before stepwise regression

From the figures above and below, formal savings is of higher significance, followed by saving for farm business, then by informal savings, internet bill payment, internet purchase, education and old age in that order. Formal savings has the same importance for both genders. Whereas males are more likely to have accounts at financial houses to enable them to save for a farm business, informal savings drive females more towards that direction. Although informal means of saving money has been providing alternative means of finance for women but women still crave the security of a financial institution account because these informal means of saving are not without its problems. For example, storing or saving money under a mattress can expose such notes to rodents, pests and robbers. Similarly local credit collectors known as Esusu are people who collect money locals who need to save funds, but many of these credit collectors abscond with hard earned funds. Females are more likely to have bank accounts for their educations than males and more likely to save for old age than males.

5.4 The decision to Own Financial Institution Account (Adult Males)

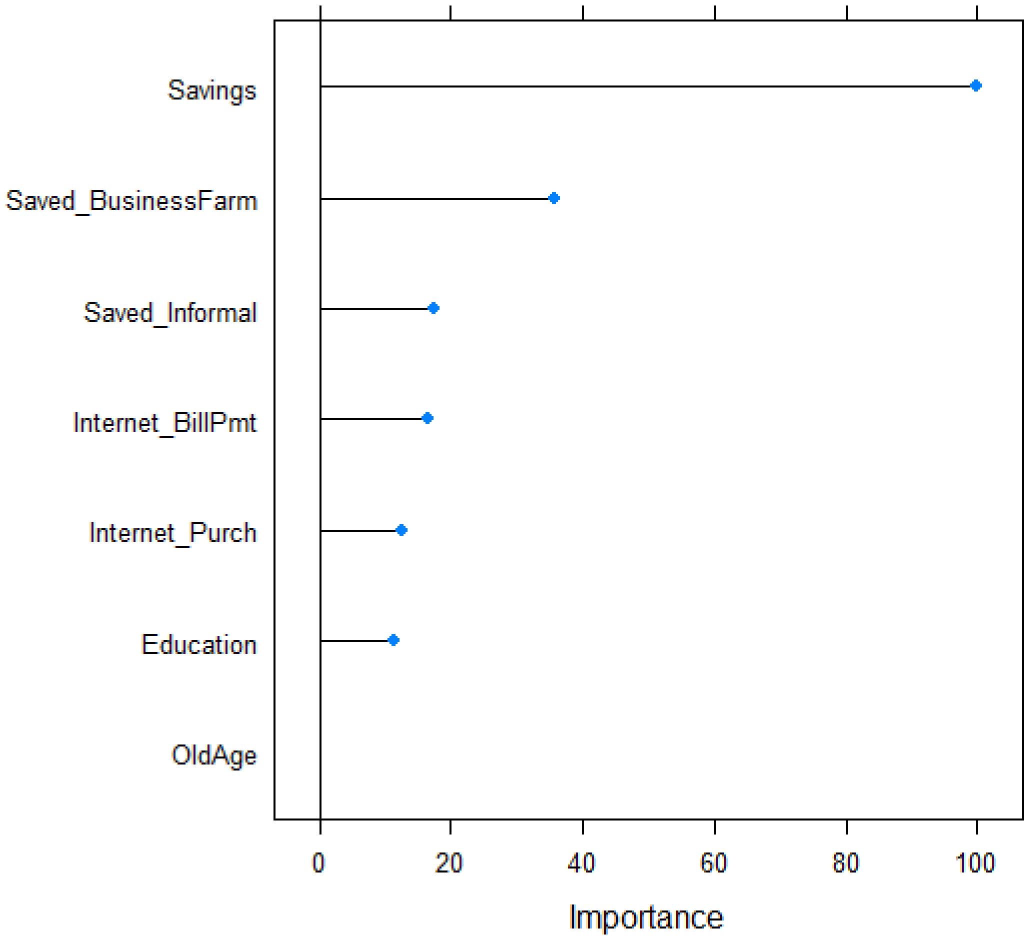

Figure 6: Male Importance before stepwise regression

The significance of the F-Statistic reveals that the model can correctly predict the dependent outcome with more than 99 per cent confidence level. Further, because of the relatively high R-squared values and the number of significant parameters, the models for both the males and females are valid for the prediction. With this, we conclude that 77.10 per cent of the variability in the womans choice to have a financial bank account is accounted for by the included independent variables in the model. In contrast, 74.4 per cent of this choice for men is explained by the independent variables. Going a step further, the training dataset for the females gave a Residual Standard Error (RSE) of 0.156, while the test showed 0.152. For the males, the train produced an RSE of 0.151 whilst 0.164 was generated by the test dataset. With these little differences, both datasets would have yielded a similar outcome. Thus, validating the output.

Table 3: R Squared Results for male and female

Financial Institution Account	R Squared	Adjusted R Squared
Males	0.749	0.744
Females	0.771	0.767

5.5 The decision to Own a Financial Institution Account after Stepwise (Adult Females)

As stated in the literature review, there are pertinent factors which influence a persons choice to have an account with a financial institution. Some factors have greater influence on the decision making process than others and the level of influence differ between the sexes. Here we look at some determinants and their level of significance after applying Stepwise Regression.

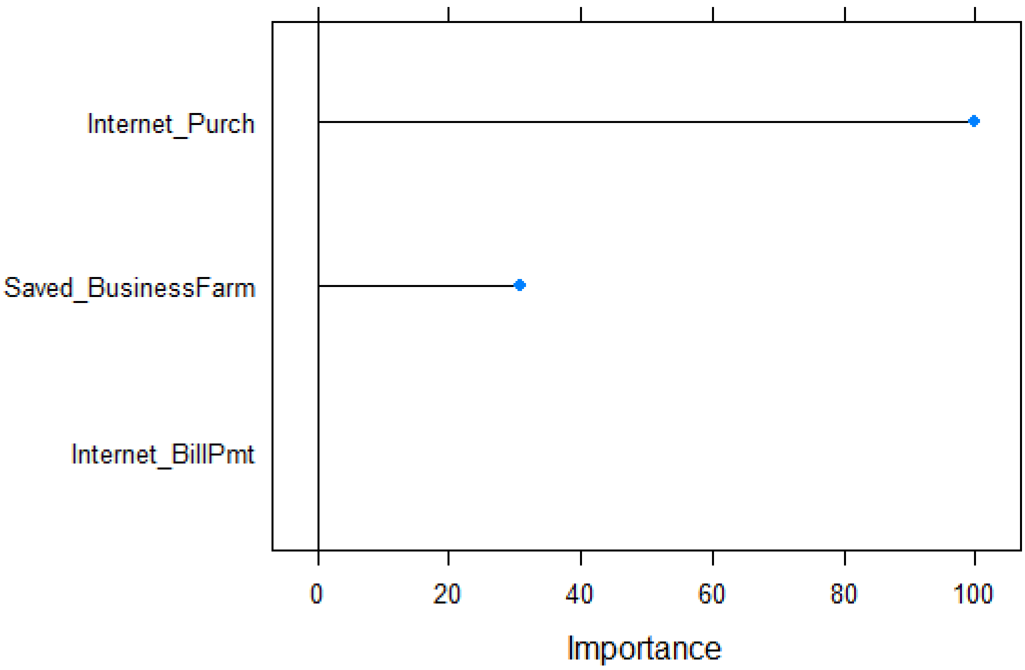

Figure 7: Female Importance after stepwise regression

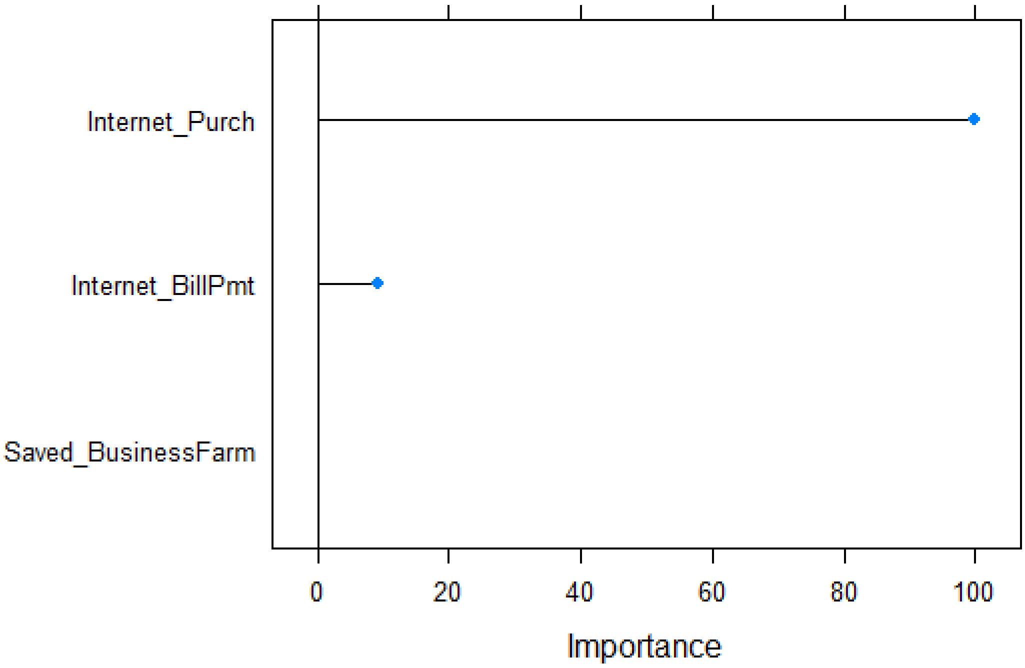

Figure 8: Male Importance after stepwise regression

From the figures above, men are more likely to own an account with a financial institution for the need to make internet bill payments than women. However, women are more likely to have said account for the need to save for a farm business than men are. The output above reveals that internet bill payment is more significant in the males model, every other factor has similar significance in both models. The significance of the F-Statistic reveals that the model can correctly predict the dependent outcome with more than 99 percent confidence level. Further, because of the relatively high R-squared values and the number of significant parameters, the models for both the males and females is valid for the prediction. With this, we conclude that 70.20 percent of the variability in the womans choice to have a financial bank account is accounted for by the included independent variables in the model. In contrast, 59.90 percent of this choice for the men is explained by the independent variables which is a big change from the value without stepwise. Going a step further, the train dataset for the females gave a Residual Standard Error (RSE) of 0.174, while the test showed 0.182. For the males, the train produced an RSE of 0.189 whilst 0.194 was generated by the test dataset. With these little differences, both datasets would have yielded similar outcome. Thus validating the output.

Table 4: R Square after stepwise regression

Financial Institution Account	R Squared	Adjusted R Squared
Males	0.602	0.599
Females	0.702	0.700

5.6 Discussion

From this research and experiments carried out, factors influencing men and women's decision to use finance are similar. Although, the factors and the rate of influence varies for men and women. From the findings we discovered that old age factor is quite low in comparison to other factors for owning a bank account, this can be attributed to the fact the variables used covered young people within the age group 15-35. In addition, the results also showed that mobile banking didn't change before and after applying stepwise due to collinearity, but the determinants for owning a financial institution account changed and the variables used to identify owndership of a bank account were not satisfactory and lastly, the R squared values reduced.

6 Conclusion and Future Work

The aim of this study was to determine what factors influence men and womens decision to have a mobile bank account and financial institution account. The model selected was able to identify, rate which is more important to men and women based on the parameters selected. This was done to understand what factors motivate them to use financial products and services, studies like this can help financial institutions and mobile money agents understand their customer, thereby creating products that target each customer. The reason for choosing this study is due to research carried out to explore the gender gap in access to and use of finance. From the results shown above, we can say that the model has identified some of the factors influencing each genders decision, the model worked better for the Mobile banking outcome and its parameters, while the decision to own a financial institution account was not satisfactory. This may be due to the parameters selected for the regression and the application of the stepwise to exclude related variables. Furthermore, the analysis may have worked better if a survey was carried out or if the researcher was able to access the Gallup World Poll responses document used by the researchers to apply this same model on their research problem. Suggestion for future work would be exploring how financial inclusion of women affects economic growth as well as the the quality and impact of digital finance on financial inclusion (how has it succeeded in providing products tailored to the disadvantaged specifically in low income economies). Finally, a recommended solution to the gender gap in access to financial services would be Mobile money applications and USSD code. Early adopters would be female farmers and small scale business owners who own mobile phones and USSD codes for those without smartphones. UI/UX design (this can be improved with a better technology) should be used to design the interface of the application because of it's simple graphical capabilities which makes it easier for women to navigate due to limited education. Furthermore, artificial intelligence can be infused into the application which can allow voice recognition and biometric identification, this will help users without identification, limited education and helps with ease of transaction. It also solves the issue of Know your customer and Anti Money Laundering regulation (KYC/AML).

7 Acknowledgement

I would like to acknowledge my Mom and Sister for their unending love and support during the course of this masters, i would also like to thank my supervisor Noel Cosgrave for his

advice and support during the course of this project, Lastly, I would like to appreciate Kate Honan for being a listening ear and great advisor on career choices.

7.1 Limitations

- Datasets used in this research is a cross-sectional panel dataset, they are commonly analysed with panel linear regression methods such as structural equation modelling, fixed and random effects model but the author decided to run multivariate regression since its a considered as a machine learning regression model and due to its success from applications by other researchers in this field.
- The author is aware of dummy variable inclusion in multiple linear regression, due to lack of survey document from Gallup World Poll and constraint that the data isn't binary, we couldn't run Probit estimations or encode dummy variable because the figures in the data are in percentages.
- Lastly, the data was gathered from sample population of people who live in the same household, community and family members which means there is bound to be relationships between variables due to how close people in the population are.

References

Abdu, M., , M., Buba, A., , A., , M. and , T. (2015). Drivers of financial inclusion and gender gap in nigeria, *The Empirical Econometrics and Quantitative Economics Letters* **4**: 186–199.

Ajide, K. B. (2017). Determinants of financial inclusion in sub-saharan africa countries: Does institutional infrastructure matter?, *CBN Journal of Applied Statistics* **8**(2): 69–89.
URL: *http://hdl.handle.net/10419/191705*

Akudugu, M. (2013). The determinants of financial inclusion in western africa: Insights from ghana, *Research Journal of Finance and Accounting* **4**: 1–9.

Alfred Ouma, S., Maureen Odongo, T. and Were, M. (2017). Mobile financial services and financial inclusion: Is it a boon for savings mobilization?, *Review of Development Finance* **7**.

Alhassan, A. (2019). Three essays on financial inclusion in Africa and the Middle East , `https://hdl.handle.net/10289/12616`. [Online; accessed 23 Jul 2019].

Arasu, B., Kuppusamy, T. and Natarajan, T. (2018). Financial inclusion and land ownership status of women, *International Journal of Development Issues* .

Arun, T. and Kamath, R. (2015). Financial inclusion: Policies and practices, *IIMB Management Review* **27**(4): 267 – 287.
URL: *http://www.sciencedirect.com/science/article/pii/S097038961500097X*

Azevedo, A. and Filipe Santos, M. (2008). Kdd, semma and crisp-dm: A parallel overview, pp. 182–185.

Behl, A. and Pal, A. (2016). Analysing the barriers towards sustainable financial inclusion using mobile banking in rural india, *Indian Journal of Science and Technology* **9**.

Chu, L. (2019). Determinants of financial inclusions: Comparing high, middle, and low-income countries, *SSRN Electronic Journal* .

Delechat, C., Newiak, M., Xu, R., Yang, F. and Aslan, G. (2018). What is driving women's financial inclusion across countries?, *IMF Working Papers* **18**: 1.

Demirguc-Kunt, A., F. Klapper, L. and Singer, D. (2013). Financial inclusion and legal discrimination against women: Evidence from developing countries.

Demirguc-Kunt, A., F. Klapper, L., Singer, D., Saniya, A. and Jake, H. (2017). *The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution*, The World Bank.
URL: *https://elibrary.worldbank.org/doi/abs/10.1596/978-1-4648-1259-0*

Dupas, P., Karlan, D., Robinson, J. and Ubfal, D. (2018). Banking the unbanked? evidence from three countries, *American Economic Journal: Applied Economics* **10**: 257–297.
URL: *10.1257/app.20160597*

Evans, O. (2018). Connecting the poor: the internet, mobile phones and financial inclusion in africa.
URL: *10.1108/DPRG-04-2018-0018*

Evans, O. and Alenoghena, R. (2017). Financial inclusion and gdp per capita in africa: A bayesian var model, *Journal of Economics and Sustainable Development* **8**: 2222–2855.

Fanta, A. (2016). Gender and financial inclusion: Analysis of financial inclusion of women in the sadc region.
URL: *10.13140/RG.2.1.1390.3605*

Fanta, A. and Makina, D. (2017). Unintended consequences of financial inclusion, pp. 231–256.

Gabor, D. and Brooks, S. (2017). The digital revolution in financial inclusion: international development in the fintech era, *New Political Economy* **22**(4): 423–436.
URL: *10.1080/13563467.2017.1259298*

Ghosh, S. and Vinod, D. (2017). What constrains financial inclusion for women? evidence from indian micro data, *World Development* **92**.
URL: *10.1016/j.worlddev.2016.11.011*

Klapper, L. and Singer, D. (2018). The role of demand-side data - measuring financial inclusion from the perspective of users of financial services, *in* B. for International Settlements (ed.), *The role of data in supporting financial inclusion policy*, Vol. 47 of *IFC Bulletins chapters*, Bank for International Settlements.
URL: *https://ideas.repec.org/h/bis/bisifc/47-17.html*

Kofi-Osei (2018). FINANCIAL INCLUSION AND FIRM PERFORMANCE IN GHANA: GENDER DIMENSION, `http://ugspace.ug.edu.gh/handle/123456789/30849`. [Online; accessed 13 Jun 2019].

Lewis, R., V. J. and West, D. (2017). THE 2017 BROOKINGS FINANCIAL AND DIGITAL INCLUSION PROJECT REPORT: Building a secure and inclusive global financial ecosystem., http://www.brookings.edu/FDIP. [Online; accessed 13 May 2019].

Mialou, A. and Amidzic, G. (2017). Assessing countries financial inclusion standing a new composite index, *Journal of Banking and Financial Economics* **2/2017**: 105–126.

Morsy, H. and Youssef, H. (2015). Access to finance: Mind the gender gap, *Working Papers 929*, Economic Research Forum.
URL: *https://EconPapers.repec.org/RePEc:erg:wpaper:929*

Peric, K. (2015). Digital financial inclusion, *Journal of Payments Strategy Systems* pp. 212–214.
URL: *https://www.ingentaconnect.com/content/hsp/jpss/2015/00000009/00000003/art00001*

Ramakrishna, S. and Trivedi, P. (2018). What Determines the Success of Financial Inclusion? An Empirical Analysis of Demand Side Factors, *Review of Economics & Finance* **14**: 98–112.
URL: *https://ideas.repec.org/a/bap/journl/180408.html*

Robino, C., Walbey, H., Villanueva, C., sachetti, F., M. L. a. V. C. and Marincioni, M. (2018). Financial Inclusion for Women: A Way Forward - G20 Insights. G20 Insights, https://www.g20-insights.org/policy_briefs/financial-inclusion-for-women-a-way-forward/#_ftn1. [Online; accessed 6 Jun 2019].

Sahay, R., Cihak, M., N'Diaye, P., Barajas, A., Mitra, S., Kyobe, A., Nian Mooi, Y. and Yousefi, S. R. (2015). Financial inclusion: Can it meet multiple macroeconomic goals?, *IMF Staff Discussion Note* **15**.
URL: *10.5089/9781513585154.006*

Taufeeque, A., Iqbal Siddiqui, K. and Kashif, I. (2017). Impact of telecommunication on financial inclusion in india: Using structural equation modeling, **7**: 40–54.

Vivek and Maheswari (2016). Empowering women: Uncovering financial inclusion barriers, *Advances in Social Sciences Research Journal* **3**(3): 182–205.
URL: *http://dx.doi.org/10.14738/assrj.33.1611*

Wang'oo, E. W. (2013). The relationship between financial inclusion and economic development in Kenya, http://hdl.handle.net/11295/63345. [Online; accessed 20 Jul 2019].

Willams, S. (2019). CLOSING THE FINANCIAL INCLUSION GAP BY UNDERSTANDING WHAT FACTORS DRIVE CONSUMER SELECTION OF FINANCIAL SERVICE PROVIDERS , https://search.proquest.com/openview/1ce61c1d263e3482e22c0866ef355460/1?pq-origsite=gscholar&cbl=18750&diss=y. [Online; accessed 20 Jul 2019].

Yorulmaz, R. (2018). An analysis of constructing global financial inclusion indices, *Borsa Istanbul Review* **18**(3): 248 – 258.
URL: *http://www.sciencedirect.com/science/article/pii/S2214845017300947*

Zins, A. and Weill, L. (2016). The determinants of financial inclusion in africa, *Review of Development Finance* **6**(1): 46 – 57.
URL: *http://www.sciencedirect.com/science/article/pii/S1879933716300549*