

**NEAR EAST UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
BANKING AND FINANCE
MASTER'S PROGRAMME**

MASTER'S THESIS

**MICROFINANCE AND POVERTY IN MALAWI, RWANDA AND
ZIMBABWE: EMPIRICAL FINDINGS FROM LOGISTIC AND PROBIT
REGRESSION**

PARDON MAKWARA

NICOSIA

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**Microfinance and Poverty in Malawi, Rwanda and Zimbabwe: Empirical Findings from
Logistic and Probit Regression**

**We certify the thesis is satisfactory for the award of degree of
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DECLARATION

I, Pardon Makwara, declare that the whole collection of work contained in this thesis has been acquired and presented as per scholarly principles and moral conduct; I am also the sole creator thereof (save to the degree unequivocally generally expressed), that regeneration by Near East University won't encroach any outsider rights and that I have not beforehand completely or to a limited extent submitted it for getting any qualification.

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ABSTRACT

The debates related to microfinance institutions' effect on poverty reduction still continue among many researchers. Therefore, this study was conducted in order to fill this gap in the literature. The probability of microfinance reaching to the poor in African developing countries that is the case of Malawi, Rwanda and Zimbabwe was investigated by using Binary Logistic and Probit Regression Models and performance of the models were compared. Also, in order to measure the dependency of the categorical/dichotomous dependent variable to the past data set, Autoregressive Models were used. The findings indicated that performance of Logistic Regression Model is better than Probit Model in Malawi and in Rwanda. In addition to this, we observed that microfinance institutions do not have direct effect to reduce the poverty in these countries.

Keywords: *Microfinance · Poverty · Logistic Regression · Probit Regression · Autoregressive Models.*

ÖZ

Mikrofinans kuruluşlarının yoksulluğu azaltma üzerine etkisi ile ilgili tartışmalar pek çok araştırmacı arasında hâlâ devam etmektedir. Bu nedenle, literatürdeki bu boşluğu doldurmak amacıyla bu çalışma yapılmıştır. Malavi, Ruanda ve Zimbabve gibi gelişmekte olan Afrika ülkelerinde mikrofinansın fakir halka erişme olasılığı İkili Lojistik ve Probit Regresyon Modelleri kullanarak araştırıldı ve modellerin performansı karşılaştırıldı. Ayrıca, kategorik/ikili bağımlı değişkenin geçmiş veri setine bağımlılığını ölçmek için otoregresif modeller kullanıldı. Bulgular Lojistik Regresyon Modeli' nin Ruanda ve Malavi de Probit Model' e göre daha iyi sonuçlar verdiğini gösterdi. Bununla birlikte, mikrofinans kuruluşlarının bu ülkelerdeki yoksulluğun azaltılmasında doğrudan bir etkisinin olmadığını gözlemledik..

Anahtar Kelimeler: Mikrofinans · Yoksulluk · Lojistik Regresyon · Probit Regresyon · Otoregresif modeller.

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LIST OF ABBREVIATIONS

A _{MFI} s:	Access to microfinances services
AMIR:	Association of Microfinance Institutions in Rwanda
BNR:	National Bank of Rwanda
DFID:	Department of International Development
IBM:	International Business Machines
MAMN:	Malawi Microfinance Network
MDGs:	Millennium Development Goals
MFI:	Microfinance Institutions
MIX:	Microfinance Information Exchange
NGOs:	Non-Governmental Organisations
RBM:	Reserve Bank of Malawi
RBZ:	Reserve Bank of Zimbabwe
SMEs:	Small to Medium Enterprises
SPSS:	Statistical Package for the Social Science
UN:	United Nations
UNDAF:	United Nations Development Assistance Framework
ZAMFI:	Zimbabwe Association of Microfinance Institutions
ZIMSTAT:	Zimbabwe National Statistics Agency

CHAPTER 1

INTRODUCTION

When dealing with Microfinance it is important to clarify the core difference and the main purpose of it to serve poor population in African developing countries as compared to World Bank. World Bank assistance is typically long-term, and its bank loans fund the projects that help an underdeveloped or unindustrialised market nation to make it productive economically. However, Microfinance is regarded as a form of commercial banking to the poor according to the Nobel laureate Muhammad Yunus. Poverty and underdevelopment have been the most vital challenges to mankind, which have led to develop methods to avert from their effects in many countries. Microfinance industry was emerged when it recognised that the poor be able to put into practice income producing activities to battle the effects of poverty Hulme and Arun (2009) [19]. Microfinance is the financial services that target the underprivileged low income individuals especially in developing countries with the view to reduce poverty levels Robinson (2001) [46]. Morduch (2000) [37] suggest that the idea of microfinance brought hope to the needy, he asserts that microfinance can be a viable tool to reduce poverty and improve the livelihoods of the low income households in African developing countries. Given the eagerness in his thoughts became an inspiration for our study to examine whether microfinance is a substantial method for poverty reduction in the selected countries, i.e. Zimbabwe, Malawi, and Rwanda.

Microfinance first became prominent in the 1970s, the best known beginning was in Bangladesh [39, 56]. According to Otero 1999 [41] the aim of microfinance is not only to distribute funds to low income households and to combat destitution at an individual level, it also has a role at an institutional level. Rosenberg and Littlefield (2004) [47] state that the poor are rejected by the monetary administration`s division in the selected countries. Hence, microfinance institutions (MFIs) have been created to end financial discrimination applied to the poor. Otero (1999) [41] expresses that MFIs can play a key role in the financial system of a country, thus they can help

the needy people. The report of Department of International Development (DFID) supports the microfinance by the following claims:

- Microfinance services are a key commitment to decrease neediness.
- Microfinance can be very useful to empower females who mostly neglected by the banking sector.
- The critical objective is to create robust and self-sustaining microfinance institutions. By the spillover effect, MFIs will be able to reach significant numbers of the poor. Hence, MFIs may access beyond the World Bank assistance.

Otero (1999) [41] authenticates that microfinance access to productive capital for the needy individuals, provides workforce, social capital, and empowers individuals to end their neediness. Johnson and Rogaly (1997) [24] advocate that MFIs offers a way for the low income households to protect their livelihoods against shocks and these institutions guarantee their livelihood activities. Also, the effect of microfinance on economic welfare needs to be taken into consideration. Regrettably, informal operators are frequently not able to get the financing from conventional capital suppliers since they need a guarantee and therefore these operators find out another method, which requires less documental procedure, different from traditional banking system. MFI can be best viewed as a parallel back model to traditional banking system Imran (2002) [22].

For instance, the government of Zimbabwe has been very supportive to the microfinance industry`s effort to reduce poverty. To improve the standards of MFIs and to control their operations effectively, the Zimbabwe government regulated legal framework for these institutions. However, many MFIs in Zimbabwe succumbed to the pressures of the capital erosion in the economy, resulting in a big decline in registered numbers from 1700 MFIs in 2003 to fewer than 70 MFIs by beginning of 2009, a noticeable 95.9% decrease occurred in the number of MFIs. In 2013, there were about 172 MFIs and by December 2015 there were 152 registered microfinance institution in Zimbabwe [61].

In Malawi, when the regime changed from dictatorship to a multiparty democratic government the neediness became the main issue to be dealt with by the new government. Under the previous regime, despite of the battle against to destitution the new government` methods became more

successful than previous one. The reason of this achievement is democratic government more focused on improving the social welfare of the poor who live in dire conditions. In contrast to that, the social life and life style in the 1990s were not supported by the government. In 1995, the number of infant death was recorded as 133 per 1,000 live births, 48% of newborn children were disabled, 30% of babies were underweight and 48.4% of the population could not access to safe wellsprings drinking water (Malawi Government/University of Malawi, 1995). According to Malawi Microfinance Network (MANN), it currently has 26 members.

As indicated by UN in Rwanda, 44% of the population live beneath the destitution line. The government is supportive to the microfinance project, it is accepted as legal establishment, to diminish population powerlessness by providing social insurance and employment upgrade plans. For Rwanda case, the UN promised to help the government to accomplish its social insurance targets by increasing household resilience to shocks, promoting long term solutions to reduce vulnerability (UNDAF Rwanda, 2008-2012). Strategic priorities include the improvement for markets and income diversification. In 2011, Association of Microfinance Institutions in Rwanda (AMIR) had 32 members including the Microfinance banks, Microfinance restricted organisations, NGOs, and this number reached 342 members in 2017.

As for Zimbabwe, ZIMSTAT (2013) states that at least 6 out of 10 households are living in dire poverty. Statistically, in 2011, 72.3% of Zimbabweans were viewed as poor as individually, while 62.6% of the family units are considered as poor. Destitution mainly predominant in rural areas compared to urban areas. While 38.2% of urban families are classified as poor, this percentage reaches about 76% in rural areas.

According to UN Zimbabwe report (2012), prevalence of individual neediness was 84.3% in rural areas but 46.5% in urban zones, and while dire destitution was 30.3% in rural however just 5.6% in urban. It was also observed that loss of formal employment had a direct effect on poverty in Zimbabwe. MFIs and lenders may request collateral in the form of household assets to easily access credit which is not allowed to use by low-income households. Although there is an increase in the expansion of financial services for low-income markets in post dollarisation era, the vast majority of people who earn less than \$1 in a day are still predominant in rural areas.

UN Report (2013) expresses that poverty in African developing countries has other dimension in addition to low income, which includes absence of access to essential needs, for example health facilities, education, unpolluted drinking water and legitimate sanitation. Generally, banks do not offer monetary services, such as, credits and savings to the low-income markets. Most of the banks shun extending financial services to the poor rural communities because they claim excess information, exchange and checking costs, inaccessibility because of the insufficient infrastructure and lack of collateral. Microfinance came into existence so as to respond to the needy people, who are being shunned by the legal banking sector Robinson (2001) [46]. However, some microfinance institutions have exploited the poor through exorbitant interests. In order to prevent these misuse circumstances, governments in African developing countries have brought strict legal regulations to the MFIs structure.

Failure of households to raise income, assemble resources and protect themselves against outside shocks despite the existence of microfinance programmes has prompted this study, where the effect of microfinance on reduction of neediness is assessed.

The developing African countries' governments are very supportive to MFIs, with microfinance bills introduced to improve the operations of MFIs and these organisations have been liberated by the governments like Techno-serve and ZAMFI, AMIR, MAMN assist for funding to MFIs. However, considering all the efforts being done and resources allocated towards microfinance, a question arises whether microfinance is helping the poor or it is worsening the level of poverty in these countries. The main aim of our study is to investigate the probability of whether Microfinance Industry reach the poor or not in African developing countries that is the case of Malawi, Rwanda and Zimbabwe. By evaluating these probabilities we attempt to answer the following questions:

- Do MFIs enrich individuals' levels of income?
- Do MFIs play a momentous role in outreach to the needy?
- Do microfinance institutions help to increase the life style of the needy?

MFIs have been developing over the past years but their contribution to the society has been subject to discussion. The purpose of this study is to give a richer and in-depth explanation related to the effects of microfinance on poverty reduction. For instance, MFIs in Zimbabwe,

Rwanda, Malawi, having challenges in their operations and some of them are not adhering to the microfinance act. Therefore, if a MFI is registered within ZAMFI, AMIR and MAMN, then it is accepted as legal establishment otherwise its operations are ceased.

The rest of the thesis includes four sections. In Chapter 2, the literature review is dealt with. Research methodology is discussed in Chapter 3. Chapter 4 contains the results of the methodology and analysis of the model estimates. Conclusion and Outlook are presented in Chapter 5.

CHAPTER 2

LITERATURE REVIEW

Microfinance and microcredit are frequently utilised reciprocally. As indicated by Sinha and Watson (1998) [51] microcredit denotes to small advances whilst a MFI can be classified as a NGO and it provide funds with additional financial services such as saving and insurance. As stated by Yunus (1999) [60] MFIs eliminated market disappointment by giving credit to the economically disadvantaged people since credit would provide financial power which would bring social power. On the other hand, Otero (1999) [41] defines microfinance as an arrangement which grants financial services to low income and extremely poor independently employed individuals.

Amenities provided by MFIs include savings and credit as expressed by Ledgerwood (1999) [30], these services can take another form which contain insurance and payment services. Morduch (1999) [35] then argues that MFIs aim to access to the poor who are financially marginalised from the economic system. They cannot applied to the financial institutions since they do not satisfy the requirements requested from them. MFI is the arrangement with the money related administrations for the poor who are barred from the formal monetary area.

As specified by Schreiner and Colombet (2001) [49] MFI is an endeavor to enhance the access to the deprived families who are ignored by banks who supply little deposits and little credits to these families. In the study, they evaluated the influence of microcredit program on poverty. It was measured by comparing change in income level and livelihood status before and after joining the credit program. To measure the components correlated with income, education and other variables of the borrowers, a multiple regression analysis performed. Results showed that credit program had significant influence on socio-economic indicators. In addition to this, findings indicated that the regulatory authorities of the countries agree that MFI is the arrangement of monetary amenities to the poor family units, as well as small to medium enterprises.

Cooper and Schindler (2003) [10] proclaim that the microfinance movement led to conflict between different ideas and ideologies which discuss the role of microfinance in the society. Rosenberg and Littlefield (2004) [47] express that the poor are the most rejected people from the monetary system, so MFIs have been developed to address the needy` disappointments. Brau and Woller (2004) [5] supported Rosenberg and Littlefield idea by underlying that the MFIs should be a bridge between the poor and the banking sector. Wrenn (2005) [57] then defined MFIs as provision of services like loans, savings and insurance to the needy individuals. As previously discussed in Sinha and Watson (1998), Oikocredit (2005) [40] also supports that microfinance includes microcredit which contains other non-credit financial services. Consequently, MFI provides a different range of financial products which also include microcredit as part of those services.

The MIX (2005) [34] outlined MFIs as an association that offers financial services to the extremely poor. The MIX report compared results of different microfinance institutions with the data of the financial reports taken from three groups, which include the Micro Banking Bulletin 2005 peer group benchmarks of 150 MFIs, the Trend Lines data set - 50 MFIs tracked over three years (2003–2005) and the MFI ranking in the September 2006 issue of Microenterprise Americas that contains 130 Latin American industry leaders. Because the Trend Lines data set consist of a smaller sample in institutions, in some cases results are different from the Micro Banking Bulletin 2005 data. The data examined by MIX`s international standards and analysed via MFIs` reporting standards. In the outcomes, a growth observed in terms of delivering financial services to the poor and MFI kept a stable pace in terms of operations and outreach to the lowest income sectors.

Microfinance institutions take a role to provide financial services to needy household units who have been financially excluded to access these services by the banking sector Kapper (2007) [26]. According to Louis et al (2013) [32] MFI is used as a universal term that incorporates variety of financial services, for example, business banks, credit unions, NGOs, non-saving monetary organisations. In the study, they dealt with whether a profitable MFI has financial efficiency and evaluated its social impact. To realise this, they investigated two categories of potential development in profitability. One of them is proficiency attainment and the other is societal effect. They employed longitudinal data set that contain 15 periods and include 456

MFIs. The evaluations were done by using ordinary least squares method in order to observe the relationship in each cluster. Model output showed that they could not support their hypothesis that claims profitable MFIs are financially efficient. Also, another consequence of the study is profitable MFIs are unsuccessful to fulfil the social objective.

In the below paragraphs, the role of microfinance institutions to battle poverty is discussed with the perspective of different authors.

Johnson and Roglay (1997) [24] argue that if poverty is defined as low levels of annual income for per household, then to reduce poverty income levels must be raised. They made scenario analysis whereby they observed that savings and credit schemes were capable to meet the needs of the poor. They also demonstrated MFI is able to provide economic security, rather than raising income levels. As a positive aspect of poverty reduction MFIs diminish vulnerability of each household.

According to Sinha and Watson (1998) [51], it is difficult to measure the impact of microfinance programs on poverty. Furthermore, they affirmed that the meaning of poverty can change country by country in Africa and therefore it is difficult to measure level of neediness. Yunus (1999) [60] emphasize that microfinance is not a miracle cure that can eliminate poverty in one swoop but it can end the poverty and reduce its severity effects.

Woller and Woodworth (1999) [55] denote that an individual is accepted as poor when he is underneath the poverty line. Poverty is lacking in basic needs desired in human life. Similarly to Otero (1999) [41] microfinance generates access to productive capital. By providing productive capital to a poor person, their sense of dignity is strengthened and this can help to empower the person to participate in the economy and society.

Then, Remenyi and Quinones (2000) [45] made a comparison between families' income levels with respect to whether they access to credit or not. They found that if a family reaches to the credit, they have higher revenue level than those who cannot access the credit. By employing a tobit regression model which assign the efficiency scores obtained from the data envelopment analysis (DEA) model on a number of institutional variables, they evaluated relationship between microfinance and poverty alleviation for Asia-Pacific region and concluded that

household income levels differ for those with access to credit than those without. Wright (2000) [58] claims that suspicions related to MFIs operations arise from the discussion on MFI do not fulfil their social objective, they do not have an impact on income levels, no considerable effect on women empowerment and lastly they do not address their services to the poor. Furthermore, Wright denote that other practitioners do not only discover MFIs are insufficient, but also they think that it wastes financial resources that could be used for funding health and education.

Navajas et al (2000) [39] conducted a study to know effect of microcredit on the poverty. They analysed performance of five MFIs in Bolivia by using index of fulfillment of basic needs (IFBN) method. Results indicated that there is an improvement related to microcredit effect on social welfare and MFIs` tendency to address the issues of needy. They also argue whether there is a danger that MFI could be misused for different projects instead of helping the poor. They further underline that policy makers must know impact of it on the poor, i.e., do the needy benefit from MFI as compared to health care or food aid services. Therefore, according to their study, policy makers should be take part in microfinance program.

In 2001, World Bank proclaims that poverty is to be able to survive by earning less than \$2 in a day and also it remains unsolvable to eradicate. Robinson (2001) [46] discusses that microcredit has an impact on low income households and he underlines to access microcredit helps to improve their welfare. Chowdhury (2001) [6] argued that for the poor instead of MFIs, another form of financial help can be provided to raise their income and productivity, e.g. self-employment.

Mayoux (2001) [33] implies that microfinance has much potential to include women into the financial system. Since MFIs benefit financial system when providing financial aid to the poor it can be considered kind of an early warning mechanism to cope with unpredictable financial shocks. Also suggested that MFIs should focus on encouraging the poor people to take an economically active role in their lives through financial and technical support for self-employment. Fisher et al (2002) [14] denote that MFIs aid to the poor to find a way out from poverty by delivering financial services through appropriate channels. Microfinance is therefore a method to improve their life style and it allows people to access financial services to meet their needs.

Moreover, the World Bank (2003) supports that there is a relationship between poverty and income level. Poverty is measured by percentage of living standard whether it is below a fixed amount, such as \$2 in a day.

Littlefield et al (2003) [31] discovered an evidence on the impact of microfinance as it relates to the attainment of the MDGs. They attest that microfinance can have a strong impact on the achievements of the millennium development goals as it can fulfil social benefits permanently on a large scale. This concurs with Simanowitz and Brody (2004) [50] who stress microfinance is a key element to fulfil the MDGs goals. Kakkadan et al (2006) [25] claim that poverty leads to social exclusion which is the inability to participate in society because of lack of resources. Hulme and Mosley (2006) [20] while admit the importance of MFI in assisting to diminish poverty, they state that in the present-day MFIs` projects are valueless than they might be. Furthermore, they express MFI is not the ultimate tool for poverty-alleviation and in some instances the poorest people have been exploited by the MFI. Diop et al (2007) [11] criticise that in terms of employment opportunities, microfinance is not beneficial to the poorest.

Hulme and Arun (2009) [19] underline that if MFI program is given to the poorest families, especially those managed by single parents to produce extra family income with advances, then the program would have proved that the poor can generate income producing activities to battle challenges of poverty. They deduced that MFI has raised the livelihoods opportunity of the marginalised poor people in the society.

Montgomery and Weiss (2011) [36] conducted a study to evaluate the impact of accessing microloans by the Khushhali Bank – Pakistan data. To test the effect of reaching to the loans, a multiple regression was employed on primary data of household survey, including 3000 both borrowers and non-borrowers. Model output revealed a positive relation between poverty and microfinance in rural areas. The research also proved that there is a rising tendency on food expenditure and social indicators, e.g. the health services for children and female economic independency.

World Bank Report (2012) announced the emergence of Millennium Development Goals (MDGs) supported the existence of MFIs that brought hope to fight the poverty on a global scale.

The following paragraphs discuss academicians' different opinions related to MFIs effect on financial sustainability and combating poverty.

On the issue of financial sustainability Otero and Rhyne (1994) [42] define it as the MFIs ability to operate independently without grants from outside for a reasonable time period. Woller and Woodworth (1999) [55] point out financial sustainability in MFIs enforces them to supply services that are appreciated by borrowers and other authorities. Hence, they receive considerable support to continue their operations. As demonstrated by Morduch (1999) [35] financial sustainability is a requirement to push MFIs` workforce who want the survival of the institutions so as to save their jobs. He also underline that microfinance institutions do not receive any subsidies from beneficiaries. Also, Morduch (1999) [35], Christen and Rosenberg (2000) [9] confirm that the critical stage of financial sustainability is being profitable where the institution is operating efficiently. A profitable microfinance institution, like any other institutions, generates excess funds for reinvestment and growth.

According to Shreiner (2000) [48] sustainability of MFIs is another form raising the standard of living of the poor. He points that the sustainability of MFI is determined by the success of credit repayments and the profit obtained from borrowed amounts which is taken from benefactors. The strict repayment policy which is regulated by MFIs eventually lead to profitability and survival. This policy guarantee permanent regulations, hence accessibility to the poor continue ceaselessly. He then stresses that any MFI whose target is rich households and provide huge amount of loans to that families are not convenient for the aim of MFIs at all because it is no longer possible to supply microfinance services to the poor Shreiner (2000) [48].

Navajas et al (2000) [39] denote financial sustainability is the ability to maintain a strong performance for a long time. Also, Evers et al (2000) [13] state that loan repayment is determined by the type of financial services and effectiveness of collection policy.

Christen and Drake (2002) [8] suggest that, in African developing countries, if the main aim of MFIs is to increase outreach to the poor and diminish the poverty, they should more focus on financial maintainability and efficiently use of commercial sources of funding.

In a study conducted by Woller and Schreiner (2002) [54] found a negative relation between sustainability and outreach to the poor and this indicated there is a trade-off between being survive and realising the social economic program for the poor.

Stephens and Clark (2002) [52] designate that the pressure on MFIs to cover their operating costs brings gradually maintainability, and then maintainability helps to get rid of being financed by grantors. However, too much focusing on the surviving cause to move away from principal social objectives of MFIs.

At the beginning of the establishment of the MFIs, they did not focus on profitability instead they gave attention to alleviate the poverty by delivering subsidies Harper (2003) [15]. This characteristics make these institutions similar to non-profitable organisations. Modurch (2000) [37] underlines that grants are no longer a trusted form of financing to MFIs. Therefore, some changes and priorities are necessary among the grantors and administration of MFIs. This would mean that when grants are ceased MFIs must rely on their profitability and use of commercial sources to fund their operations.

Brau and Woller (2004) [5] stress MFIs have potential when they try to alleviate poverty at the same time they can also make profits. However, there are several challenges affecting MFIs. The development and survival of MFIs depend on availability of funds to cover their operating costs and credit advances. For those, MFIs do not generate enough income from their operations, so they depend on subsidies.

Amendariz and Morduch (2005) [2] propose some strategies to raise profitability, such as new policies on credit repayment and cost reduction from their operations. They applied a multivariate regression on high dimensional data with 124 institutions in 49 countries. The model displayed that there is a possibility of making profits whilst fulfilling the social responsibilities. As a result of the study, they observed that a trade-off emerges between profitability and helping the poorest. Additionally, they found that to raise fees which are taken from poor clients and to decrease the cost which taken from rich customers do not ensure more profitability. UNESCAP (2006) point out microfinance institutions are sustainable when they are able to supply services to the poor on a continuous basis and at the same time being profitable.

Otero and Rhyne (2006) [43] state being financial sustainable is critical for MFIs workforce. The workers' motivation is an important effect on operational performance and survival of MFIs. In financial sector, the need for sustainability stems from technological changes, which facilitate the operations and help reducing operating costs. Pollinger et al (2007) [44] concur with the study by Otero and Rhyne (2006) [43] that emphasize manageability is the ability to cover annual expenses including wages, donations and bills. On the other-hand, Ditcher and Harper (2007) [12] support the idea which point out MFIs have to operate in a friendly economic environment so as to help large number of poor clients. For instance, if a MFI uses credit there could be a default risk because of not being able to make repayment. In this case, favourable conditions, such as low interest, more time to make payments, or restructuring for the credit payment, can be provided in order to survive these institutions.

As explained in previous paragraphs, the principal objective of the MFIs is to diminish poverty through supplying financial services to the poor and low-income households. The outreach goal can only be realised if MFIs have enough funds for the operational efficiency, costs and the loan demands. Armendariz and Morduch (2005) [2] made a research on credit repayment rates can be affected by default risk policy, efficiency of work force and MFIs investment policy. Hence, all of these can be thought as factors that influence the MFIs' sustainability.

ZAMFI report (2009) denotes the challenges building a durable commercial microfinance industry in other African developing countries which include limited management capacity in MFIs, institutional inefficiencies, inadequate regulations and management deficiency on supervision of deposit taking, insufficient capitalisation and high default rates. The report further emphasizes that insufficient funding, inadequate information technology infrastructure and the absence of Credit Reference Bureau (CRB) also affect the viability of MFIs. According to the MIX (2010), the CRB provides information related to individuals' borrowing and paying bill habits, which help lenders such as, for MFIs this information is very valuable to assess the creditworthiness of borrowers.

In order to evaluate which factors trigger the financial sustainability of MFIs, Ayayi and Sene, (2010) [3] conducted a research by applying multiple regression on data of 217 MFIs in 101 countries over the period 1998-2006. Findings from the study revealed that MFIs' sustainability

depends on its operational viability, then it is followed by financial sufficiency to compensate operating costs and unsubsidized capital requirements. The study of Hermes and Lensink (2011) [16] claim that commercialisation of microfinance operations, competition among institutions, technological advancement, financial liberalisation and microfinance regulation are the major effects on financing methods of MFIs.

The study of Kipesha and Zhang (2013) [27] examined the existence of tradeoffs between sustainability, profitability and outreach. Panel data regression was used to analyse data of 47 MFIs for the four periods of 2008 to 2011. Findings of this study one more time underlined that MFIs` sustainability is centered on the understanding that decisions and actions taken by the organisations today have an effect on the future of them. There are some on-going concerns related to institutions whether they will survive or not in future; therefore some financial and operational precautions must be determined from today to guarantee the future of MFIs. In conclusion, they imply that to assess performance of MFIs, sustainability and profitability are key factors to be considered since to increase and expand outreach to the larger number of the poor, these factors play crucial role.

In literature, generally the matter of microfinance has been dealt with by using linear models although binary choice models are also applied, the difference and scientific contribution of this study is the first time we employ two different binary choice models together with Autoregressive models to analyse effects of microfinance institutions on poverty reduction. In this research, the performance of these binary choice models are compared. In addition to this, as an econometrics approach by using Autoregressive Models we measure the dependency of the dichotomous dependent variable to its past values.

A summary of literature review is provided in the following table.

Table 1: Literature review summary

Literature review related to definitions of Microfinance			
Author	Title of Article	Methodology	Results
Schreiner and Colombet (2001)	From Urban to Rural: Lessons for Microfinance from Argentina	Multiple regression	Results showed that credit program had significant influence on socio-economic indicators
Micro Finance Information Exchange (MIX) (2005)	Benchmarking African Microfinance	Compared results of different institutions with the data of the financial reports. Data examined by MIX` international standards, analysed via microfinance reporting standards	A growth observed in terms of delivering financial services to the poor in the selected countries
Louis et al (2013)	Financial efficiency and social impact of microfinance institutions using self-organizing maps	Panel data approach	Negative relationship found between profitability and financial efficiency
Literature review related to Microfinance and Poverty			
Johnson and Rogaly (1997)	Microfinance and poverty reduction.	Scenario analysis	Observed that MFI is able to provide economic security, rather than raising income levels
Remenyi and Quinones (2000)	Microfinance and Poverty Alleviation: Case studies from Asia and the Pacific.	Tobit regression model	A positive correlation was obtained between household income levels and accessing to the credit provided by MFIs
Navajas et al (2000)	Microcredit and the Poorest of the Poor: Theory and Evidence from Bolivia	Multiple regression	Results indicated that there is an improvement related to microcredit effect on social welfare

Littlefield et al (2003)	Is microfinance an effective strategy to reach the millennium development goals?	Reviews the official reports about the impact of MFI as it relates to the attainment of the MDGs	Positive correlation was obtained between the goals of MFIs and the MDGs
Montgomery and Weiss (2011)	Can commercially-oriented microfinance help meet the millennium development goals? Evidence from Pakistan.	Multiple regression	Model output revealed a positive relation between poverty and Microfinance in rural areas
Literature review related to Microfinance and financial sustainability			
Woller and Schreiner (2002)	Poverty Lending, Financial Self-Sufficiency, and the Six Aspects of Outreach	Ordinary Least Square (OLS)	Results showed a negative relation between sustainability and outreach to the poor
Amendariz and Morduch (2005)	The Economics of Microfinance	Multiple regression	Results displayed there is a possibility of making profits whilst fulfilling the social responsibilities and they observed that a trade-off emerges between profitability and helping the poorest
Ayayi and Sene, (2010)	What drives microfinance institution's financial sustainability?	Multiple regression	Findings reveal that MFIs` sustainability depends on its operational viability
Kipsha and Zhang (2013)	Sustainability, Profitability and Outreach Tradeoffs: Evidence from Microfinance Institutions in East Africa	Panel data regression	Performance of MFIs mostly rely on their sustainability and profitability

CHAPTER 3

RESEARCH METHODOLOGY

This section presents methodology furthermore, procedures to be used in conducting the research. For this research, in order to estimate probability of reaching to MFIs secondary data have been taken from AMIR, MANN, ZAMFI, World Bank, and the central banks of chosen countries.

In our study, the dependent variable is the probability of whether neediness reach to the MFIs or not. To explain the dependent variable, based on the previous studies [7, 18, 21], our indicators are adolescent fertility rate, arable land rate, manufacturing ratio, age dependency ratio, agricultural production ratio and total fisheries production. Since the structure of our study is a binary choice problem, *the logistic regression* and *the probit regression* models have been applied.

3.1 The structure of Binary Dependent Variable and Regression Method

Linear regression is employed to explain a relationship among dependent and independent variables, which is appropriate to forecast the dependent variable in case independent variables change. It is given by an equation as follows:

$$Y_i = \beta_0 + \sum_{j=1}^p \beta_j x_{ij} + \varepsilon_i \text{ for } i \in \{1, \dots, n\} \quad (1)$$

where $Y_i \in \mathbb{R}$ is the real-valued response for the i th observation, $\beta_0 \in \mathbb{R}$ is the regression intercept, $\beta_j \in \mathbb{R}$ is the j th predictor's regression slope, $x_{ij} \in \mathbb{R}$ is the j th predictor for the i th observation and $\varepsilon_i \stackrel{iid}{\sim} N(0, \sigma^2)$ is a Gaussian error term.

Linear regression is not an appropriate model to deal with binary choice problems since it presumes that $\Pr = E(Y = 1|X)$ where X is the vector of household' characteristic Kürüm et al. (2012) [29]. Particularly, the probability of reaching MFIs, \Pr , increases linearly by X , i.e. the

incremental effect of independent factors remains constant throughout. This presumption sometimes is not appropriate to reality Vasisht (2007) [53]. Therefore, we need a probability model with two features. The first one is when X rises, $Pr = E(Y = 1|X)$ rises but always stays in the interval [0, 1]. The second one is the relevance between Pr and X is nonlinear, this leads to probability approaches 0 by slower rates as X becomes small, and the probability to tent to 1 by slower and slower scales as X becomes very large [53]. Since Logistic and Probit regression models satisfy these requirements, these models can be employed to forecast the probability of reaching MFIs in target countries which are Rwanda, Malawi and Zimbabwe.

Both models generate different parameter predictions. In binary response models, the forecast of a logistic model are approximately $\pi/\sqrt{3}$ times more than those of the corresponding probit model. However, these estimators generate almost the same standardised impacts of explanatory variables [23]. In our research, we compare the performance of each model. By using probit regression model, hence, we also consider the probability of whether the existence of an unobserved latent variable or not.

3.2 Logistic regression model

Logistic regression takes the categorical values either 0 or 1, denoting no access to MFIs services and access to MFIs services, respectively. If we indicate the probability of reaching MFIs as $Pr(Y=1|X= x_k)$ for the k th household, and we presume that we have m households the logit model is expressed by Hosmer and Lemeshow (2000) [17] as follows:

$$\log\left(\frac{Pr(Y = 1|X = x_k)}{Pr(Y = 0|X = x_k)}\right) = \beta_0 + \beta_1 \cdot x_{k1} + \beta_2 \cdot x_{k2} + \dots + \beta_r \cdot x_{kp} \quad (2)$$

where $x_k = (1, x_{k1}, x_{k2}, \dots, x_{kp})^T \in \mathbb{R}^{p+1} (k = 1, 2, \dots, m)$ and $\beta_r (r = 0, 1, 2, \dots, p)$ are the coefficients. Predictors are shown by x_{kr} . Here, they display the k th household's r th characteristics that can be anyone of qualitative and quantitative properties. For m households, k takes the values from 1 to m . Moreover, Y is a dichotomous dependent variable, introducing a binary response. Namely, Y follows a Bernoulli distribution. Hence, for a Bernoulli variable, $Pr(Y=1 | X) = E(Y | X)$ equation satisfied Müller (2004) [38]. Here, 1 and 0 correspond to the

reaching MFIs and not reaching to MFIs status of a household, respectively. By using the Eqn.(2), $Pr(Y=1|X=x_k)$ follows a logistic distribution:

$$Pr(Y = 1|X = x_k) = E(Y|X = x_k) = \frac{\exp(X^T \beta)}{1 + \exp(X^T \beta)} \Bigg|_{X = x_k} \quad (3)$$

Here, $E(Y|X)$ is attributed to a linear function of the independent variables by the logistic cumulative distribution function (cdf) Korn and Baydar (2006) [28]:

$$F(\eta) = \frac{1}{(1 + e^{-\eta})} = \frac{e^\eta}{(1 + e^\eta)} \quad (4)$$

In Eqn. (3), the relations are indicated between $v = E(Y|X)$ and $\kappa = X^T \beta$ by the invertible function $\kappa =: G(v)$, or $E(Y|X) = G^{-1}(X^T \beta)$. Here, G is identified as *link function*. In this study, we employ logit link, $\kappa = \log(v/1 - v)$ such that

$$Pr(Y = 1|X = x_k) = \frac{\exp(X^T \beta)}{1 + \exp(X^T \beta)} \Bigg|_{X = x_k} \quad (5)$$

Firstly, we obtain the probability of reaching to MFIs for each household, then these probabilities are modified to the score of each household by the following expression:

$$S_k = \Phi^{-1}(P(Y = 1|X = x_k)) \quad (k = 1, 2, \dots, m) \quad (6)$$

Here, Φ is the standard normal cdf, $S = (S_1, S_2, \dots, S_m)^T$ is the vector of scores Kürüm et al. (2012) [29]. The objective of Eqn. (6) is to transform the uniformly distributed accessing to MFIs probabilities into normally distributed scores.

In order to measure the performance of binary choice models, there are some tests which are Hosmer-Lemeshow test (HL test), Wald test, and Chi-Square test as discussed in the following sections.

3.2.1 Hosmer-Lemeshow (HL) Test

In order to evaluate the fitness of the model, Hosmer and Lemeshow proposed to group based on the values of forecasted probabilities. If there are q columns as corresponding to the q values of the forecasted probabilities, the first column corresponds to the smallest value, and the q th column to the largest value. For either grouping strategy, the HL goodness-of-fit statistic, \hat{K} , is obtained by calculating the Pearson chi-square statistic from the observed table results and predicted expected frequencies. The formula for \hat{K} is defined as follows:

$$\hat{K} = \sum_{l=1}^t \frac{(H_l - m'_l \pi_l)^2}{m'_l \pi_l (1 - \pi_l)} \quad (7)$$

where m'_l is the total number of elements in the l th group, c_l displays the number of covariate patterns in the l th decile,

$$H_l = \sum_{j=1}^{c_l} z_j \quad (8)$$

is the number of the responses between the c_l covariate patterns, and

$$\pi_l = \sum_{j=1}^{c_l} \frac{n_j \hat{\pi}_j}{m'_l} \quad (9)$$

is the average predicted probability.

If the result of p-value of the test greater and equal to 0.05, the null hypothesis is not rejected (H_0 = there is no distinction between observed and model estimated values). In other words, the model's output fit the data at an acceptable level. Well fitted model indicates non-significance, non-significance demonstrates the model prediction does not significantly differ from the observed values Hosmer Lemeshow (2000) [17].

3.2.2 Wald Test

The Wald test is obtained by comparing the MLE (maximum likelihood estimate) of the slope parameter, $\hat{\beta}$ to an prediction of its standard error. The obtained ratio, under the hypothesis that, $\beta_1 = 0$, follows a standard normal distribution. This is calculated by the following formula:

$$W = \hat{\beta}_1 / SE(\hat{\beta}_1) \quad (10)$$

Each Wald test statistic is compared with a Chi-Square distribution with degrees of freedom 1 Hosmer Lemeshow (2000) [17].

3.2.3 Chi-Square (χ^2) Test

This test statistic is a measure of how close the observed frequencies are to the expected frequencies. It can be explained by the following formula

$$\chi^2 = \sum \frac{(O - E)^2}{E} \quad (11)$$

where O is observed frequency and E corresponds to expected frequency. If the value of χ^2 is very large, then the null hypothesis of the independence is not accepted since the meaning of this the observed frequencies and expected frequencies are separated. If the outcome of the p-value of the χ^2 test is less than 0.05, the model is statistically significant, otherwise insignificant.

3.3 Probit regression model

The Probit model is presented as $\Pr(Y=1|X) = \Phi(X\beta)$. Here, Φ is the cumulative distribution function of standard normal distribution and $X\beta$ is stated as probit score or index.

$$\Phi(X\beta) = \int_{-\infty}^{X\beta} \phi(z) dz = \Pr(Y = 1|X) \quad (12)$$

where $\Phi(z) = \frac{1}{\sqrt{2\pi}} e^{-z^2/2}$ and $X\beta = \beta_0 + \beta_1 X_1 + \dots + \beta_n X_n = \Phi^{-1}(\Pr(Y = 1|X))$

The interpretation of a probit coefficient, β , is that one unit increase in the X causes to rise the probit index by β standard deviations. In other words, probit regression represents the probability that $Y = 1$, accessing MFIs, via the cumulative standard normal distribution function, assessed at $z = \beta_0 + \beta_1 X$, z-score of the probit model.

The reason to employ probit model is to observe the existence of an unobserved latent variable. Suppose there exists a latent variable Y_i^* , $Y_i^* = \beta_0 + \beta_1 X_i + u_i$, $u_i \sim N(0, \sigma_u^2)$

where Y_i^* is the unobserved. The observed Y is 1 if $Y_i^* > 0$ and it is 0 if $Y_i^* < 0$.

3.4 Autoregressive Models

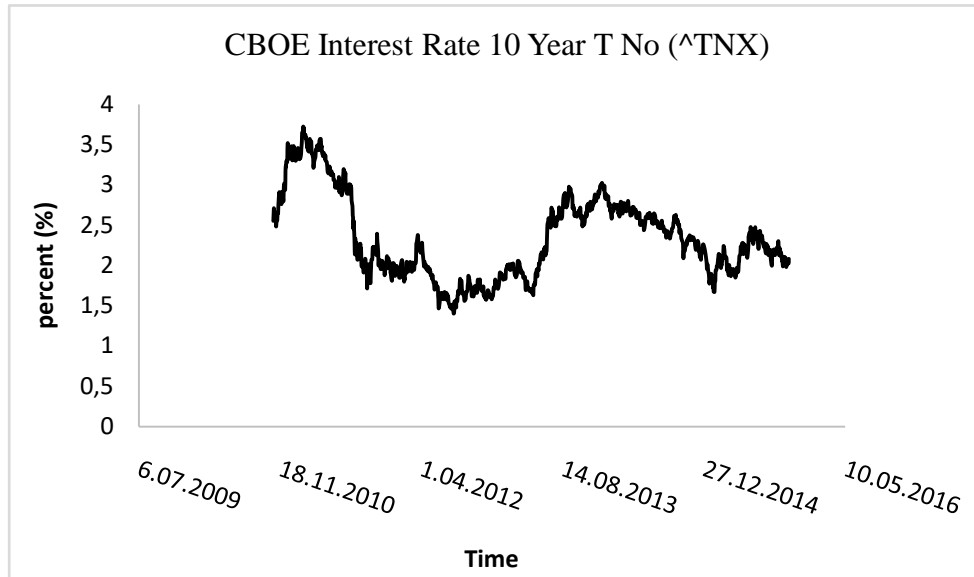
In a multivariate regression model, predicted variable is found by a linear combination of regressors. However, in the autoregression model, forecasted variable is obtained by using a linear combination of past values of itself. Here, the term *autoregression* means the regression is made by the variable against itself.

An auto regressive model of degree n is defined as follows:

$$Y_t = \delta + \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + \dots + \varphi_n Y_{t-n} + \varepsilon_t. \quad (13)$$

where δ is a constant and ε_t is white noise. The formula looks like a multivariate regression but with lagged values of Y_t as predictors. This formula is called as $AR(n)$ model. Fig. (1) and Fig.(2) show series from $AR(1)$ and $AR(2)$ models.

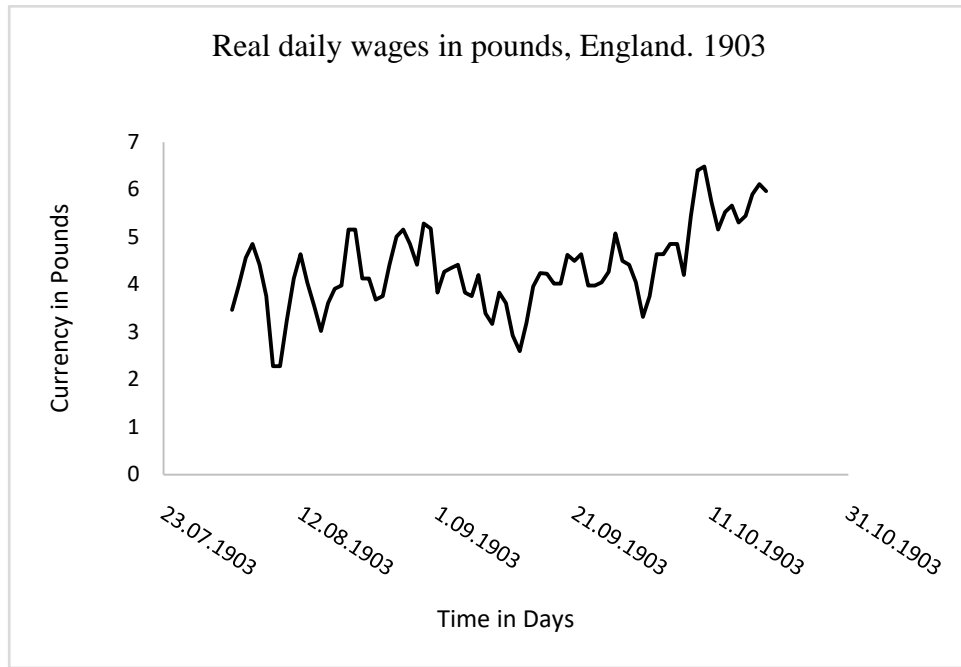
Figure 1: First Order Autoregressive Model



$$Y_t = 0.0436 + 0.9806 Y_{t-1} + \varepsilon_t. \quad (14)$$

Fig. (1) indicates a weekly historical data of 10 Year Bond (Chicago Options) in USD currency. In this figure, we adopt the AR_p model to formulate our AR_1 model for the first order autoregressive equation. Data AR_1 obtained from Yahoo Finance [59].

Figure 2: Second Order Autoregressive Model



$$Y_t = 1.15983 + 1.035067 Y_{t-1} - 0.29879 Y_{t-2} + \varepsilon_t. \quad (15)$$

Fig. (2) is a time plot for daily wages in pounds, in England for a period from February, 1903 to October, 1903. The picture depicts our AR_2 model which is adapted from the AR_p model. Data taken from Bank of England [4].

In Fig. (1), AR (1) with $Y_t = 0.0436 + 0.9806 Y_{t-1} + \varepsilon_t$, and in Fig. (2) AR (2) with $Y_t = 1.15983 + 1.035067 Y_{t-1} - 0.29879 Y_{t-2} + \varepsilon_t$.

In both circumstances ε_t is normally distributed white noise with mean zero and variance one.

For AR (1) model, when $\varphi_1 = 0$, Y_t corresponds to white noise. However, when $\varphi_1 = 1$ and $\delta = 0$, Y_t corresponds to a random walk. Normally, autoregressive models are restrained to stationary data, and some conditions on the values of the parameters are necessitated. For AR (1) model, $\varphi_1 \in (-1,1)$. For AR (2) model, $\varphi_2 \in (-1,1)$, $\varphi_1 + \varphi_2 < 1$ and $\varphi_2 - \varphi_1 < 1$.

3.5 Decision Making Process related to independent variables

The study adopted the use of VIF, AIC and AR model in determining which variables are significant for the research. Firstly, VIF criterion is used to determine which independent variables are most appropriate. For VIF, if an independent variable has a greater value of 5, the variable is then dropped, and hence for this case two models are formulated, and an ordinary regression is applied to these two models, to compare their AIC, the one with lower AIC is assigned as the most appropriate.

3.5.1 Variance Inflation Factor (VIF)

In order to estimate multicollinearity, the variance inflation factor (VIF) is used. If VIF equals to 1, there is no multicollinearity among regressors but if the VIF is greater than 1, the regressors may be moderately correlated. If the value of VIF is greater than 5, this indicates high correlation among regressors and this cause a problem. Therefore, these regressors are dropped from the model. VIF is computed by the following formula:

$$VIF = \frac{1}{1 - R_j^2} \quad (16)$$

where R_j^2 is the multivariate R^2 for the regression of X_j on the other predictors. Here, the important point is that the regression does not include Y . In other words, the regression is applied between independent variables to measure the correlation among them. Hence, VIF is employed to select the most appropriate independent variables for the model.

3.5.2 Akaike Information Criterion (AIC)

Akaike's Information Criterion (AIC) evaluates the relative value of a statistical model for a given set of data Akaike (1974) [1]. The AIC is employed to choose the best model. To calculate AIC, Eqn. (17) is used:

$$-2L(\beta) + 2(n), \quad (17)$$

where n is the number of parameters in the model plus 1 and L is the log-likelihood of the model given the data. AIC rewards goodness of fit and penalises for over fitting. A model with the lowest AIC value will be most preferred model.

We compare the performance of both *logistic* and *probit regression models* by using their AIC, the one which has a lower AIC, is the one used as our model, to determine the effects of MFI in poverty reduction.

In determining the dichotomous variable, which is the access to MFIs is measured using the following formula:

$$\text{Access to Microfinance services} = \frac{\text{Household final consumption expenditure (\% of GDP)}}{\text{Population growth (annual \%)}}$$

The literature provides that income or consumption levels can be used to measure individual level of deprivation and how can one increase their household income. Also, in the classification of main causes of poverty it is to note that independent variables are chosen according to household` and individual` most important characteristics, which contain the demographic, economic and social characteristics.

Hence, a dichotomous variable is given below, as to whether household have access to microfinance industry services or not. That is,

$$A_{\text{MFIs}} = \begin{cases} 1, \text{ yes, household has accessed to MFIs services} \\ 0, \text{ otherwise} \end{cases}$$

Where A_{MFIs} denotes access to microfinance service.

Description of the independent variables

Since the following variables directly or indirectly related to poverty in the selected countries, we benefit from them.

Adolescent fertility rate (births per 1,000 women ages between 15-19): It included in the model as it has positive correlation to poverty. The more the young population drops out at school because of pregnancy the more it contributes to poverty levels. Therefore, it is significant to assess whether microfinance can actually make a positive contribution to their welfare.

Age dependency ratio, (% of working-age young population): There is a close connection between age dependency and poverty. To answer whether MFIs are crucial to reduce poverty in African developing countries, therefore it is one of the important variable.

Arable land (% of land area): As part of economic characteristics, ownership of arable land area relates to the level of welfare of a household. Arable land rate is statistically correlated to poverty. So, in the research, it is substantial to evaluate whether MFIs make a positive effect on poverty.

Manufacturing rate (value added as % of GDP): Manufacturing industry play a pivotal role in reducing poverty, owning a small scale business empowers individuals. Therefore, to measure effect of MFIs to decrease poverty this independent variable is important.

Agricultural production ratio (added value as % of GDP): Since agriculture is a form of survival skill in developing countries and agriculture is highly linked to poverty, to evaluate whether MFIs effect to aid to the family units, this variable is significant.

Total fisheries production (metric tons): Malawi is a country where households mostly depend on the fishery business. Here, unfortunately, this industry operates under international scale. Since most of the household's livelihood depend on fishery total production, in this region, it has a crucial role. So, to assess whether MFIs help diminishing poverty level, this variable is important.

Independent variables used for the case of Rwanda:

X₁ - adolescent fertility rate (births per 1,000 women ages between 15-19)

X₂ - age dependency ratio (% of working young population age)

X₃ – arable land ratio

X₄ - manufacturing rate (value added as % of GDP)

Independent variables used for the case of Malawi:

X₁- adolescent fertility rate (births per 1,000 women ages 15-19)

X₂ – arable land (% of land area)

X₃ - agriculture value (added (% of GDP)

X₄ - Total fisheries production (metric tons)

Independent variables used for the case of Zimbabwe:

X₁ - age dependency ratio (% of working young population age)

X₂ - adolescent fertility rate (births per 1,000 women ages between 15-19)

X₃ – arable land ratio

X₄ - manufacturing rate (value added as % of GDP)

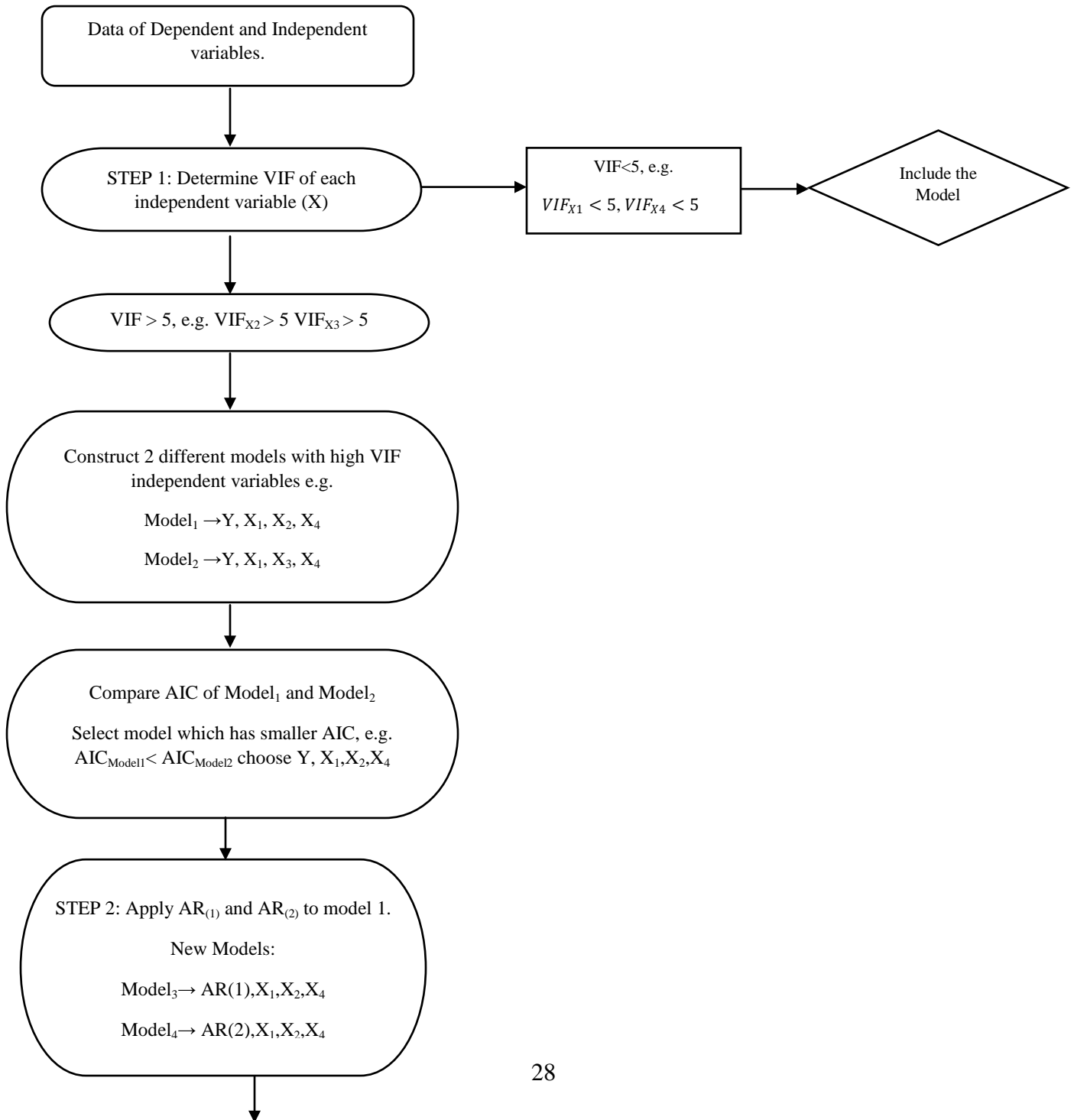
To answer the research questions, data have been examined utilising IBM SPSS version 23 and Microsoft Excel (2013) Real Statistics Resource Pack.

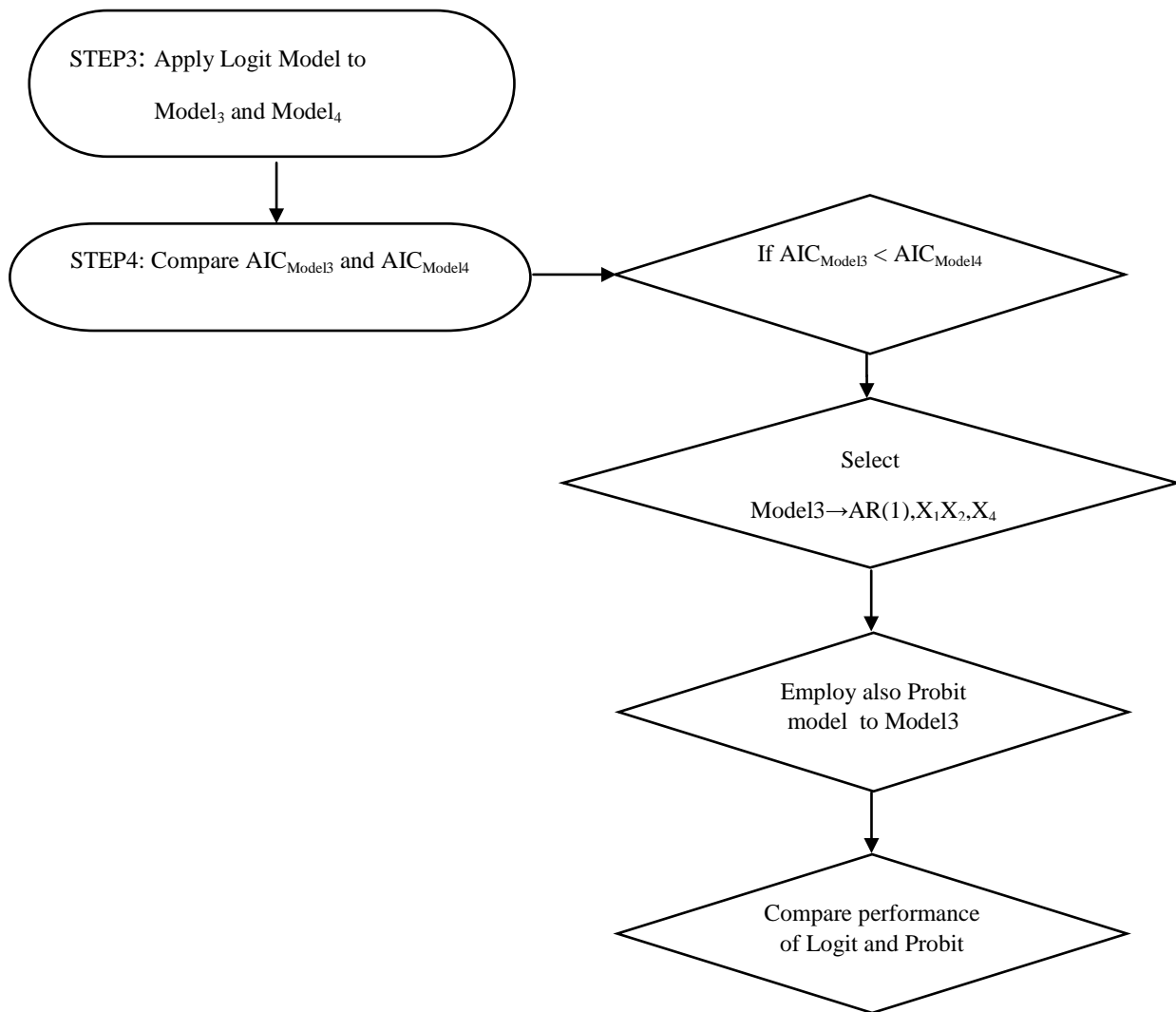
In the following section, we also explain our methodology process by a diagram.

3.6 Model Selection Process

Our model selection process is explained by a diagram in Fig. (3). This flow chart is applied to each country that is dealt with in the study.

Figure 3: Model Selection Process





CHAPTER 4

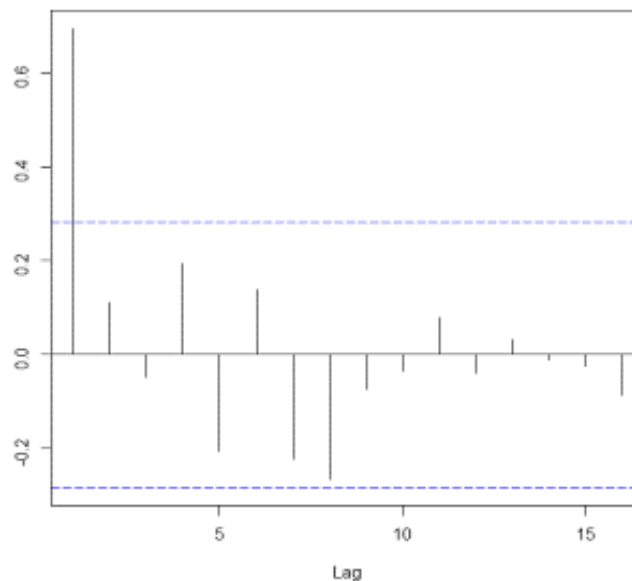
INTERPRETATION AND ANALYSIS OF RESULTS

This section presents the findings and discussion of results. To obtain the outcomes, IBM SPSS (v.23) and Microsoft Excel (2013) Real Statistics Resource Pack have been used.

Rwanda: Results and Interpretation

Firstly, we check the autocorrelation for the dependent variable to test whether there is a dependency to the past values.

Figure 4: Autocorrelation results for Rwanda



As we see in Fig. (4), the past values of dependent variables are not highly correlated. This means that there is no serious dependence to the past values; therefore we do not have to include a covariance structure to our models.

Variance Inflation Factor Results

Table 2: Variance Inflation Factor for Rwanda

Independent Variables	VIF
X1	13.4224
X2	6.09764
X3	5.22187
X4	1.15806

As seen from Table 2, the VIF column suggests that there is multicollinearity between X_1 , X_2 and X_3 since $VIF > 5$. In this case, in order to find the most suitable variables for the model, we have constructed three different models as shown in the following table

MODELS	DEPENDENT VARIABLE	INDEPENDENT VARIABLES
Model 1	Y	X_1, X_4
Model 2	Y	X_2, X_4
Model 3	Y	X_3, X_4

We have applied Logistic Regression to each model, then the following AIC results have been obtained as shown in Table 3.

Table 3: AIC Results for Logistic Regression (Rwanda)

Models	LL	AIC
Model 1	-18.81	43.62
Model 2	-18.79	43.59
Model 3	-18.98	43.96

Since AIC of Model 2 is less than the other models, we continue with this model and then we passed to Step 2 which is explained in Subsection 3.6. When we have separately employed AR(1) and AR(2) structures in Model 2, we have found that AR(1) is more significant than AR(2) according to the AIC results which is summarized in Table 4.

Table 4: Model Summary for Autoregressive Processes (Rwanda)

Models	Variables	LL	AIC
Model 4	Y, X ₂ , X ₄ , AR(1)	-11.59	31.18
Model 5	Y, X ₂ , X ₄ , AR(1), AR(2)	-11.23	32.47

In the last step, we make comparison between Logistic and Probit regression models.

Table 5: Model Summary of Logistic and Probit (Rwanda)

Models	Variables	LL	AIC
Model 4 (Logistic)	Y, X ₂ , X ₄ , AR(1)	-11.59	31.18
PROBIT	Y, X ₂ , X ₄ , AR(1)	-11.73	31.47

As we see from Table 5, Logistic regression is slightly better than Probit model.

Table 6: Hosmer-Lemeshow Test Result (Rwanda)

Models	HL Test	df	p-value	Alpha
Model	62.33	46	0.0545	0.05

Table 6 demonstrates that p-value is greater than 0.05, i.e. test is insignificant, which means that logistic regression provides a good fit.

Table 7: Chi-Square Test Result (Rwanda)

Model	Chi-Square	df	p-value	Alpha
Model 4	19.70	3	0.00019	0.05

As shown in Table 7, the model is statistically significant because the p-value is less than 0.05. In other words, the model assumptions are met and model provides a good-fit according to Tables 6 and 7.

Table 8: Model Summary for Rwanda

MODEL	coeff b	s.e.	Wald	p-value	exp(b)
Intercept	-0.53945	6.048274	0.007955	0.92893	0.583067
X2	-0.00734	0.06808	0.011628	0.914129	0.992686
X4	0.055064	0.058883	0.874506	0.349711	1.056609
AR(1)	3.944244	1.215965	10.52168	0.00118	51.63728

The results of Wald Test in Table 8 display the only significant predictor for response variable is the past value lag 1 (AR(1)) and the model equation is given as follows:

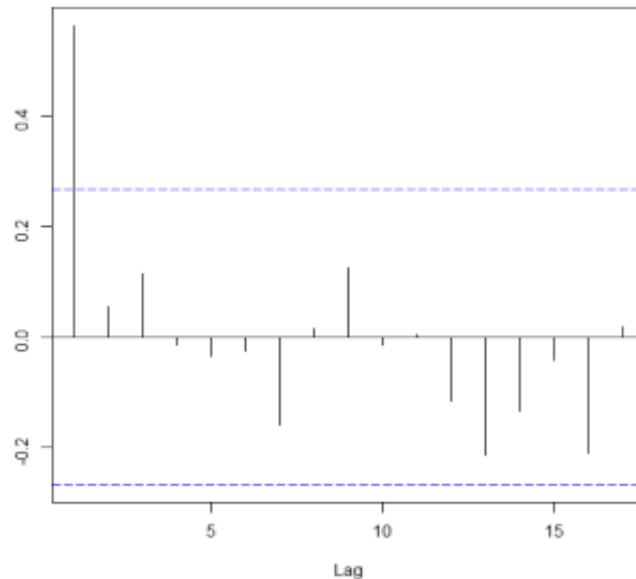
$$\log \left(\frac{p(Amfis)}{1-p(Amfis)} \right) = -0.53945 - 0.00734X_2 + 0.055064X_4 + 3.9442AR(1). \quad (18)$$

According to Eqn. (18), for instance, the estimated odds ratio for X_2 is $\exp(-0.00734) \approx 0.99268$, i.e., for each increase in one unit of X_2 , the estimated odds of accessing to at least 1 household decreases by roughly $1 - 0.99268$.

Malawi: Results and Interpretation

As we observe from Fig. (5), the past values of dichotomous dependent variable are independent of each other. Therefore, we do not have to include a covariance structure to our models.

Figure 5: Autocorrelation results for Malawi



Variance Inflation Factor Results

Table 9: Variance Inflation Factor for Malawi

Independent Variables	VIF
X1	2.23709
X2	5.83405
X3	8.94315
X4	2.36888

As seen from Table 9, the VIF column suggests that there is multicollinearity between X_2 and X_3 since $VIF > 5$. Hence, to decide the most suitable variables for the model, we have constructed two different models as shown in the following table:

MODELS	DEPENDENT VARIABLE	INDEPENDENT VARIABLES
Model 1	Y	X_1, X_2, X_4
Model 2	Y	X_1, X_3, X_4

Logistic regression has been applied to each model, then we have found the following AIC results as shown in Table 10.

Table 10: AIC Results for Logistic Regression (Malawi)

Models	LL	AIC
Model 1	-22.89	53.78
Model 2	-25.58	59.17

Since AIC of Model 1 is less than the other model, we continue with this model and, then we proceeded to Step 2. When we separately applied AR(1) and AR(2) to Model 1, we found that AR(1) is more appropriate than AR(2) as indicated by the AIC results given in Table 11.

Table 11: Model Summary for Autoregressive Processes (Malawi)

Models	Variables	LL	AIC
Model 3	Y, $X_1, X_2, X_4, AR(1)$	-20.80	51.60
Model 4	Y, $X_1, X_2, X_4, AR(1), AR(2)$	-20.66	53.33

Finally, a comparison between Logistic and Probit regression models is performed.

Table 12: Model Summary of Logistic and Probit (Malawi)

Models	Variables	LL	AIC
Model3 (Logistic)	Y, $X_1, X_2, X_4, AR(1)$	-20.80	51.60
PROBIT	Y, $X_2, X_4, AR(1)$	-21.02	52.04

Table 12 demonstrates that Logistic regression performs slightly better than the Probit model.

Table 13: Hosmer-Lemeshow Test Result (Malawi)

Models	HL Test	df	p-value	alpha
Model	62.43	51	0.13	0.05

Since the p-value is greater than 0.05 in Table 13, the test is insignificant. In other words, Logistic regression provides a good fit.

Table 14: Chi-Square Test Result (Malawi)

Model	Chi-Square	df	p-value	alpha
Model 4	30.94	4	0.000003	0.05

As shown in Table 14, the model is statistically significant because the p-value is less than 0.05. As a consequence, the model assumptions are satisfied and model provides a good-fit according to Tables 13 and 14.

Table 15: Model Summary for Malawi

MODEL	coeff b	s.e.	Wald	p-value	exp(b)
Intercept	12.84541	5.15923	6.199062	0.012782	379043.8
X1	0.040188	0.088068	0.208241	0.64815	1.041007
X2	-0.05931	0.027875	4.526858	0.033367	0.942416
X4	-6.8E-05	2.43E-05	7.884833	0.004985	0.999932
AR(1)	1.658283	0.818755	4.102129	0.042829	5.250289

The results of Wald Test in Table 15 indicate that the significant predictors for response variable are X2, X4 and AR(1) and the model equation is given as follows:

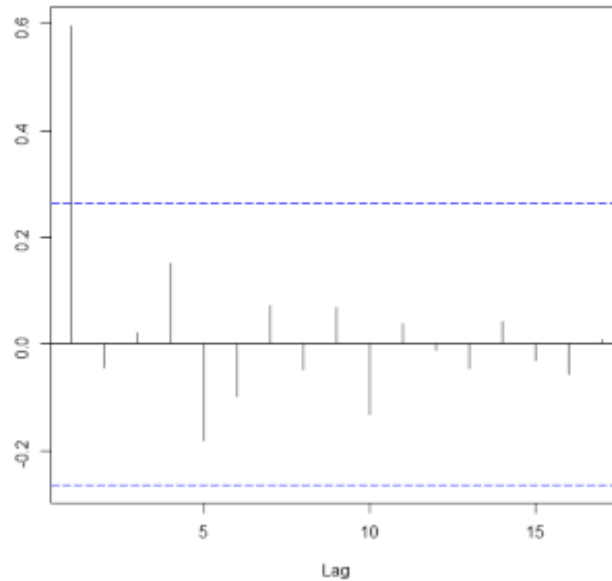
$$\log \left(\frac{p(Amfis)}{1-p(Amfis)} \right) = 12.8454 + 0.040188X_1 - 0.05931X_2 - 0.000006X_4 + 1.6582AR(1) \quad (19)$$

Here, for example, the estimated odds ratio for X_4 is given by $exp(-0.000006) \approx 0.999994$. This means that for each increase in one unit of X_4 , the estimated odds of accessing to at least 1 household decreases by roughly $1 - 0.999994$.

Zimbabwe: Results and Interpretation

Fig. (6) display the autocorrelation results for the dependent variable. There is no consistent trend over the entire time span. This means that there is no serious dependency to the past values; therefore we do not have to include a covariance structure to our models.

Figure 6: Autocorrelation results for Zimbabwe



Variance Inflation Factor Results

Table 16: Variance Inflation Factor for Zimbabwe

Independent Variables	VIF
X1	10.27759
X2	3.95421
X3	11.22696
X4	2.23896

According to VIF outcomes in Table 16, there is a multicollinearity between X_1 and X_3 since $VIF > 5$. In this case, we construct two different models as depicted in previous chapter to decide

which variables are most appropriate for the model. These models are generated as shown in the following table:

MODELS	DEPENDENT VARIABLE	INDEPENDENT VARIABLES
Model 1	Y	X ₁ , X ₂ , X ₄
Model 2	Y	X ₂ , X ₃ , X ₄

We have employed Logistic regression to each model, then we have obtained the following AIC results as shown in Table 17.

Table 17: AIC Results for Logistic Regression (Zimbabwe)

Models	LL	AIC
Model 1	-17.11	42.22
Model 2	-13.41	34.82

Since AIC of Model 2 is less than the other model, we continue with this model and, then we passed to Step 2. When we separately applied AR(1) and AR(2) to the Model2, we found that AR(1) is more significant than AR(2) according to AIC results which is summarized in Table 18.

Table 18: Model Summary for Autoregressive Processes (Zimbabwe)

Models	Variables	LL	AIC
Model 3	Y, X ₂ , X ₃ , X ₄ , AR(1)	-12.67	35.35
Model 4	Y, X ₂ , X ₃ , X ₄ , AR(1), AR(2)	-11.92	35.85

In the last step, a comparison between Logistic and Probit regression models has been made.

Table 19: Model Summary of Logistic and Probit (Zimbabwe)

Models	Variables	LL	AIC
Model3 (Logistic)	Y, X ₂ , X ₃ , X ₄ , AR(1)	-12.67	35.35
PROBIT	Y, X ₂ , X ₃ , X ₄ , AR(1)	-12.66	35.32

As we see from Table 19, Probit regression is slightly better than Logit model.

Table 20: Chi-Square Test Result (Zimbabwe)

Model	Chi-Square	df	p-value	alpha
PROBIT	23.33	4	0.000109	0.05

As shown in Table 20, the model is statistically significant because the p-value is less than 0.05.

Table 21: Model Summary for Zimbabwe

MODEL	coeff b	s.e.	Wald	p-value
Intercept	25.66609	17.71856	2.098274	0.147466
X2	-0.11418	0.077289	2.18265	0.139574
X3	-1.25389	0.913497	1.884101	0.169869
X4	0.067878	0.169677	0.160033	0.689126
AR(1)	0.811836	0.68562	1.40207	0.236377

According to coefficients in Table 21, the model equation is given as follows:

$$\Phi^{-1}(P(Y = 1|X))=25.66609-0.11418X_2-1.25389X_3+0.067878X_4+ 0.811836AR(1). \quad (20)$$

The results of Wald Test in Table 21 demonstrate that there are no significant independent variables. In order to solve this problem this might suggest that the length of lag might be increased or more informative independent variables should be measured and included to the model.

CHAPTER 5

CONCLUSION AND OUTLOOK

In this study, we model probability of reaching to MFIs by the poor population in African developing countries which are Rwanda, Malawi and Zimbabwe. Hence, we aim to measure MFIs' effect on poverty reduction in these countries.

Many studies were done prior to this thesis as an attempt to find out the reasons of the poverty and ways to reduce the poverty. The difference between this research and previously dealt with studies is that, here, the dependent variable is a dichotomous variable that explains to access to microfinance services or not. Since the response variable is a categorical variable, Logistic and Probit regression models have been employed. Except that the dependent variable is a categorical variable, the reason of using Probit Model is that to consider the probability of whether there is an unobserved latent variable. Then, the performance of each model has been compared. We also benefit from autoregressive processes, AR(1) and AR(2), to test dependency of the dichotomous dependent variable to its past values.

The outcomes of the thesis indicate that the explanatory variables which are, adolescent fertility rate, arable land, agriculture ratio, total fisheries production, manufacturing ratio can be used to find the probability of reaching MFIs in some developing countries in Africa such as Malawi, Rwanda. However, for Zimbabwe case, that might be suggested to include more informative variables to the model. We also conclude that there is no direct effect of microfinance institutions to diminish the level of poverty in these countries. Hence, the results of the study indirectly answer the beginning research questions which are:

- Do MFIs enrich individuals' levels of income?
- Do MFIs play a momentous role in outreach to the needy?
- Do microfinance institutions help to increase the life style of the needy?

Since the consequence of the study demonstrates the microfinance institutions do not have direct impact on poverty reduction in the selected African countries, the responses of the above questions are found as negative.

Microfinance sector is a crucial part of development methodology in African developing countries and it should be improved by expanding acknowledgement. The African governments, benefactors and professionals support these institutions by activities and a proper responsibility.

It is vital for microfinance sector to understand the access to MFIs services enables the longevity of them. Therefore, based on the outputs of the research, it is critical to monitor continuously the factors that have negative impact on accessing to microfinance services in the area of study. By improving and expanding their reach more and more, MFIs provide financial services to the poor population more effectively to reduce the poverty.

Also, we have formulated a framework for policy makers and regulators to make MFIs more beneficial for the society. Administration costs and cost of borrowing are major concerns in the microfinance sector. If these two costs are diminished relatively, this will reduce burden of borrowers, and thus brings more income to clients. In addition to this, based on the financial reports, MFIs need to consider their capital base so as to increase the number and size of loans. It is also recommended that MFIs should publish their efficiency levels in the form of both financial and social contributions based on a multiple input-output framework.

As for the limitations of the study, data obtained from World Bank are secondary data. This is because data may not be representative for larger population and using secondary data may cause lack of control on the quality of the data. Also, our outcomes are limited by these countries. As a future work, our study can be expanded to different developing countries in Africa. Additionally, the results are obtained based on the definite independent variables which are defined in Chapter 3, as another future work, with different explanatory variables, the relationship between poverty and microfinance can be observed in a different aspect.

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