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INTEREST RATE CEILING AND FINANCIAL SUSTAINABILITY OF MICROFINANCE INSTITUTIONS IN ZAMBIA

A Dissertation

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ABSTRACT

Interest rate ceilings are often considered as an effective way of preventing lenders from charging extortionate interest rates. However, setting the rates too low may cause institutions to fail to raise enough revenue to cover their costs. Low rates may pressure MFIs to reduce costs, increase loan sizes, withdraw services from areas where it is expensive to operate, or exit from the market altogether. A 42% interest rate ceiling was introduced in Zambia on the effective annual lending interest rate of MFIs in January 2013, which was later removed in November 2015. This research was aimed at investigating the effect of interest rate ceiling and microfinance direct costs on the financial sustainability of microfinance institutions in Zambia.

The study used time series data from consolidated quarterly financial statements from March 2006 to September 2016 and employed Autoregressive Distributed Lags (ARDL) approach to analyse the effect of Yield on Gross Portfolio, Cost of Funds, Operating Expenses and Loan Loss provisions on Operational Self Sufficiency (OSS). OSS was used as a proxy for financial sustainability (dependent variable). Results of the time series analyses showed a positive and significant effect of Yield on Gross Portfolio and Cost of Funds on OSS in the long run. On the other hand, Operating Expenses and Loan Loss provisions had a negative relationship with OSS, albeit statistically insignificant.

Trend analysis of the Yield on Gross Portfolio showed a downward trend and consequently the OSS also trended downwards, with the lowest OSS being recorded during the period interest rate ceilings were introduced. However, the trend showed that the microfinance sector was generally sustainable during the study period. The reduction in OSS following the introduction of the ceiling confirmed findings from prior studies regarding the negative impact of interest rate ceilings on the financial sustainability of MFIs.

Although the study results showed that the MFIs were generally sustainable during the study period, it was evident that they were negatively impacted by the interest rate ceiling. Therefore the recommendation from this study is that interest rates must be set at levels where costs can be adequately covered. Furthermore, managing costs and loan delinquency should be core priorities among Zambian MFIs to ensure financial sustainability.

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GLOSSARY OF TERMS

APR	Annual Percentage Rate
ARDL	Autoregressive Distributed Lags
BLUE	Best Linear Unbiased Estimator
BOZ	Bank of Zambia
CGAP	Consultative Group to Assist the Poor
CF	Cost of Funds
CLRM	Classical Linear Regression Model
CUSUM	Cumulative Sum of Recursive Residuals
EIR	Effective Interest Rate
FSS	Financial Self-sufficiency
IMF	International Monetary Fund
JB	Jargue-Berra
LL	Loan Loss
MIX	Microfinance Information Exchange
MFI	Microfinance Institution
NBFI	Non-Bank Financial Institution
NGO	Non-Governmental Organization
NPL	Non-performing Loan
OE	Operating Expenses
OLS	Ordinary Least Square
OSS	Operational Self-Sufficiency
PP	Phillips-Perron
RESET	Regressions Specification Error Test
ROA	Return on Assets
ROE	Return on Equity
SDI	Subsidy Dependence Index
YGP	Yield on Gross Portfolio

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CHAPTER ONE
INTRODUCTION

1.0 Background

Microfinance refers to the provision of financial services to the poor, or people with low incomes who have no access to mainstream commercial bank services (Hudon & Sandberg, 2015). The words “microfinance” and “microcredit” are sometimes used interchangeably. However, microcredit is “the provision of credit services to low-income entrepreneurs” while microfinance includes additional services such savings, money transfer, insurance, etc., in addition to providing credit (Elia, 2006).

Microfinance was introduced upon the realisation that low income households can also benefit from accessing more broadly defined financial services such as savings (Armendáriz de Aghion & Morduch, 2005). According to Ledgerwood (1999), microfinance programs started in the 1980s. However, Elia (2006) noted that the actual concept was there as early as the 1970s. There has been substantial growth in microfinance since then (Ledgerwood, 1999; Long & Marwa, 2015) and donors have been actively supporting MFIs that are devoted to achieving financial sustainability and extensive outreach. Growth has been fueled by a number of reasons such as “the promise of reaching the poor” by supporting income generation through their microenterprises and “the promise of financial sustainability” through establishing locally managed, subsidy-free and financially self-sufficient (sustainable) institutions (Ledgerwood, 1999).

The advent of microfinance led to the establishment of fully regulated and more commercially oriented institutions (Armendáriz de Aghion & Morduch, 2005). However, a number of recent research findings indicate that most countries exhibit consistently high microfinance loan interest rates (Hudon & Sandberg, 2015), compelling a number of governments to introduce interest rate ceilings (Duval, 2004). An interest rate ceiling is “a policy rate issued by a regulatory agency, limiting the maximum lending interest rate charged by financial institutions” (MicroFinance Transparency, 2016). While interest rate ceilings are often considered as an effective way of preventing lenders from charging unreasonably high interest rates, there have been arguments that setting the rates too low may cause Microfinance Institutions (MFIs) to fail to raise enough revenue to cover their costs (Hug, 2014). Considering that a financially sustainable MFI is one which is able to "to cover all its expenses by its revenue and to generate a margin to finance its growth" (Ayayi & Sene, 2010), failure to generate enough revenue may compel MFIs to withdraw their services from operationally expensive areas, or exit the market altogether (Hug, 2014).

In Zambia, interest rate ceiling was introduced in January 2013 following the "continued charging of exorbitant interest rates" by some Non-Bank Financial Institutions (NBFIs). The maximum effective annual interest rate for MFIs was set at 42% (Bank of Zambia, 2013b). The effective annual interest rate is "the total costs of borrowing expressed as an annual percentage rate". Total cost of borrowing includes all known costs such as interest, commissions and fees relating to the credit agreement, costs of ancillary services in the process of providing credit, etc. (IMF, 2014). Following the decline in interest margins after the interest rate ceiling was introduced, some MFIs responded by implementing cost cutting measures. These included closures of marginal branches and adjusting their business models. Four (4) MFIs exited the sector following the introduction of the interest rate ceiling. However, the central bank continued receiving applications for setting up new MFIs (IMF, 2014). In November 2015, interest rate ceilings were removed by the Bank of Zambia and financial institutions were encouraged to be transparent when pricing credit products as well as to follow responsible and fair lending practices (Bank of Zambia, 2016). According to the Bank of Zambia (BOZ), maintaining the ceiling "wasn't producing the actual outcome" but rather reduced the level of credit as some MFIs stopped lending (The Post, 2016).

1.1 Research Area

Interest rate ceiling has been a common approach by a number of countries in trying to resolve the problem of high lending interest rates. The "stock-taking exercise" which was undertaken by Maimbo and Gallegos (2014) found that 76 countries around the world were using some form of loan interest rate ceilings. This study is concerned with the relationship between interest rate ceiling and financial sustainability of MFIs in Zambia. Interest rate ceiling was introduced in January 2013 in Zambia but was later removed in November 2015.

A number of studies have been done in the area of interest rate ceiling and financial sustainability. For instance, Islam, Porporato and Waweru (2014) examined the cost structures of 216 MFIs in Bangladesh in order to determine whether the MFI's will be able to achieve financial sustainability following the introduction of interest rate ceiling. They measured financial sustainability using ROA and OSS. Results of their study showed general administrative costs and interest rate spread as the two main factors that had a significant relationship with financial sustainability. Islam *et al*., (2014) concluded that MFIs with low administrative costs but with a large interest rate spread were most likely to attain financial sustainability even with the introduction of the interest rate ceiling.

Campion *et. al.,* (2010) examined interest rates and their determinants and found that interest rate ceilings reduced outreach in 29 MFIs located in seven countries. Similar results were found when Alshebami and Khandare (2015) reviewed the impact of interest rate ceilings on the microfinance industry. Alshebami and Khandare (2015) concluded that interest rate ceilings lead to credit shortage, limitation on the scope of operation for MFIs, reduced opportunities for the underprivileged to access loans, and a reduction in actual loan price transparency. Reduced loan pricing transparency and reduced access to financial services were also some of the findings after Helms and Reille (2004) examined the relationship between microfinance and interest rate ceilings. Helms and Reille (2004) found that ceilings make it difficult and sometimes impossible to cover costs and in extreme cases causes MFIs to be driven out of the market. The findings by Helms and Reille (2004) were aligned to those of Iezza (2010) who found that high loan interest rates were one of the statistically significant variables which influenced the MFIs' long term financial self-sufficiency. Acclassato (2006) also observed that financially sustainable MFIs in West Africa applied interest rates as high as 84%. Similarly, Hussien (2006) conducted an assessment of the relationship between outreach and financial sustainability of three Ethiopian MFIs and found low interest rates to be one of the major restraining factors to the attainment of financial sustainability. Contrary to the results of the above studies, Ek (2011) examined the key characteristics of financially sustainable MFIs and argued that the success of MFIs was not high interest rates but the ability to cut costs and ultimately charge less interest. These findings were in agreement with the study by Flosbach and Fellow (2013) who found that profitable MFIs were offering lower loan interest rates after examining the relationship between the profitability of MFIs and the interest charged to their clients.

Helms and Reille (2004) noted that despite several arguments against interest rate ceilings and the fact that they do not often bring out the desired effect, concerns regarding the high cost of microfinance loans are still valid. As such, a number of countries still have interest rate ceilings in place. This was confirmed by the "stock-taking exercise" conducted by Maimbo and Gallegos (2014) who found that 76 countries around the world were using some form of loan interest rate ceilings. This therefore brings to the fore the necessity for continued studies in the area of interest rate ceiling and financial sustainability, apart from the mixed findings from previous studies. Furthermore, Marwa and Aziakpono (2015) noted that the most authoritative statement regarding the performance and sustainability of MFIs in the recent past is probably the one by Morduch (2000) that "less than 1% of MFIs are sustainable and no more than 5% will ever be". Contrary to the assertion made by Morduch (2000), Marwa and Aziakpono (2015) observed that the empirical results from the research conducted by Gonzalez (2005) revealed that about 50% of MFIs attain sustainability between 5 and 10 years of being in operation. Marwa and Aziakpono (2015) therefore concluded that this controversy in the literature forms the basis for the need to do more empirical studies regarding the performance and sustainability of MFIs. Therefore, this research is aimed at investigating the effect which interest rate ceiling and microfinance direct costs could have had on the financial sustainability of Zambian MFIs.

1.2 Problem Statement

Interest rate caps or ceilings are often considered as an effective way of preventing lenders from charging unreasonably high interest rates. However, setting the rates too low may cause financial service institutions to fail to raise enough revenue to cover their costs. Low rates may pressure MFIs to reduce costs, increase loan sizes, or withdraw their services from areas where it is expensive to operate or simply exit from the market altogether (Hug, 2014). Therefore, interest rates must be set at levels where MFIs are able to cover all administrative and capital costs (including inflation), as well as loan losses, and a "provision for increasing equity". Failure to cover these costs will cause MFIs to fail to reach many clients and operate for a limited time only since permanent financial services can only be provided by sustainable MFIs (Rosenberg, 2002). Accordingly, the Consultative Group to Assist the Poor (CGAP) through the "key principles of microfinance" it developed in 2004 acknowledged that the poor need reasonably priced financial services. It also recognized that "financial sustainability is necessary to reach a significant number of poor people", and that "interest rate ceilings can damage poor people's access to financial services" (Alalade, Amusa & Adekunle, 2013).

The central bank of Zambia introduced an interest rate cap of 42% on the effective annual lending interest rate of MFIs in January 2013 in order to protect consumers from excessive interest rates. Just before the introduction of the cap, the average annual effective interest rates for MFIs were 120.8% and 115.5% during the first half and second half of 2012 respectively (Bank of Zambia, 2013a). Miller (2013) noted that the introduction of interest rate caps in Zambia "reopened an old debate over the appropriateness of regulatory intervention to limit the charging of rates". According to Agri-ProFocus Zambia (2014), "anecdotal evidence" indicated that Zambian MFIs were not able to cover their operational costs following the introduction of the interest rate cap causing them to scale down on their operations. The IMF (2015) article IV consultation staff report indicated that interest rate ceilings in Zambia were impeding access to finance, especially access by small and medium scale enterprises. The IMF (2015) noted that the level of the ceiling was particularly too low to adequately compensate for high operational costs and the credit risk relating to microenterprise loans.

In May 2016, three Zambian NBFIs namely, Cetzam Financial Services, Commercial Leasing Zambia Limited and Genesis Finance Limited were declared insolvent and taken over by the central bank. The former Chief Executive Officer of Cetzam Financial Services, one of the major deposit taking MFIs which was wholly owned by Zambians claimed that revenues for the individual institutions were "chocked" by the interest rate ceiling set by the central bank in 2013 (The Post, 2016). In view of the foregoing, this research is aimed at investigating the effect of interest rate ceiling on the financial sustainability of microfinance institutions in Zambia.

1.3 Objectives and Significance of the Research

1.3.1 Objectives of the Research

The objectives of the research were;

1. To examine the effect of interest rate ceiling on financial sustainability of Zambian MFIs
2. To examine the effect of microfinance direct costs on the financial sustainability of Zambian MFIs

1.3.2 Significance of the Research

MFIs that are focused on helping their clients out of poverty should consider the significance of sustainability in fostering their Institutions' continued existence to serve the poor. Furthermore, outside investors not only expect a financial return on their investments but also the efficient use of their resources. Therefore, most MFIs' financial objectives are profitability and sustainability (Millson, 2013).

According to Brouwers *et al*. (2014), the 2009 FinScope survey revealed that access to financial services by adult Zambians stood at only 37.3% while access to credit was only 17.9%. Furthermore, much of the credit in Zambia is provided to those in formal employment through payroll loans representing 32% of the total credit portfolio for both MFIs and commercial banks. Considering these low percentages and the potential effect of interest rate ceilings on the provision of financial services, it is imperative to conduct a study to investigate the effect of interest rate ceiling on the financial sustainability of microfinance institutions in Zambia.

The study will also contribute to the ongoing debate regarding the implications of interest rate ceilings for MFIs as well as the presumably excessive MFI interest rates. Furthermore, apart from filling the gap by providing empirical evidence in literature since no such study has been conducted in Zambia before, the study will also benefit the regulators by enabling them understand the Zambian microfinance market further and thus implement appropriate regulatory measures. Microfinance practitioners will also benefit by understanding the implications of interest rate caps in Zambia thereby enabling them to implement appropriate management measures.

The significance of studying financial sustainability was also pointed out by Ayayi and Sene (2010) who were of the view that since continued donor support cannot be guaranteed, only financial sustainability can lead to increased access to financial services by the poor and other groups excluded from the financial sector and ultimately impact poverty reduction.

1.4 Research Questions and Scope

The study sought to answer the following research questions;

1. What is the effect of interest rate ceiling on the financial sustainability of Zambian MFIs?
3. What is the effect of microfinance direct costs on the financial sustainability of Zambian MFIs?

1.5 Research Assumptions

The following were the assumptions used in this research;

i. All the MFIs continued receiving the same undisclosed amount of subsidies if any during the period of study.
ii. All the MFIs incurred financing costs, hence the inclusion of this cost in the formula for calculating OSS

1.6 Organisation of the Study

This study comprises five (5) chapters with the remaining chapters organized as follows; Chapter 2 provides the literature review. Chapter three (3) provides details of the research methodology; Chapter four (4) provides the research findings and analysis; Chapter five (5) provides the research conclusions and recommendations for future research.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter reviews the literature relating to the subject of interest rate ceiling and financial sustainability of MFIs. The chapter begins with the discussion of the Microfinance sector in Zambia. Theoretical issues relating to financial sustainability, the Welfarist and Institutionist approach, as well as the measures of financial sustainability are then discussed. The chapter further reviews the literature on interest rate ceiling including the rationale, forms, and impact of interest rate ceiling, after which the theoretical framework of this study is discussed. Lastly the chapter reviews empirical studies on financial sustainability.

2.1 The Microfinance Sector in Zambia

The microfinance sector in Zambia emerged in the 1990s at which time it was largely donor driven and concentrated in the urban areas. Most MFIs which were established in the early years of the microfinance sector's formation heavily depended on government subsidies and targeted credit thereby rendering them susceptible to high default. A number of major providers of rural financial services which were sustained by the government collapsed in the nineties thereby leaving a huge gap in the provision of rural and agricultural financial services. This was exacerbated by the decision to close rural branches by commercial banks due to inadequate business and high costs associated with managing their rural branch networks (Agri-ProFocus Zambia, 2014). As of November 2016, the number of licenced MFIs were 34 according to the BOZ website.

Currently the microfinance sector in Zambia is in the category of the formal Non-Bank Financial Institutions (NBFIs) and are regulated by BOZ under the Banking and Financial Services (Microfinance) Regulations Act of 2006 (Agri-ProFocus Zambia, 2014). The Act provides for both deposit taking and non-deposit taking MFIs. Deposit-taking MFIs are allowed to offer various other services such as savings, domestic money transfers, etc. (Arora et.al, 2012). In 2013, the Bank of Zambia re-categorised the MFI sector into the Enterprise Lending and Consumer lending MFIs. The Enterprise Lending category comprises MFIs whose exposure to micro-enterprises constitute 80% or more of total loans while the rest fall under the Consumer Lending category (Bank of Zambia, 2014).

2.1.1 Recent Performance of the Zambian Microfinance Sector

The historical performance of the microfinance sector has not been very good particularly due to high loan repayment defaults, relatively high operating costs and high client exit. The MFI sector was also affected by a limited scope of services, low savings mobilization, low outreach, and poor governance (Siwale & Ritchie, 2011).

Performance in the recent past has, however, been generally fair. According to the Bank of Zambia (2016), the performance and overall financial condition of the Enterprise Lending MFIs in 2015 was fair. The sub sector's capital position and asset quality was fair while the earnings performance was unsatisfactory having recorded a profit before tax loss of K12.2 Million. Total assets declined by 3.8% mostly due to the adjustment of assets by one MFI whose license was revoked in 2015. The regulatory capital ratio was 16.2%, marginally above the 15.0% required minimum. The drop in the regulatory capital ratio was mainly due to the profit after tax loss of K10.8 million coupled with loan loss provisional adjustments for prior periods amounting to K35.6 million (Bank of Zambia, 2016).

The overall Consumer Lending MFIs' financial performance and condition was satisfactory in 2015. Total assets increased by 37.3% largely driven by a 41.7% increase in loans and advances to K2,635.5 million at the end of 2015 which were financed by shareholder loans and equity. The sub sector's regulatory capital position was also rated satisfactory at 36.9%. In terms of earnings performance, consumer Lending MFIs were rated satisfactory in 2015. The profit before tax rose to K133.2 million from K38.5 million the previous year mainly due to the rise in interest income from K535.3 million the previous year to K887.4 million in 2015 (Bank of Zambia, 2016).

2.2 Financial Sustainability

Financial sustainability is the ability of an MFI to cover both direct costs and indirect costs with earned revenue (Ledgerwood, 1999). Ayayi and Sene (2010) defined financial sustainability as the capacity for an MFI "to cover all of its expenses by its revenue and to generate a margin to finance its growth". Accordingly, an MFI attains financial sustainability when it is able to operate without the need for subsidies either in the form of donations or concessional loans (Ayayi & Sene, 2010). However, income for MFIs is sometimes limited when interest rate ceilings, which limit the maximum lending interest rate to be charged by the MFI, are imposed. Since microfinance costs are mainly covered by interest income (De Ridder, 2010), interest rate ceilings have a bearing on the financial sustainability of MFIs.

2.2.1 The Institutionists and Welfarists Approach

The institutionists believe that the effective way to fight poverty is to build an MFI industry that is able to reach a large number of people. This requires a huge amount of financial resources which donors may not be able to provide. Therefore, institutionists assume that donors cannot subsidize enough number of MFIs to enable them provide financial services to all their potential clients. According to the institutionists, the subsidy can be overcome by attracting private sources of capital which in turn requires MFIs to be profitable and sustainable. Accordingly, sustainable institutions are necessary if the main goal of MFIs is a substantial reduction of poverty. In this regard emphasis should be placed on breadth (number of clients reached) and not the depth (clients' poverty level) of outreach. Failure to increase the number of clients reached would result into failure to reduce poverty. Conversely, the overall impact of targeting the poor with subsidized programs will be low due to limited and unstable donor funding (Elia, 2006). According to Elia (2006), the institutionist position has recorded success in the microfinance industry. Examples of successful MFIs, international institutions and networks which follow the institutionist approach include Banco Solidario (BancoSol) in Bolivia, Bank Rakyat Indonesia (BRI), the Grameen Foundation, ACCION International, the Consultative Group to Assist the Poor (CGAP), USAID, and the World Bank. Elia (2006) further noted that most of the microfinance literature follows the institutionist approach.

Unlike the Institutionists approach, the focus of the welfarist approach is the depth (clients' poverty level) and not so much the breadth (number of clients reached) of outreach and an ongoing acceptance of subsidies. Acceptance of subsidies is based on the concern that sustainability can put the accomplishment of the MFIs social mission at risk. The emphasis of the institutionists is on banking, while welfarists' emphasis is on social goals. Financial self-sufficiency is recognized as important but is not considered necessary as the main attention is towards clients and not so much the institution (Elia, 2006).

2.2.2 Measures of Financial Sustainability

According to Ayayi and Sene (2010), financial sustainability is measured by either the Subsidy Dependence Index (SDI) or the Financial Self-Sufficiency (FSS) index. UNCDF (2002) also discussed the OSS as another alternative measure of financial sustainability while some researchers also use the Return on Assets (ROA) (Kar, 2010).

SDI quantifies an MFI's subsidy dependence and measures the overall financial costs from the operations of an MFI. It is a measure of the microfinance social cost and thus indicates the minimum social benefit levels generated by the MFI (Manos & Yaron, 2008).

OSS is the most basic measure of sustainability and focuses on revenues and expenses from the core business of the MFI (excluding donations and non-operating revenue) (Barres *et. al.,* 2005). Ledgerwood (1999) noted the variation in the definition of OSS. One definition is the ability to generate "enough operating revenue to cover operating expenses, financing costs, and the provision for loan losses". In this case OSS indicates whether or not sufficient revenue has been generated to cover the direct costs, including financing costs, but excluding the cost of capital. According to Barres *et.al* (2005), the OSS reflects the ability of an MFI to continue with its operations if no further subsidies are received since it focuses on cost coverage. The alternative definition excludes financing costs in the formula. The argument for excluding financing costs is that their inclusion makes the comparison of self-sufficiency ratios between institutions less relevant since MFIs do not incur financing costs equally. This is because there are some MFIs whose loans are entirely funded through grants or concessional loans and therefore do not borrow funds or collect savings and thus they either do not incur any financing costs or they only incur minimal financing costs. Some MFIs access concessional or commercial borrowings as they progress towards financial viability in which case they incur financing costs. Proponents of the second definition therefore argue that since only operating and loan loss provision costs are incurred by all MFIs, MFIs should only be measured on the management of these costs. Ledgerwood (1999) advised that both formulas are correct and either of them can be used. The following is the formula for calculating OSS adopted from Barres at.al (2005);

$$OSS = FR \div (FE + LL + OE) \quad 0.1$$

Where FR = Financial Revenue, FE = Financial Expenses, LL = Loan Loss Provisions, OE = Operating Expenses.

The significance of an MFI attaining Operational Self-sufficiency as spelt out by Ledgerwood (1999) is that MFIs that fail to attain Operational Self-sufficiency incur losses which ultimately reduce their equity (loan fund capital). This will mean only smaller amounts will be available to loan borrowers. The extreme case will be to close down the MFI once the funds completely run out. The only remedy when the MFI fails to attain Operational Self-Sufficiency is to source additional grants to cover operating shortfalls. MFIs must either increase their return on assets (yield) or reduce expenses relating to operations, financing or provision for loan losses.

FSS is adjusted OSS (Barres et.al, 2005). It is a ratio of "adjusted operating income and adjusted operating expenses" (Marwa & Aziakpono, 2015). Four adjustments affect FSS by increasing financial expense, impairment loan losses, and expense from operations. The "write off adjustment" is an exception since it has no effect both on the income and on expenses (Barres et.al, 2005). The adjustment is meant to show the MFI's financial picture if funds were raised from the commercial market (on an unsubsidized basis) rather than through grants from donors or subsidized capital. Debt and customer deposits are also adjusted in order to reflect market rates. Furthermore, considering that the value of equity is eroded by inflation, financial equity balances are also adjusted for inflation. Other income, such as subsidies and in-kind cash are also adjusted accordingly (Marwa & Aziakpono, 2015).

In summary, the difference between FSS and OSS is that apart from measuring the MFI's ability to cover operating costs, FSS also measures the ability to maintain its equity value relative to inflation as well as being able to operate and expand without receiving subsidies. Generally, OSS is a measure of the ability to survive while FSS is an indicator of the ability to grow. MFIs are expected to aim at achieving an FSS ratio above 100 percent (Barres et.al, 2005). The following is the formula for calculating FSS adopted from Iezza (2010);

$$FSS = OI \div (OE + CF + LL + CC) \quad 0.2$$

Where OI = Operating Income, OE = Operating Expenses, CF = Cost of Funds, LL = Loan Loss Provisions, and CC = Cost of Capital.

The above formula takes into account both the cost of equity and cost of debt in cases where the MFI accessed concessional loans (at below market rates) (Iezza, 2010).

ROA indicates the ability to use the MFIs total assets well in order to maximize profits (Kar, 2010). According to Islam *et al*. (2014), ROA is used to measure firm profitability and as such can be used as another proxy for sustainability. The following is the formula for calculating ROA adopted from Barres at.al (2005);

$$ROA = (Net\ Operating\ Income - Taxes) \div Average\ Assets \quad 0.3$$

2.3 Microfinance Interest Rates

According to Persky (2007), the word “interest” is defined as “the rental price of money” in modern economics. Its origins are closely linked to the changing meaning of “usury” which, in the middle ages, was commonly interpreted as “a loan repayment exceeding the principal amount”. The modern word “interest” is derived from the medieval Latin “interesse” which originally referred to a penalty for defaulting or making late payments on an otherwise legitimate and non-usurious loan. With the passage of time, the word “interest” became the standard term for genuine and accepted payments on loans (Persky, 2007).

2.3.1 Microfinance Interest Schools of Thought

Islam *et al*. (2014) discussed three schools of thought concerning MFI interest rate levels. The first school contends that the poor cannot afford market interest rates. As such interest on their loans must be charged at very low interest rates (between 1% and 3%) irrespective of the inflation rate. Islam *et al*. (2014) noted that such a model can only work with subsidies and is particularly endorsed by the western NGOs and their partners from developing countries. The second school of thought proposes MFI interest rates slightly below the ones charged by commercial banks. Proponents of this model include savings and credit unions and mutual societies. The third school is the one supported by organisations that promote managing microcredit by using effective rates to achieve financial sustainability. Microfinance practitioners who support this school of thought argue that interest rates must be close to market rates, and even a bit higher in order to guarantee the MFIs’ sustainability

(Garrido et.al, 2007). For instance, CGAP (2004) supports interest rates that are higher than the ones for the banking sector but below the ones charged by informal borrowers such as loan sharks in order to guarantee financial sustainability.

2.3.2 The High Microfinance Interest Rates Debate

One major concern regarding MFIs has been the excessive interest rates, considering that the clientele have little or no bargaining power (Rosenberg *et. al.*, 2013). This is despite the fact that microfinance was created to protect the poor from excessive interest rates charged by informal money lenders (Skinner & Payne, 2010). Fernando (2006) observed that although the growth of the MFI industry has been greatly helped by high interest rates and millions of poor and low income people have been enabled to access credit, there are still many who cannot afford the high cost of such loans.

Contrary to these criticisms, Rosenberg *et. al.* (2009) concluded that microfinance interest rates were generally reasonable with no evidence of widespread pattern of abuse after analysing 2006 MFI data from the Mix Market. However, their research did not use any theoretical framework or benchmark against which to judge what an excessive rate is and what it is not. Instead they formed their own intuitive judgment regarding reasonableness from available data. They also found that there was an annual decline of 2.3 percentage points in MFI interest rates since 2003, faster than bank interest rates. They therefore concluded that cases of excessively high interest rates that attracted condemnation were not representative of the entire microfinance industry.

De Ridder (2010) noted that interest paid by clients is the main income for MFIs and therefore must be relatively high to cover costs. Similarly, Julien (2009) maintained that microfinance is like any other business and must operate profitably and sustainably and that countries with high MFI interest rates have had an expansion of operations and outreach to the poor and unbanked. Islam *et al*. (2014), however, cautioned that unreasonably high interest rates will penalise the clients which the MFI may in turn lose and thus undermine its social mission.

Other arguments in favor of high MFI interest rates are that large geographies and small loan amounts result in high operational costs and risks (De Ridder, 2010), although Helms and Reille (2004) clarified that the high microcredit costs are not because it is inherently highly risky to lend to the poor clientele considering that good microcredit programs are often characterized by lower default rates compared to commercial banks. Rather, the high cost of microcredit is due to high delivery costs associated with small transactions. Rosenberg *et. al.* (2009) also explained that interest rates on MFI loans are often much higher than those for bank loans mainly because of comparatively higher costs when lending and collecting many tiny loans than lending and collecting a few large loans. These observations were also made by Fernando (2006) and Skinner and Payne (2010). Fernando (2006) observed that micro lending is a labour-intensive operation with high personnel and administrative costs. Loan recoveries are often executed by visiting clients thereby increasing costs due to time taken and transportation. Inflation also increases the cost of microfinance funds by "eroding microlenders' equity" and thus pushes the nominal microcredit interest rates up (Fernando, 2006).

High interest rates are also justified on the basis of the poor people's ability to "afford" them. It is argued that poor people's livelihoods often produce "windfall returns" thereby enabling them to afford high interest rates (De Ridder, 2010). The affordability of high MFI interest rates is also due to the fact that they are low in comparison to other alternatives such as local money lenders (De Ridder 2010; Sandberg 2012; Rosenberg *et.al.*, 2009).

2.3.3 Information Asymmetry, Adverse Selection, and Moral Hazard

Lending institutions are subjected to the problem of information asymmetry to the degree that they lack information on the borrower's usage of money lent as well as their ability and willingness to pay back. This risk can be absorbed by the lender's interest rate, with a high interest rate justifiably corresponding to high risk. However, as the loan interest rate increases, the risk of default also grows. As such, financial institutions are only eager to charge high rates if they are sure that they will be able to recover the loans in the event of default (Armendáriz de Aghion & Morduch, 2005).

An adverse selection problem happens when financial institutions fail to identify more risky customers whom they can charge more than what is charged to safer customers in order to compensate for the default probability. By not distinguishing riskier from less risk customers, interest rates may be raised for everyone with the resulting possibility of driving less risk customers out of the credit market. The moral hazard problem emanates from the inability to ensure that borrowers fully apply themselves to ensure that their investment projects are successful. Moral hazard also comes from the possibility of borrowers trying to escape with the loaned funds. The adverse selection and moral hazard problems can theoretically be eliminated by using cheap ways to gather and evaluate client information and enforcing contracts. However, the difficulty with this solution is the high transactions costs of processing many small loans (Armendáriz de Aghion & Morduch, 2005).

2.4 Interest Rate Ceiling

An interest rate ceiling is "a policy rate issued by a regulatory agency, limiting the maximum lending interest rate charged by financial institutions" (Microfinance Transparency, 2016).

2.4.1 Forms of Interest Rate Ceiling

According to Maimbo and Gallegos (2014), when loan interest rate ceilings are introduced, the scheme to be used, the "source of the rate-setting authority", the legislation type, and the entity required to set the ceiling need to be defined. Further clarification also need to be made regarding the legal instruments to be used to establish the ceiling, whether the ceiling will only apply to interest rates or they will also apply to charges and other commissions, whether the ceiling will vary depending on the credit type, duration or any other criteria, and whether the ceiling will be absolute or relative. Additionally, clarification needs to be made where the rate is relative as to whether the benchmark will be exogenous or endogenous to the credit market, and whether the ceiling will be a "multiplication coefficient or a fixed margin over the benchmark rate". Maimbo and Gallegos (2014) further elaborated the above issues as follows;

Source of Authority: Based on the source of authority, an interest rate ceiling regime can either be in the form of usury limits, interest rate controls, or de facto ceilings. Interest rate controls are commonly found in banking or central banking laws that authorise the regulators to set the maximum lending interest rates for regulated institutions. In most countries, the central bank sets the interest rate ceilings. Usury limits are commonly encoded into usury laws and they authorize a government agency to set interest rate limits for financial institutions. De facto ceiling is used by some countries where formal interest ceilings are not codified into law, even though interest rates are kept below specified levels due to "political pressure or judicial activism" (Maimbo & Gallegos, 2014).

Legal instruments: These are instruments commonly used to implement interest rate ceilings. They include usury laws, criminal or civil codes, consumer credit laws, microfinance laws, credit union acts, consumer credit laws, decrees, and banking laws. Zambia used the banking laws to set the interest rate ceiling (Maimbo & Gallegos, 2014).

Criteria: The criteria specifies what is to be capped and includes clarification as to whether fees and commissions are to be considered part of the interest rate. Maimbo and Gallegos (2014) found three types of interest where a ceiling is applied namely, the annual percentage rate, the nominal interest rate, and the effective interest rate. Of these, the effective interest rate was the most commonly used. This is the "interest rate that covers all financial costs (such as interest rates, fees, and commissions) expressed as a percentage of the loan used during each payment period" This is the definition which was adopted by Zambia to determine the ceiling. The annual percentage rate (APR) is the "effective interest rate multiplied by the number of periods in a year" and therefore it also takes into account all fees and commissions. The nominal interest rate is less frequently used. It denotes the "rate to be paid on a loan contract" and does not therefore include commissions, fees or other expenses (Maimbo & Gallegos, 2014).

Unique or Different Ceilings: During their study Maimbo and Gallegos (2014) found that most countries that had interest rate ceilings implemented different ceilings on the type of credit, the amount of credit to be extended, the credit duration, or a combination of these. Different ceilings were also imposed depending on the type of institution were the loan was made. Some countries also used unique interest rate ceilings where unique ceilings are set on, for instance, only for microloans, consumer loans, the microfinance sector etc.

Methodologies: Two different criteria may be applied when countries decide to set a ceiling on loan interest rates. These are the absolute ceiling (fixed nominal rate) or the relative ceiling (calculated against a benchmark rate). When a relative ceiling is applied a choice must be made between a "reference rate in the credit market in practice (endogenous) or a base rate such as the interbank refinancing rate (exogenous)". A choice must also be made between using a "multiplication coefficient or a fixed margin over the reference rate". Normally, multiplication coefficients are expressed as "x times the benchmark rate or as x percent over the benchmark rate" while fixed margins are expressed as the "benchmark rate plus x percentage points" (Maimbo & Gallegos, 2014). Miller (2013) noted that the flexible approach of linking the interest ceiling to the base rate which has been set by the central bank implies that the ceiling moves according to market conditions, that is, it rises and falls with monetary tightening and easing respectively. According to Miller (2013), this is the model which was adopted in Zambia where banks were lending at nine percentage points above the policy rate while the pricing for MFI lending was a multiple of this.

2.4.2 The Rationale for Interest Rate Ceiling

Interest rate ceilings are used by governments for various economic and political reasons such as the need to support a specific industry or economic area. For instance the government may identify a market failure in a particular industry, or it may want to shift a greater focus of financial resources towards a particular sector than the market would determine on its own (Miller, 2013). Interest rate ceilings may also be justified on the basis of excessive profits by financial institutions due to exorbitant interest rates. For instance, Sandberg (2012) noted that prior to the debate around the high interest rates charged by bank Compartamos of Mexico in 2007, compulsory interest rate ceilings had been introduced in more than 40 developing countries in order to address "usurious" MFI pricing practices. According to Miller (2013), usurious pricing signifies market failure and therefore warrants the need for the government to intervene in order to protect borrowers.

According to Reifner, Clerc-Renaud, and Knobloch (2009), the underlying philosophy of interest rate restrictions corresponds to the following three distinct goals;

i. The ethical and religious concept of preventing exploitation
ii. The market concept of regulating prices when competition is either inadequate to do so or does not produce the desired impact on the vulnerable
iii. Regulating credit products considered to be detrimental to the economy

Ramsay (2010) discussed the following rationales for interest rate ceilings;

i. reacting to "behavioural mistakes" in cases where consumers seemingly underestimate the risks of expensive credit
ii. providing a "bright line rule" significantly higher than the market rate in order to reduce the high costs of exploitation or proving fraud in credit markets
iii. addressing market competition problems leading to supra normal prices
iv. preventing externalities such as costs of support by the state towards borrowers who become over-indebted due to expensive credit

v. ensuring fair transaction prices

vi. providing "cross-subsidisation" of higher risk borrowers by lower risks thereby demonstrating social solidarity

2.4.3 Arguments against Interest Rate Ceilings

Notwithstanding the above justifications, literature and empirical evidence also provides arguments against interest rate ceiling. Ramsay (2010) argued that interest rate ceilings are a "blunt and over-inclusive instrument" because not all loans with high interest rates are to be perceived as unfair or lead to over indebtedness and not all consumers may underestimate the risks associated with expensive credit. Bowsher (1974) observed that interest rate ceilings are "relics of ancient and medieval thought" which have continued to the present day mainly due to lack of confidence in market forces or because of assumed benefit to higher credit risks. According to Bowsher (1974), indications from history are that the main forces which were in reality keeping interest rates at existing levels were the supply and demand for funds and not interest rate controls. (Paul, 2009) contended that interest rate ceilings are targeted at the symptom instead of the cause of high interest rates namely, high operating costs. Interest rate ceilings can therefore cause lenders to incur losses if the ceiling is set below what is appropriate for cost recovery (Skinner & Payne, 2010).

If the interest rate restrictions reduces the overall volume of credit, the implication is to distribute overheads to a lower number of total credit thereby increasing the average rate of interest **(**Reifner *et. al*., 2009). Likewise, Miller (2013) revealed that past evidence from some developed markets has shown that interest rate ceilings can actually lead to an increase in the level of interest rates. In Colorado for instance, although a study of payday loans showed that the imposition of a price ceiling initially reduced interest rates, interest rates steadily rose towards the interest rate cap in the long run. The explanation for this was implicit collusion, by which a focal point was set by the price ceiling such that lenders knew that price rises would be limited and hence the natural collusive behavior (Miller, 2013). Staten (2008) noted, however, that interest rates do not necessarily reach the regulatory ceiling and are not very likely to do so as the ceiling rises. Rather, the forces that enables credit to be available at prices proportionate to the costs and risks of credit provision are the well-informed consumers and free entry of new competitors. Existing creditors' pricing power is kept in check by the threat of being undercut by competitors. However, interest rate ceiling may incentivise MFIs to stay outside the regulatory system. For instance, the imposition of a ceiling on lending in Bolivia led to a notable reduction in the licensing of new entities thereby posing the risk of increasing the potential for exploitative lending and inability to offer consumer protection (Miller, 2013).

2.4.3.1 Interest Rate Ceiling and Price Elasticity of Demand

According to Karlan and Zinman (2008), the prescription by some policymakers for MFIs to increase interest rates in order to avoid subsidies is only logical if the poor are not sensitive to interest rate changes, in which case MFIs will be able to attain sustainability without reducing the poor's ability to access credit. Accordingly, Karlan and Zinman (2008) tested the assumption of price inelastic demand through randomized trials in South Africa and found downward sloping demand curves which were steeper for price increases. Demand sensitivity rose sharply at prices higher than the lender's standard rates, and repayments also reduced. This implied that even small interest rate increases would bring about a substantial reduction in credit demand. Similar findings were r ecorded by Dehejia *et. al* (2012) after examining demand patterns of MFI loan interest rate increases in the slums of Dhaka in Bangladesh using *Safe*Save microfinance records. Results indicated that borrowers are sensitive to interest rate increases and they tend to take smaller and frequent loans, and making quick repayments leading to reduced overall loan balances. Loan demand was found to recover over the longer term, although four years later it was still not back to the same level as before the interest rate hike.

Similarly, Karlan and Zinman (2016) examined the long run price elasticities of demand for credit in Mexico. Working with Compartamos Banco to estimate the general-equilibrium, long-run, and short-run price elasticities, they used randomized interest rates across 80 regions and found long-run demand to be price elastic, with elasticities growing over time. The number of borrowers was also elastic. According to Karlan and Zinman (2016), long-run elasticities may be different from short-run elasticities. On the borrower side, it may take time for clients to learn about new rates and adjust their choice sets or production functions (fixed costs change to variable in the long-run).

Given the forgoing study results, Karlan and Zinman (2008) argued that this kind of responsiveness to interest rate changes by the poor is an indication that usurious lending cannot be commercially sustainable and as such there is less need for interest rate ceiling.

2.4.3.2 Impact of Interest Rate Ceilings on Microfinance Outreach

Historically, MFIs have been able to fund their network expansion and rapidly expand outreach using profits from existing borrowers. Ceiling interest rates can therefore negatively affect outreach since MFIs may remain profitable in their current markets but reduce investment in new markets (Miller, 2013). Fernando (2006) submitted that outreach expansion has been taking place in environments where institutions have the liberty to determine interest rates based on their institutional and market factors. “Cross-subsidisation” or credit exclusion for some consumers in cases where lenders decide to exit the market will thus hurt most low income borrowers despite being the intended beneficiaries of the ceilings (Ramsay, 2010). This was the case in Nicaragua where MFIs and commercial banks withdrew from some locations following the introduction of the Microfinance Association Law in 2001 which restricted microloan interest rates (Miller, 2013). Interest rate ceilings were also among the obstacles to the proliferation of microfinance in Latin America (Skinner & Payne, 2010). According to Fernando (2006), the proposition that liberal interest rate policies foster the growth of the microfinance industry was supported by empirical evidence from the Asia and Pacific region as more than fifty million poor people were able to access microcredit both from formal and semi-formal institutions. On the other hand, outreach was low in countries where markets were mainly characterised by interest rate ceilings such as Viet Nam and China.

While MFIs may not be as willing or able to expand their operations due to interest rate ceiling, potential investors may consequently also be discouraged from supporting the microfinance industry (Fernando, 2006).

2.4.3.3 Impact of Interest Rate Ceilings on MFIs’ Transparency

Interest rate restrictions may lead to the reduction in the interest margin which may in turn cause the lender to consider other sources of income in order to meet the required return **(**Reifner *et. al*., 2009). Lenders may opt to recover the shortfall on their required return through higher fees on unregulated margins such as prepayment penalties, higher application fees, or elevated charges (Staten, 2008). Thus, ceilings may lead to reduced transparency as MFIs attempt to evade the ceiling by charging higher interest rates through hidden fees and complex interest structures (Paul, 2009) which may have adverse substitution effects where clients are compelled to go for less convenient, less transparent, and more expensive forms of credit (Ramsay, 2010). For instance, Skinner and Payne (2010) noted that some of the lenders in Ecuador attempted to "end-run" interest rate ceiling by charging assorted fees in addition to the specified interest rate. Effectively, this resulted into a rise in loan interest rates since the borrower would have to pay back the principal, interest and the fees at the end of the loan term. This practice, known as "fee shifting", enabled lenders to technically comply with interest rate ceiling while effectively receiving higher interest rates from loans.

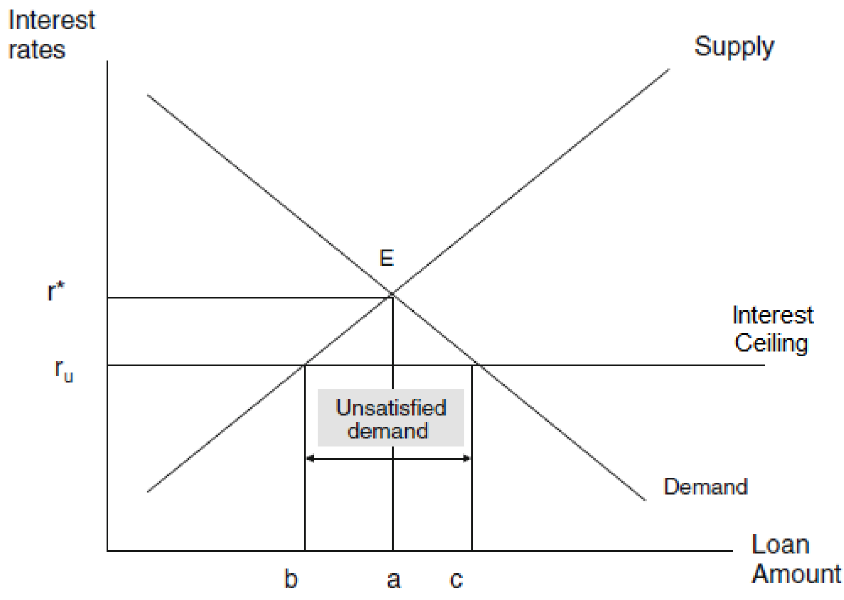
2.4.3.4 Impact of Interest Rate Ceilings on Credit Supply

Staten (2008) noted that warnings that loan supply would contract and the cost of borrowing increase because of interest rate ceilings can be traced as far back as 300 years to the time of John Locke who predicted a reduction in the supply of credit as a result of lowering the usury ceiling from 6% to 4% in 1691. According to Fernando (2006), interest rate ceilings may reduce the creditworthiness of MFIs, reduce their ability to access funds from the market to finance operations, and induce a reduction in credit supply.

The buffer between the borrower's income and essential expenses has to be large enough to assure the lender that the likelihood of loan default is less. Since lenders are often faced with a high default risk when lending to low income customers due to their small buffer, a higher interest rate is usually charged to the low income borrowers compared to other customers in order to compensate for the high risk. This kind of price discrimination is considered efficient from an economic perspective and is envisaged to maximise credit supply in the market **(**Reifner *et. al.,* 2009). On the other hand, interest rate ceilings exacerbate the adverse selection problem as they restrict the ability of lenders to price discriminate (Miller, 2013). If interest rate restrictions are enforced, financial institutions will only be able to charge interest rates which can compensate up to a specific risk level. Beyond this risk level, credit will not be provided to all customers at the maximum legal rate of interest **(**Reifner *et. al.,* 2009). This is because low interest rate ceilings prevent the flow of credit to higher risk individuals and businesses as available funds tend to be channeled towards well established functions with low risk (Bowsher, 1974). Therefore entrepreneurs who might need to access more expensive credit for their riskier business ventures may not have access to such funds (Miller, 2013). As a result, innovation is discouraged, economic progress is slowed, and competition is reduced (Bowsher, 1974).

Apart from reasons relating to the likelihood of default as elaborated above, some of the higher risk borrowers are rationed out of the market because the cost of servicing them become relatively higher than the revenue received when interest rate ceilings are set. Also, competition prevents lenders from subsidizing high risk borrowers through increased charges to low risk borrowers (Staten, 2008). Lenders can decide to ration their credit supply either by eliminating some borrowers, or by giving out lower amounts to all the borrowers, or a combination of credit rationing and a reduction in credit amounts (Ashta *et. al.*, 2013). Ledgerwood (1999) and Fernando (2006) observed that when reliable credit is scarce and desirable, credit tend to be predominantly allocated to those with the influence to obtain them, side-lining those who need smaller loans. Staten (2008) noted that in most cases, excluded customers are the young, those who are not very old on their job or at their residence, unskilled workers, low income earners, people with few assets, and those with short or irregular credit histories. All these have attributes that tend to increase the creditor's risk and projected costs. In other words, the ones who are often rationed out of the market are the financially vulnerable who are in fact the very consumers interest rate ceilings were apparently intended to protect**.** The graph in figure 2.1 below depicts the impact of interest rate ceiling on the supply of credit.

Figure 2.1: The Impact of Interest Ceilings on the Credit Market



Source: Adopted from Ashta *et. al*. (2013)

Point E represents the equilibrium between the demand curve and supply curve of microloans when there are no interest ceilings while “a” is the total amount of loans at r* rate of interest. An interest ceiling of r_u prevents equilibrium E from taking place. At interest rate r_u, the maximum credit supply is limited to b whereas the quantity demanded moves to c. Thus the difference between “c” and “b” represents unsatisfied demand (consumer surplus) (Ashta *et. al*., 2013). Imposing a maximum loan price increases the adverse selection problem as the resulting consumer surplus is a larger pool of willing borrowers whose creditworthiness is unidentifiable (Miller, 2013). An artificially high microcredit demand relative to supply which would be created by interest rate ceilings may subsequently create opportunities for rent seeking (Fernando, 2006).

2.4.3.5 Impact of Interest Rate Ceilings on Savings

According to Ledgerwood (1999), a liberalized financial sector, without interest rate ceilings, promotes effective savings mobilization by MFIs. Furthermore, Ledgerwood (1999) considered interest rate ceilings as one of the regulations that lead to financial repression (distortion of financial markets and induction of inefficiency in financial institutions) thereby creating an environment which is not conducive to financial intermediation. Correspondingly, Bowsher (1974) contended that small savers are negatively affected by interest rate controls by denying them the right to a competitive return on their funds. This is because interest rate ceilings on microcredit will cause deposit taking MFIs to reduce their deposit rates thereby negatively affecting savers (Fernando, 2006). Bowsher (1974), noted that unlike small savers, savers with large amounts can easily go around the controlled market by investing in capital markets and uncontrolled central money. Savers may also not be willing to place deposits with the deposit taking MFIs considering that the profitability and viability of MFIs is depressed by interest rate ceilings which may jeopardise funding for MFIs (Fernando, 2006). Table 2.1 below outlines some of the general impacts of interest rate ceilings;

Table 2.1: General Impact of Interest Rate Ceilings on Microfinance Interest Rates

The Supply Side	The Demand Side
Short Term • Lenders forced to reduce interest rates • Rent-seeking incentives among lending staff created by excess demand creates • Reduction in viability of lending to the poor • Profits on loans to the poor reduced • Reduction in incentives to lend to the poor • Reduction in incentives to increase investments aimed at expanding loans to the poor • Increase in policy risk on lending to the poor (possibility of new ceilings) • Potential investors receive negative signal • Increase in risk of lending to microlenders • Reduction in incentives for commercial banks to enter the microcredit market	**Short Term** • Increase in demand for loans at the ceiling rate • New clients seek loans at new rates • Creation of an excess demand for loans at the ceiling rate • Reduction in price of credit to some who get loans • Higher transaction costs paid by some borrowers than before
Medium to Long Term • Creditworthiness for microlenders' reduced • Increase in price at which microlenders can borrow from the market • Decline in microlenders' profits • Decline in the supply of donor funds • Some of the lenders exit the market • Decline in loan supply to the poor • Quality of service to the poor declines • Reduction in interest rates on the poors' deposits • Transaction costs of small deposits increased • Decline in the supply of other financial services to the poor	**Medium to Long Term** • Some of the borrowers move to informal markets • Some of the former borrowers become worse off due to the decline in credit supply • Increase in loan defaults

Source: Fernando (2006)

2.5 Theoretical Framework - Determinants of Microfinance Interest Rates

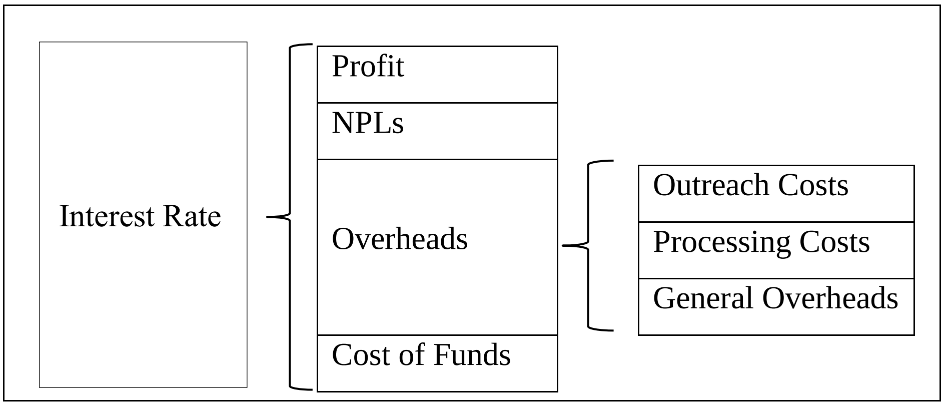
Interest income covers MFI costs. The difference between the MFIs' costs and their income is profit (or loss) simplified by the following equation (Rosenberg *et. al.*, 2013);

$$Income\ from\ Loans = CF + LL + OE + P \qquad 0.4$$

Where CF = Cost of Funds, LL = Loan Loss Expense, OE = Operating Expense, P = Profit

Interest income moves up or down with changes in one or more of the factors on the right side of the above equation (Rosenberg *et. al.,* 2013). In line with the above equation, consumer credit interest rates are composed of four elements namely a compensation for default risk, the market interest rate, the profit margin, and operational costs **(**Reifner *et. al*., 2009). Miller (2013) discussed these four components under the headings of cost of bad debts, cost of funds, profit margin, and overheads (administrative costs) respectively.

Figure 2.2: Components of Interest Rates



Source: Adopted from Miller (2013)

The cost of funds is the amount that the institution pays when it borrows funds that it in turn lends out (Miller, 2013). MFI loans are funded using a combination of equity (owner's money) and debt (funds borrowed from depositors or external lenders). Borrowed funds involve an interest expense while equity may be free if the MFI is not for profit and therefore does not have shareholders to be paid dividends (Rosenberg *et. al.,* 2013). For deposit taking MFIs, the cost of funds is generally the interest paid out on deposits. For other institutions such as non-deposit taking MFIs, the cost of funds could also be the cost of wholesale funds or a subsidised rate on funds provided by donors or the government (Miller, 2013).

Overhead costs include expenses such as salaries, taxes, regulatory fees, legal fees associated with collections, rents, property insurance charges, depreciation, utilities, vehicle maintenance, fuel expenses, and any other business expenses (Campion *et. al*., 2010). Miller (2013) grouped these costs into three broad categories namely, general administration and overheads which relate to running the branches and other offices, the cost of processing and assessing loans, and outreach costs. Campion *et. al.*, (2010) submitted that all of these expenses have to be met using income from lending if the operations of an MFI are to be sustainable. Rosenberg *et.al*. (2013) noted that operating expenses are usually the largest determinant of the interest rate charged since much of the MFIs' loan income is spent on them. One of the empirical studies in support of the assertion by Rosenberg *et. al*. (2013) was the study conducted by Hudgens (2011) were operating expenses were found to be the main drivers of interest rates.

An allowance for non-performing loans (NPLs), i.e. the cost of bad debts, must also be written off by lenders in the rate they charge (Miller, 2013). This is because most MFI loans are either not secured by any collateral or they are secured by collateral which cannot cover a defaulted loan amount after taking into account the collection expenses. Also, poor households often lack documented repayment history (Campion *et. al*., 2010).

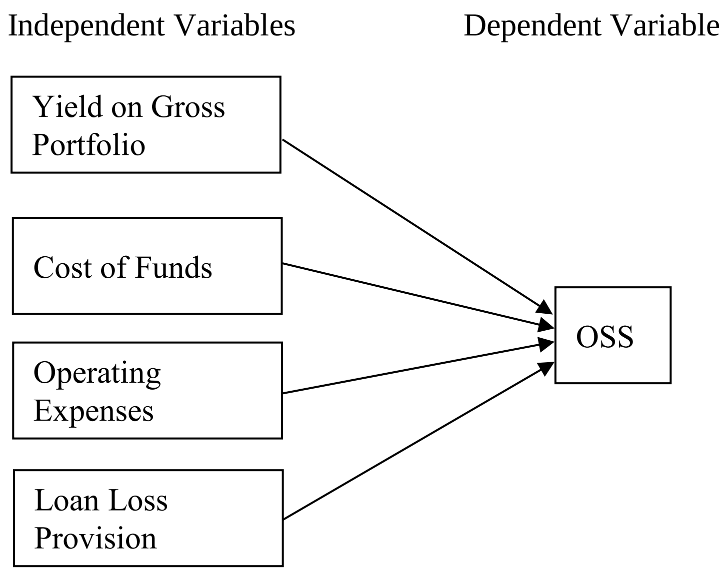
When loan repayments are behind by several repayment periods or something puts the eventual loan collection in doubt, sound accounting practice requires booking the relevant amount as a loan loss provision expense in order to reflect the reduced possibility of collecting in full. By so doing, the probable loan losses are promptly recognized. In the event that the loan which was earlier booked as a provision expense is later fully recovered, the lender will at that point simply reverse the provision expense (Rosenberg *et. al.*, 2013). Everything else being equal, a high number of nonperforming loans and related provisions leads to a lower profit margin. Higher loan losses will in turn necessitate raising the MFI interest rates in order to maintain the desired profit margin. If MFI regulations require a high level of loan loss provisioning despite very low default rates, compliance will raise the cost of lending and, in turn, interest rates (Campion *et. al*., 2010).

Another component of interest rates is the profit margin (Miller, 2013). Profit is the difference between income and expenditure amounts (Rosenberg *et. al.,* 2013). Campion *et. al.,* (2010) noted that the ability to determine appropriate profit levels is at the core of the debate regarding the MFIs' interest rate setting. Adequate profits enable MFIs not only to recover their costs but also to increase their capitalization. Because shareholders or investors for profit oriented MFIs normally expect a certain level of return, the interest rates charged tend to naturally be higher than those for nonprofit MFIs. Although nonprofit MFIs may not necessarily need to generate above cost revenue to the same level as for profit MFIs, they also need to increase their capital base for them to be able to fund investments and thus improve their performance and growth. One of the findings from the study conducted by Hudgens (2011) was that the MFI's profit status had significant effects on interest rates especially in developed microfinance markets. On the other hand, Rosenberg *et. al.* (2009) found that profits were not a predominant determinant of interest rates and contended that in the unlikely and unrealistically extreme scenario of completely eliminating all profit, the interest rate for the average MFI would only drop by about one sixth which would still leave MFI interest rates at seemingly abusive levels to those who do not understand the high costs involved in small loans. The study by Campion *et. al.* (2010) also showed trends of lower interest rates being charged by for profit MFIs.

Skinner and Payne (2010) pointed out that in the typical microfinance context, additional factors contribute to the interest rate. These include business type, competition, local market rates, repayment frequency, and loan size. Campion *et. al.*, (2010) discussed some of the specific external factors that contribute to high MFI interest rates such as the lack of macroeconomic stability, poor infrastructure, and political and other risks. Regarding macroeconomic instability, Campion *et. al.* (2010) noted that average domestic financial market interest rates tend to rise when a country continually finances a growing debt due to a large public deficit. This affects the cost of funds for financial institutions and contributes to inflationary pressures. Similarly, a country having problems with its balance of payments may have its currency depreciate and microfinance operators with foreign debts may raise their interest rates to avoid "unhedged foreign indebtedness". Both lenders and borrowers are also susceptible to inflation uncertainty. A sudden spike in inflation can affect loan profit margins (Skinner & Payne, 2010). Therefore, interest rates must also account for the effects of inflation in order to maintain the purchasing power of loanable capital. Thus, all else equal, high inflation rate leads to high interest rates (Campion *et. al*., 2010). Besides, macroeconomic factors, challenges relating to poor physical infrastructure such as sporadic and unreliable electricity services, poor road network, poor and expensive internet connectivity etc., also contributes to high client outreach costs and consequently high interest rates. Furthermore, changes in the rules, policies, and regulations relating to financial operations may sometimes increase MFI costs (Campion *et. al*., 2010).

Based on the foregoing literature review, this study conceptualizes a framework linking the variables as in figure 2.3 below:

Figure 2.3: Conceptual relationship between the dependent and independent variables



Source: Author

2.6 Review of Empirical Studies on Financial Sustainability

Iezza (2010) showed that high loan interest rates contribute to sustainability after examining MIX market data for 687 MFIs based in 63 countries in order to study the determinant factors of financial self-sufficiency. The study found several variables which together influenced the MFIs' long term financial self-sufficiency. These variables included the capital structure, the collection of client deposits, inflation, and lending interest rates. Other significant factors included low portfolio at risk, low non-earning liquid assets, and Yield on Gross Portfolio. The latter suggested that high loan interest rates contribute to sustainability. Other studies in which the Yield on Gross Portfolio was positively related to microfinance financial sustainability was the quantitative research conducted by Woldeyes (2012) using panel data regression on the six years mix-market secondary data for twelve

Ethiopian MFIs, and the study by Marwa and Aziakpono (2015). Marwa and Aziakpono (2015) examined the financial sustainability as well as the profitability of Tanzanian Saving and Credit Cooperatives (SACCOs) using the 2011 audited financial reports. ROA was used to estimate profitability while the ratio of total expenses to total revenue was used to estimate financial sustainability. Investigation of the determinants of financial sustainability using linear regression revealed that about 61% of SACCOs from the sample were operationally sustainable and 51% were both operationally and financially sustainable. The relationship between yield on gross loan portfolio and both OSS and FSS were found to be positive and significant while cost per client, administrative expenses per borrower, and average disbursed loan size did not affect OSS and FSS. Furthermore, Nyamsogoro (2010) studied factors that affected financial sustainability of MFIs in rural Tanzania by way of a quantitative research approach with FSS as the dependent variable. Panel data regression was used as the main technique during data analysis based on primary and secondary data spanning 4 years for 98 Tanzanian rural MFIs. Nyamsogoro (2010) found that interest rates charged, cost per borrower, and yield on gross loan portfolio, among other factors, affected financial sustainability of rural MFIs in Tanzania.

The other studies in support of high interest rates were the ones conducted by Islam *et al*. (2014) and Ayayi and Sene (2010) both of which were aimed at identifying the determinants of sustainability. Islam *et al*. (2014) examined the cost structures for 215 MFIs from the Microcredit Regulatory Authority of Bangladesh. They used management accounting ideas and frameworks, primarily contingency theory during the identification of MFI's cost structure components. The results indicated general administrative costs and interest rate spread as the two key factors that were significantly related to financial sustainability. Specifically, the study endeavored to predict the impact of MFIs' cost structure on OSS as a proxy for sustainability or the survival of an MFI if an interest rate ceiling is introduced. Their conclusion was that MFIs with lower administrative costs and larger interest rate spreads were more likely to attain sustainability and "survive the interest rate cap". Ayayi and Sene (2010) used data from the MIX Market database for 217 MFIs located in 101 countries to examine the factors that determine the financial sustainability of MFIs. The data used was distributed by region and MFI type and covered a 9 year period from 1998 to 2006. Regions covered included Sub-Saharan Africa, Latin America-Caribbean region, and Eastern Europe-Central Asia. Financial sustainability was the dependent variable while portfolio at risk at 30 days and interest rate applied were the independent variables. One of the conclusions from the study was that a high quality credit portfolio, combined with the application of high enough interest rates that can give a reasonable profit are key to the financial sustainability of MFIs.

Similarly, Hussien (2006) conducted an assessment of the relationship between outreach and financial sustainability of three Ethiopian MFIs namely, OMO Micro Finance Institution (OMFI), Sidama Micro Finance Institution (SMFI) and Addis Credit and Saving Institution (AdCSI). Both qualitative and quantitative methods were used to analyse financial performance. Hussien (2006) collected primary data through semi structured questionnaires and observations while secondary data was extracted from audited financial statements. The study results showed that the three MFIs attained widespread outreach with significant growth in the savings volumes as well as the gross loan portfolio. However, all the sample MFIs had not attained financial self-sufficiency. Major restraining factors to the attainment of widespread outreach and financial sustainability included low interest rates.

Mwangi (2014) and Lupia (2014) conducted studies in Kenya to determine whether there is a relationship between lending interest rates and the financial performance of MFIs. Results for both studies showed a strong positive relationship between lending interest rates and financial performance of MFIs. The study by Mwangi (2014) involved analyzing secondary data from Central Bank of Kenya, nine deposit taking MFIs and the Association of Microfinance Institutions. The data spanning a period of five years (from 2009 to 2013) was analyzed using the multivariate regression model. Lupia (2014) investigated the relationship between interest rates and financial performance of Kenyan MFIs by applying multiple regression analysis on secondary data from published reports for 24 MFIs. ROA was the dependent variable while independent variables used were the interest rates, Inflation, and 91-Day Treasury bill rate. Apart from influence of the rate of inflation on financial performance, Lupia (2014) also found a positive relationship between interest rates and financial performance of Kenyan MFIs. Similarly, Kar and Swain (2014) conducted an investigation as to whether profitability is improved by the high MFI interest rates, and whether the high rates also lead to the reduction in repayment rates and mission drift. A global panel database for 379 MFIs from 71 countries spanning 6 years (from 2003 to 2008) was used in the investigation. The study hypothesised a link between FSS, loan delinquency and MFI portfolio yield. Results showed the real yield on loan portfolio (the interest rate proxy) to have a high positive and significant impact on the financial performance and loan repayment rates for MFIs. In addition, individual-based lenders who charged higher interest rates were found to be more profitable compared to others. However, this was only up to a certain level, beyond which the MFIs profitability tended to be worse. Kar and Swain (2014) concluded that their findings were in line with agency cost theory predictions which posits that "the lenders' loan delinquency rates increase with the interest rates that they charge to their loan clients". Furthermore, Cull *et. al.* (2006) examined profitability, cost reduction, and loan repayment patterns for 124 organisations in 49 countries. They found a positive and significant coefficient for real gross portfolio yield across three profitability indicators namely, Return on Assets, Operational Sustainability, and Financial Self-Sufficiency. Arising from this, their conclusion was that there was a relationship between raising interest rates and improved financial performance for "individual-based lenders". Similar results were obtained by Long and Marwa (2014) regarding portfolio yield in their study to establish the drivers of financial sustainability for 25 Ghanaian MFIs using a six year unbalanced panel secondary dataset (from 2006 to 2011) from the MIX Market. They used panel data regression analysis with FSS as the proxy for financial sustainability (dependent variable). Their econometric results indicated that the administrative efficiency ratio and the Yield on Gross Portfolio were positively related to sustainability of microfinance institutions.

Similar results and conclusions to the studies by Long and Marwa (2014), Cull *et. al.* (2006), and Kar and Swain (2014) were found in a more recent study by Beg (2016) which was aimed at determining the factors impacting financial sustainability and analyzing the impact of increasing interest rates on the financial performance of MFIs in Andhra Pradesh. Beg (2016) used cross sectional unbalanced panel data from MIX Market for the period 2005 to 2013 covering 10 MFIs with a total of 76 observations. FSS was the dependent variable while independent variables were real gross portfolio yield, average loan balance per borrower, portfolio at risk, personnel productivity ratio, capital cost to total assets ratio, gross loan portfolio to total assets ratio, and age of MFIs. Results from the pooled OLS model showed a significantly strong positive relationship between the yield on gross loan portfolio and FSS. Other significant determinants of financial self-sustainability were the portfolio at risk (30) days, and the size and age of an MFI. Beg (2016) concluded that MFIs need to charge optimum interest rates not only in order to cover operating costs but also to cover the possible loan default losses, thereby enabling them to be financially sustainable.

In another study, Nwachukwu (2014) analysed data from 2004 to 2008 for 426 MFIs from 41 developing countries to study the role of interest rates and institutional design in assisting MFIs achieve financial self-sufficiency. The data examined was from MIX database for MFIs from Middle East and Sub-Saharan Africa, Eastern and Central Europe, South and East Asia, and Latin America. The strength of the affirmation that interest charges have a major role in determining the financial self-sufficiency of MFIs in developing countries was first explored. Secondly the validity of the hypothesis that "abusively high interest rates will undermine the profitability prospects of micro-lenders" was tested. Thirdly, the "statistical power of the supposition that the relationship between interest rates and financial self-sufficiency varies with institutional design" was investigated. Estimation of the "unrestricted slope coefficients on the linear and quadratic interest rate variables" showed that MFIs would, on average, improve the possibility of attaining profitability up to 4.71% a year for every 1% increase in their portfolio yields. However, this was only up to the 76% annualized interest rate threshold above which a 1% rise in interest rates would lower chances of earning higher net returns by an annual average of 3.10%.

Contrary to the above findings, Ek (2011) conducted a study on the key characteristics of financially sustainable MFIs and argued that the success of the studied MFIs was not high interest rates but ability to cut costs and ultimately charge less interest. After analyzing data for 1109 MFIs using MIX market data, results showed that the yields on gross portfolio for sustainable MFIs was lower than for non-sustainable MFIs implying that sustainable MFIs did not become self-sufficient by charging high interest rates. Similar results were obtained by Flosbach and Fellow (2013) who found that profitable MFIs tend to offer lower microloan interest rates after examining the relationship between the profitability of MFIs and the interest charged to their clients. Furthermore, Campion *et. al.* (2010) examined MFI interest rates and their determinants. The research used data for 35 MFIs located in Bolivia, the Dominican Republic, Ecuador, Haiti, Mexico, Nicaragua, and Peru for the period 2005 to 2008. The second data source was through telephone interviews with 12 MFI managers. The third data source was from client interviews in Haiti and Nicaragua. Regression analysis results showed trends of lower interest rates being charged by profit-making MFIs while interest rate ceilings reduced outreach to the poor, women, and rural clients.

Other studies which particularly brought out the effects of interest rate ceilings on MFIs include those conducted by Maimbo and Gallegos (2014), Alshebami and Khandare (2015), and Helms and Reille (2004). Maimbo and Gallegos (2014) undertook a "stock-taking exercise" to find out the number of countries with loan interest rate ceilings in force as well as the main characteristics of the regimes used by such countries. They used information from other research done on interest rate ceilings, the Consultative Group to Assist the Poor (CGAP) blogs, websites for various government agencies, and news sites which included the Financial Times and Reuters. 76 countries around the world were found to be using some form of loan interest rate caps. The effects of interest rate ceiling, which varied from country to country, included the withdrawal of financial services from the poor or from specific market segments, increased total cost of loans through additional fees and commissions, etc. The study by Alshebami and Khandare (2015) was aimed at reviewing the impact of interest rate ceilings on the microfinance industry by using secondary data from an assortment of sources such as microfinance books, websites, published papers and reports, etc. Alshebami and Khandare (2015) discovered that the introduction of interest rate ceilings inhibits the free interaction of supply and demand in the credit market. Specifically, they concluded that interest rate ceilings leads to the shortage of credit in the market, reduction in transparency regarding the actual cost of credit, limitation on the scope of operation for MFIs, and reduction in opportunities for the underprivileged to access loans. Helms and Reille (2004) examined the relationship between microfinance and interest rate ceilings using "current state of knowledge", literature review, anecdotal evidence from experts, and survey of interest rate ceilings conducted by CGAP around the world. Helms and Reille (2004) contended that rather than protecting the vulnerable, interest rate ceilings often hurt them by reducing their access to financial services. In addition, interest rate ceilings makes the formal and semi-formal microlenders' ability to cover costs difficult and sometimes impossible. In extreme cases, these institutions are driven out of the market (or prevented from entering the market). As a result, access to financial services by poor clients is reduced causing them to resort to the services of expensive informal credit markets such as local moneylenders. They further argued that interest rate ceilings can also reduce transparency regarding the cost of credit as lenders may add "confusing" fees to their services.

2.7 Literature Review Summary and Conclusion

The literature review highlighted prior studies relating to interest rate ceiling and financial sustainability of MFIs. Prior studies involved MFIs from various countries but mostly from developing countries, with data largely obtained from MIX. The most common proxy for interest rate was the portfolio yield while the FSS and OSS were commonly used as proxies for financial sustainability. Methodologies varied but mainly involved regression analysis. Research objectives also varied but broad categories included determining factors affecting financial sustainability, determining the relationship between interest rates and financial sustainability, examining determinants of interest rates, and effects of interest rate ceilings.

Findings depended on the research objectives, variables, and methodology. Generally, variables which significantly influenced financial sustainability included interest rates, interest rate spread, portfolio yield, and administrative costs. Effects of interest rate ceiling included reduced outreach, shortage of credit, increased cost of loans, reduced loan pricing transparency, and inability to cover costs. Some studies provided unexpected results which required further investigation. For instance, Marwa and Aziakpono (2015) found that administrative expenses did not affect OSS and FSS. Furthermore, Ek (2011) found that sustainable MFIs had comparatively lower portfolio yields, while Campion *et. al.* (2010) found lower interest rates being charged by for profit MFIs.

The reviewed literature gives no indication of studies done on the subject of interest rate ceiling and financial sustainability exclusively of Zambian MFIs. This research will therefore fill this gap. Furthermore, unlike previous studies, this research will use quarterly aggregate time series data from the consolidated quarterly financial statements and use the Autoregressive Distributed Lags (ARDL) approach to determine the relationship between interest rate ceiling on financial sustainability of the microfinance sector as a whole instead of the individual MFIs.

CHAPTER THREE
RESEARCH METHODOLOGY

3.0 Introduction

This chapter specifies and discusses the methodology employed in this research. The chapter begins with a discussion of the approach and strategy for this research and further gives a description of the variables used. The data, data analysis method, research model, research reliability, and research validity are also discussed. The chapter ends with an outline of the limitations for this research.

3.1 Research Approach and Strategy

This study analysed time series data extracted from quarterly consolidated financial statements for Zambian MFIs from March 2006 to September 2016. The study employed ARDL procedure to analyse 5 variables. The reason for using the ARDL model is because of its suitability for first order $I(0)$ and second order $I(1)$ small sample time series data (Gujarati, 2012). While using aggregate data does not reveal the OSS of individual MFIs, the research sought to determine whether there were any changes in the financial sustainability of the microfinance sector in general. One of the reasons for using this approach was based on the argument by Yaron and Manos (2010) that OSS cannot be used for purposes of comparing the self-sufficiency of individual MFIs, such that if MFI X has a larger OSS than MFI Y, it does not imply that MFI X is more self-sufficient than MFI Y.

Some analysts consider FSS to be a more comprehensive measure of sustainability because it includes all costs apart from those associated with its own funds (De Crombrugghe *et. al*., 2008). Ayayi and Sene (2010) also noted that FSS has become the key indicator for financial sustainability while Yaron and Manos (2010) noted that unlike OSS, FSS (as well as ROE and ROA) at least partly account for the subsidies received.

Despite the above observations by De Crombrugghe *et. al*. (2008), Ayayi and Sene (2010), and Yaron and Manos (2010), the OSS was used as the measure of financial sustainability (dependent variable) in this study due to the following reasons;

i. OSS is a measure of an MFI's ability to survive while FSS indicates ability to grow (Barres *et. al*., 2005). The major interest of this study was to ascertain the ability of Zambian MFIs to survive following the introduction of the interest rate ceiling.
ii. OSS reflects the ability of an MFI to continue operating if no further subsidies are received since it focuses on cost coverage (Barres *et.al.*, 2005) and assists in comparing the sustainability for both institutionalist MFIs and welfarist MFIs "without discriminating between the usages of subsidies" (Nadiya *et. al.,* 2012).
iii. OSS is a simple and useful measure which can easily be calculated manually and used to monitor sustainability (Barres *et. al.,* 2005). Conversely, FSS is a more advanced measure which requires computing concessional funds used and the associated opportunity costs for which data is not easy to obtain (Nadiya *et. al*., 2012). De Crombrugghe *et. al*. (2008) also noted the difficulty of estimating an MFI's own funds or equity and the associated opportunity costs and for this reason concluded that OSS is more likely to be reliable than FSS.
iv. OSS is an indicator of the MFI's profitability in a "traditional accounting sense" and indicates the MFI's future performance, assuming that there will be no change in the modes of operations, scope, and size, and provided that the MFI will continue receiving the same undisclosed amount of subsidies (Yaron & Manos, 2010). This research also adopted these assumptions.

3.2 Description and Justification of Variables

According to Islam *et al*. (2014), financial sustainability cannot be measured directly. "A priori idea of sustainability is believed to be reflected by proxies such as OSS and ROA", hence the usage of OSS as a proxy for financial sustainability in this study. The independent variables used in this research are the Yield on Gross Portfolio (YGP), also called Portfolio Yield, Cost of Funds (CF), Operating Expenses (OE), and Loan Loss provision (LL).

The Yield on Gross Portfolio ratio has been used in place of actual interest rates due to incomplete data for effective interest rates for the study period and also in line with the observation by Flosbach and Fellow (2013) that it is often used as an alternative to Effective Interest Rates (EIR). Gross Portfolio Yield is a "ratio of interest revenues to the average size of the loan portfolio" (Cull *et. al*., 2006) and is thus the "weighted average interest rate actually received by the MFI as a whole" (Gonzalez, 2010). The ratio measures how much was received through cash interest payments, fees, and commissions during the period

(Barres *et. al.*, 2005). The measure is intended to capture the "ex-ante interest rate" charged by the MFI instead of the "ex-post interest rate realized on the portfolio since loan losses are not netted out of the revenues (Cull *et. al*., 2006), and is thus an initial indicator of the ability to generate operations cash from the gross loan portfolio (Barres *et. al.*, 2005).

However, Gonzalez (2010) noted that there are many cases where the actual EIR charged by MFIs is underestimated by portfolio yield. Therefore, a low MFI portfolio yield does not necessarily imply a low EIR is charged to borrowers. For instance, MFIs can charge high EIRs, but if there is high loan delinquency both yield and interest income will be low (Gutie´rrez-Nieto *et. al*., 2016) due to an automatic reduction in the interest yield (i.e. the actual cash which has been received by the MFI) compared to the contract rate (i.e., the cash which should have been paid by the borrower) (Gonzalez, 2010). Furthermore, portfolio yield is sensitive to the sequence of loan payments such as "principal first and interest last" schedules as well as to "loans with grace periods or re-scheduling" due to delayed payments. Also, the requirement for borrowers to deposit a certain percentage of their loan with the MFI (compulsory savings) increases the difference between EIR and portfolio yield (Gutie´rrez-Nieto *et. al*., 2016).

Flosbach and Fellow (2013) noted that despite having some shortfalls, portfolio yield is often used as an alternative to EIR because of the ease with which it is calculated using financial statements. Furthermore, the portfolio yield indicator is not distorted by unrealistic accrual or deferral policies, refinancing, or non-cash payments that can conceal problems relating to loan delinquency (Barres *et. al*, 2005).

Robinson (1996) cited by Islam *et al*., (2014) argued that microfinance interest rates should cover all operating costs for the MFI while Ayayi and Sene (2010) showed that integration of quality management and good expense control is vital for financial sustainability. Based on these arguments and other previous studies, Islam *et al*., (2014) proposed that microfinance sustainability is influenced by operating expenses, and also hypothesized a significant negative relationship between cost of funds and OSS. Hence the inclusion of operating expenses and cost of funds as independent variables in this study.

The inclusion of loan loss provision as one of the independent variables is based on the premise that OSS indicates whether or not sufficient revenue has been generated to cover the direct costs including loan loss provisions (Ledgerwood, 1999). Kanake (2014) conducted a research on the effect of credit risk management indicators on financial sustainability of Kenyan MFIs using data for 37 MFIs. The research used FSS as the dependent variable and loan loss provision, risk cover ratio, and portfolio at risk as independent variables. Portfolio at risk and loan loss provision were both found to have a significant negative effect on financial sustainability.

The five 5 variables used in this research are described in table 3.1 below. Descriptions for Cost of Funds, Operating Expenses, and Loan Loss Provision are adopted from CGAP (2003) while the description for Operational Self-Sufficiency and Yield on Gross Portfolio are adopted from Barres et.al (2005).

Table 3.1: Description of variables

A. Dependent Variable				
	Variable	**Description**		
1	Operational Self-Sufficiency (OSS)	Financial Revenue/(Financial Expenses + Loan Loss Provision Expenses + Operating Expenses)		
B. Independent Variables				
	Variable	**Description**	**Expectation**	**Supporting Research**
2	Yield on Gross Portfolio (YGP)	Cash Received from Interest, Fees, and Commissions on Loan Portfolio/Average Gross Loan Portfolio	Positive	Cull *et. al.* (2006)
3	Cost of Funds (CF)	All interest, fees, and commissions incurred on all liabilities including client deposit accounts, and all borrowings and credit line facility fees	Negative	Islam *et al*. (2014)
4	Operating Expenses (OE)	All personnel and administrative expenses incurred while providing financial services	Negative	Islam *et al*. (2014)
5	Loan Loss Provision (LL)	A non-cash expense calculated as a percentage of the gross loan portfolio at risk of default.	Negative	Kanake (2014)

3.3 Data Collection, Choice, and Frequency

Most previous studies on financial sustainability of MFIs used data from the Microfinance Information Exchange organization (Mix Market). Mix Market collects data from various MFIs around the world which it uses to compute various MFI-specific indicators. The data is made available via the website www.mixmarket.org. While the Mix Market is considered by many researchers to provide the most accurate microfinance data, MFIs have no reporting obligation to the organisation. Therefore a natural sample selection bias is involved when using such data (Dorfleitner, *et al.*, 2013). For instance their website only included twelve (12) out of thirty four (34) Zambian MFIs in the country's data for 31 December 2014. For this reason, this study used secondary quantitative time series data extracted from consolidated quarterly microfinance financial statements prepared by the BOZ. A time series data set is made up of observations on one or more variables over time and therefore the data is arranged chronologically with a particular time frequency such as hourly, daily, monthly, quarterly, annual, biannual etc. (Gujarati & Porter, 2009). The time series data that was extracted from the quarterly financial statements (income statements and balance sheets) included the financial revenue, operating expenses, cost of funds, loan loss provisions, interest income, interest expense, non-interest income, fee and commission income, as well as gross loans and advances.

3.4 Sampling

Aggregated quarterly time series financial data comprising 43 observations and covering 34 MFIs for the period March 2006 to September 2016 was used. The study included all MFIs that were registered by the central bank of Zambia during this period.

3.5 Model Specification and Data Analysis Methods

Time series analysis was performed by using the following Ordinary Least Squares (OLS) regression model;

$$OSS_t = \alpha + \beta_1 YGP_t + \beta_2 LL_t + \beta_3 CF_t + \beta_4 OE_t + \varepsilon_t \qquad 3.1$$

Where *t* denotes period. OSS, YGP, LL, CF, OE and LL are as defined in Table 3.1. α and ε represents the intercept and the error term respectively.

Quantitative analysis of the data was done using the EViews 9.5 Statistical Package software (student version). Microsoft excel 2013 was also used to make some of the calculations as well as graphs and tables.

3.6 Model Diagnostics

Considering that this study used time series data, the properties of the data were examined in order to ascertain its stationarity and thus determine the appropriate data analysis method and ensure valid regression results. In addition, since ARDL is a linear regression model, the underlying assumptions under the classical linear regression model (CLRM), and the model's goodness of fit were also verified through various diagnostic and stability tests. The verified assumptions included linearity (using Ramsey RESET test), normality (using Jarque-Bera test), homoscedasticity (using the Breusch-Pagan-Godfrey test), serial correlation (using the Breusch-Godfrey LM test), and stability (using cumulative sum of recursive residuals i.e. CUSUM test).

3.6.1 Stationarity of Time Series

Empirical studies involving time series data assumes that the underlying time series are stationary. A time series is stationary "if its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed". Conversely, a nonstationary time series is characterized by a "time varying mean, or a time varying variance, or both". However, despite the assumption of stationarity, nonstationary time series are sometimes encountered resulting in autocorrelation ("the correlation between a variable lagged one or more periods and itself") (Gujarati & Porter, 2009), hence the need for stationarity tests.

The other reason for ensuring stationarity of data is because the behavior of nonstationary time series can only be studied for the time period being considered and cannot be generalized to other time periods thereby rendering such studies less relevant for policy analysis or forecasting. Furthermore, a very high R^2 is sometimes obtained when a time series variable is regressed on another time series variable(s) even if there isn't a meaningful relationship between the regressed variables thereby giving "spurious or nonsense regression" results. Spurious regression results can be avoided by transforming time series from nonstationary to stationary series (Gujarati & Porter, 2009). Stationarity can be tested in various ways such as graphical analysis, correlogram test, and unit root test.

3.6.1.1 The Unit Root Test

According to Gujarati and Porter (2009), the unit root test is one of the most widely used test of stationarity and it starts with the unit root (stochastic) process as follows;

$$Y_t = \rho\, Y_{t-1} + u_t \qquad -1 \le \rho \le 1 \tag{3.2}$$

where u_t is a white noise error term.

If $\rho = 1$ (in the case of the unit root), equation 3.2 becomes a random walk model without drift, which is a nonstationary time series. Therefore, Y_t can be regressed on its (one-period) lagged value Y_{t-1} in order to determine whether the estimated ρ is statistically equal to 1. If the estimated ρ is statistically equal to 1, then Y_t is nonstationary. Equation 3.2 cannot however, be estimated by OLS and the hypothesis that $\rho = 1$ cannot be tested by the usual t test because such a test is highly biased in the case of a unit root. As such, Y_{t-1} is subtracted from both sides of equation 3.2 to obtain:

$$\begin{aligned} Y_t - Y_{t-1} &= \rho\, Y_{t-1} - Y_{t-1} + u_t \\ &= (\rho - 1)\, Y_{t-1} + u_t \end{aligned} \tag{3.3}$$

which can also be written as:

$$\Delta\, Y_t = \delta\, Y_{t-1} + u_t \tag{3.4}$$

where $\delta = (\rho - 1)$ and Δ is the first difference operator

Equation 3.4 is normally estimated in practice and the null and alternative hypotheses that $\delta = 0$ and $\delta < 0$ respectively are tested (since $\delta = (\rho - 1)$), ρ should be less than 1 for stationarity. Thus, δ must be negative for this to happen). If $\delta = 0$, then $\rho = 1$, in which case a unit root exists and therefore the time series is nonstationary. Equation 3.4 becomes;

$$\Delta\, Y_t = (Y_t - Y_{t-1}) = u_t \tag{3.5}$$

where ΔY_t is the first difference of Y_t, and u_t is a white noise error term and therefore stationary, implying stationarity of the first differences of a random walk time series.

The above is called first-order differencing. Differencing is applied in order to entirely remove the trend component from a series (i.e. to make it stationary) by computing absolute changes from period to period. The differenced series is differenced one or more times if it still exhibits a trend after first-order differencing (Gujarati & Porter, 2009).

3.6.1.2 The Dickey-Fuller Test

The first differences of Y_t are regressed on Y_{t-1} in equation 3.4 to check if the regression's estimated slope coefficient ($=\hat{\delta}$) is zero or not. If the estimated slope coefficient is zero, the conclusion is that Y_t is nonstationary while if it is negative the conclusion is that Y_t is stationary. Since the t value of the estimated coefficient of Y_{t-1} does not follow the t distribution under the null hypothesis that $\delta = 0$ (i.e. $\rho = 1$), that is, it doesn't have an "asymptotic normal distribution", the t test cannot be used to check if the estimated coefficient of Y_{t-1} in equation 3.4 is zero or not. The alternative is the Dickey-Fuller (DF) test. The key insight of the DF test is that testing for nonstationarity is equivalent to testing for the existence of a unit root (Gujarati & Porter, 2009).

Under the null hypothesis that $\delta = 0$, the estimated t value of the coefficient of Y_{t-1} in equation 3.4 follows the τ (tau) statistic. Thus the tau statistic or test is also referred to as the DF test. If the hypothesis that $\delta = 0$ is rejected, the series is stationary. The alternative hypothesis is that $\delta < 0$ (or $\rho < 1$) and therefore the test is one-sided (Gujarati, 2009).

Considering that a random walk process may or may not have drift, or it may have both stochastic trends and deterministic trends, the DF test is estimated under three different null hypotheses in order to take into account the various possibilities (Gujarati & Porter, 2009).

Y_t is a random walk: $$\Delta Y_t = \delta Y_{t-1} + u_t \quad 3.4$$

Y_t is a random walk with drift: $$\Delta Y_t = \beta_1 + \delta Y_{t-1} + u_t \quad 3.6$$

Y_t is a random walk with drift around a deterministic trend: $$\Delta Y_t = \beta_1 + \beta_{2t} + \delta Y_{t-1} + u_t \quad 3.7$$

where t is the time or trend variable. The hypotheses in each of the above cases are:

H_0 : $\delta = 0$ (presence of a unit root or nonstationary time series, or stochastic trend)

H_1 : $\delta < 0$ (Stationary time series, possibly around a deterministic trend)

Rejecting the null hypothesis (H_0) means either Y_t is stationary with zero mean (for equation 3.4), or Y_t is stationary with nonzero mean (for equation 3.6). For equation 3.7, a test for $\delta < 0$ (no stochastic trend) and $\alpha \neq 0$ (presence of deterministic trend) can be simultaneously conducted with the F test, but using the DF table of critical values. A time series may have a combination of both a deterministic and a stochastic trend (Gujarati & Porter, 2009).

The estimation procedure is done by estimating equation 3.4, or equation 3.5, or equation 3.6 by OLS and then computing the (τ) tau statistic for each case, dividing the estimated coefficient of Y_{t-1} by its standard error. Reference is then made to the DF tables (or statistical package) for critical values. The hypothesis that $\delta = 0$ is rejected if the absolute value of the computed tau statistic ($|\tau|$) is larger than the absolute DF or MacKinnon critical tau values, and thus the time series is stationary. If, however, the computed $|\tau|$ is smaller than the absolute critical tau value, the null hypothesis is not rejected, and thus the time series is nonstationary (Gujarati & Porter, 2009).

3.6.1.3 The Augmented Dickey-Fuller Test

The assumption in conducting the DF test in equation 3.4, 3.6, and 3.7, is that the error term u_t is uncorrelated. If however, the u_t are correlated the Augmented Dickey Fuller (ADF) test is used. The ADF "augments" the three preceding equations by adding extra lagged values of the dependent variable ΔY_t in order to remove autocorrelation. The ADF also tests whether $\delta = 0$ and the test follows the same asymptotic distribution as the DF statistic. Therefore the same critical values as in DF can be used (Gujarati & Porter, 2009).

3.6.1.4 The Phillips-Perron Unit Root Test

The DF tests are supported by the distribution theory that is based on the assumption that the "error terms are statistically independent and have a constant variance". Therefore the error terms must be uncorrelated and their variance constant when using the ADF methodology. The Phillips-Perron (PP) test is essentially a generalized ADF test procedure that takes into account relatively "mild assumptions" concerning the distribution of errors

(Asteriou & Hall, 2007). While the ADF test makes adjustments to the DF test to take into consideration any possible serial correlation among error terms by adding lagged difference terms of the dependent variable, the PP test does not but uses nonparametric statistical methods to take care of the serial correlation in the error terms. The ADF test statistic and the asymptotic distribution of the PP test are the same (Gujarati & Porter, 2009).

The following is the PP test regression;

$$\Delta Y_t = \alpha + Y_{t-1} + e_t \quad 3.8$$

With the foregoing, the ADF tests were conducted to determine whether the variables in this study were stationary at levels, at 1st difference, or a mixture of both, and to also ensure that none of the variables was integrated of order 2 [I(2)] in which case it would be inappropriate to use the ARDL model. Employing the ARDL model in data analysis requires the time series data to be stationary purely at level $I(0)$, or purely at first difference $I(1)$, or mixture of level and first difference. The ADF test results were further verified by the PP test.

3.6.2 Cointegration

Time series variables are said to be cointegrated when some of their linear combinations are stationary (Gujarati & Porter, 2009) i.e. they have a "long-term, or equilibrium relationship" among them (Asteriou & Hall, 2007). Cointegration is an overriding requirement for models that use nonstationary time series data because lack of cointegration among variables normally results into a spurious regression (Asteriou & Hall, 2007).

Cointegrated variables are characterized by a mean reverting spread that causes the variables to move around the "common stochastic trends". For two nonstationary variables, the error can be represented as a combination of two cumulated error processes (stochastic trends). It is expected that these cumulated error processes would combine to produce another nonstationary process. However, were two variables, say Y_t and X_t are actually related, it is expected that they would move together and the two stochastic trends would be very similar such that it will be possible to find their combination which eliminates nonstationarity (stochastic trends cancel out). Variables in this special case are said to be cointegrated. If there is a real long-run relationship between Y_t and X_t, then there will be a common trend linking them together even though the variables will rise overtime (since they are trended). For a long-run relationship (equilibrium) to exist, a linear combination of Y_t and X_t (i.e. a stationary variable) is required (Gujarati & Porter, 2009).

The Y_t and X_t linear combination is drawn from the following (Gujarati & Porter, 2009):

$$Y_t = \beta_1 + \beta_2 X_t + u_t \tag{3.9}$$

taking the residuals gives:

$$\hat{u}_t = Y_t - \hat{\beta}_1 - \hat{\beta}_2 X_t \tag{3.10}$$

The variables Y_t and X_t are cointegrated if $\hat{u}_t \sim I(0)$.

In this study, the short and long run relationship of the dependent variable (OSS) on the independent variables, was estimated through the bounds test. The bounds test is based on the F-Test which relies on the hypothesis that:

$H_0{:} = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$

There is no cointegration among the variables

$H_0{:} \neq \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$

There is cointegration among the variables

3.6.3 Misspecification and Normality Tests

In reality, it is difficult to be certain about the specification or form of the equation to be estimated. For instance it is common to have specification errors by estimating an equation which omits one or more significant independent variables or an equation that includes independent variables that do not belong to the "true" specification. Other functional form misspecification issues can arise when the assumption that the relationship among the *Y* and *Xs* is linear, is no longer true (Asteriou & Hall, 2007).

General misspecification is mostly tested using the Regressions Specification Error Test (RESET). If F-statistic is greater than the F-critical value, the null hypothesis of correct specification is rejected and the conclusion is that the model is somehow misspecified.

Alternatively, if the F-statistic p-value is smaller than the required significance level (e.g. 0.05), then the null Ramsey's RESET test is rejected.

Observing the regression residuals is another way of detecting misspecification problems. Additionally, one of the CLRM assumptions is the normal distribution of residuals with a constant variance and a zero mean. When this assumption is violated, the regression model’s inferential statistics are invalidated. Therefore, tests for normality of residuals are quite critical (Asteriou & Hall, 2007). Normality test in this study was done by computing and interpreting the Jargue-Berra (JB) statistic.

3.6.4 Heteroscedasticity

One of the important CLRM assumptions is the homoscedasticity of disturbance terms u_i in the population regression function (that is, they have an equal variance). Failure to satisfy this assumption leads to the problem of heteroscedasticity, or unequal variance (Gujarati & Porter, 2009). There are various reasons for heteroscedasticity which may include; the presence of outliers in the data, incorrect regression model functional form, incorrect data transformation, mixing observations with different measures of scale, etc. (Gujarati, 2012).

Consequences of heteroscedasticity include (Gujarati, 2012);

i. Failure to alter the “unbiasedness and consistency properties” of OLS estimators
ii. OLS estimators are not best linear unbiased estimators (BLUE), that is, they are no longer of minimum variance or efficient but simply linear unbiased estimators (LUE)
iii. Consequently, the t and F tests under the CLRM standard assumptions may be unreliable, which may further lead to inaccurate conclusions about the statistical significance of the regression coefficients.

In view of the heteroscedasticity consequences, heteroscedasticity tests were conducted.

3.7 Research Reliability and Validity

All the data for this research was obtained from the BOZ which is the country’s central bank. The BOZ has the regulatory authority over all registered MFIs in Zambia and receives periodic financial returns from them partly for purposes of monitoring their performance. Thus the data source provides the assurance that this research is valid and reliable.

3.8 Limitations

The following limitations were noted for this study;

- The composition of the microfinance sector kept changing as new MFIs were being opened while some closed during the period under study
- The research did not distinguish between subsidized and unsubsidized MFIs
- The research did not distinguish between deposit taking and non-deposit taking MFIs
- The research is limited to the Zambian microfinance sector

3.9 Research Methodology Summary

This chapter specified and discussed the methodology employed in this research. The study used quarterly financial statements for the Zambian microfinance sector from March 2006 to September 2016 obtained from the central bank to extract quarterly secondary data for four (4) independent variables namely, Portfolio Yield, Cost of Funds, Operating Expenses, and Loan Loss provision. OSS was the dependent variable. The quarterly secondary aggregate data covered 34 MFIs and yielded 43 observations. ARDL was employed for the time series analysis using the Eviews 9.5 statistical package software (student version). Various diagnostic tests such as tests for normality, homoscedasticity, serial correlation, and stability were also carried out to ensure a robust and stable model.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSION

4.0 Introduction

This chapter presents the findings of this study and provides their analysis. The chapter presents and discusses the descriptive statistics as well as the model diagnostics. The time series analysis of stationarity, cointegration, and the long and short run estimates of the determinants of operational self-sufficiency are also discussed in this chapter.

4.1 Descriptive Statistics

From the descriptive statistics table 4.1, the mean OSS was 1.37 (137%) signifying that the MFIs were on average sustainable since this is well above 100%, although the lowest OSS indicator of 0.93 (93%) signified that the MFIs were not sustainable during the respective quarter. The relatively small standard deviation implies that the OSS of the individual MFIs were generally close to the mean OSS value.

Table 4.1: Descriptive Statistics for Individual Variables

	OSS	YGP	LL	OE	CF
Mean	1.374044	0.147277	9199.925	58960.52	38957.68
Median	1.305167	0.155405	7323.000	48472.01	13592.16
Maximum	1.993670	0.283913	32568.27	156146.1	165916.4
Minimum	0.927897	0.058252	-157.3000	10758.00	4226.000
Std. Dev.	0.271137	0.057108	8381.318	38963.69	47554.08
Skewness	0.490485	0.396018	1.392490	0.642994	1.575124
Kurtosis	2.306628	2.523682	4.225968	2.360107	4.247325
Jarque-Bera	2.585494	1.530442	16.58925	3.696618	20.56812
Probability	0.274516	0.465231	0.000250	0.157503	0.000034
Sum	59.08390	6.332921	395596.8	2535302.	1675180.
Sum Sq. Dev.	3.087642	0.136974	2.95E+09	6.38E+10	9.50E+10
Observations	43	43	43	43	43

Note: OSS=operational self-sufficiency; YGP= Yield on Gross Portfolio; LL= Loan Loss Provision; OE= Operating Expenses CF= Cost of Funds.

Source: EViews 9.5 output

The mean YGP shows that MFIs were able to generate operations cash from their gross loan portfolios at an average rate of 14.73%, almost half the maximum rate of 28.39%. The minimum YGP was comparatively low at 5.83% signifying a large range for this variable.

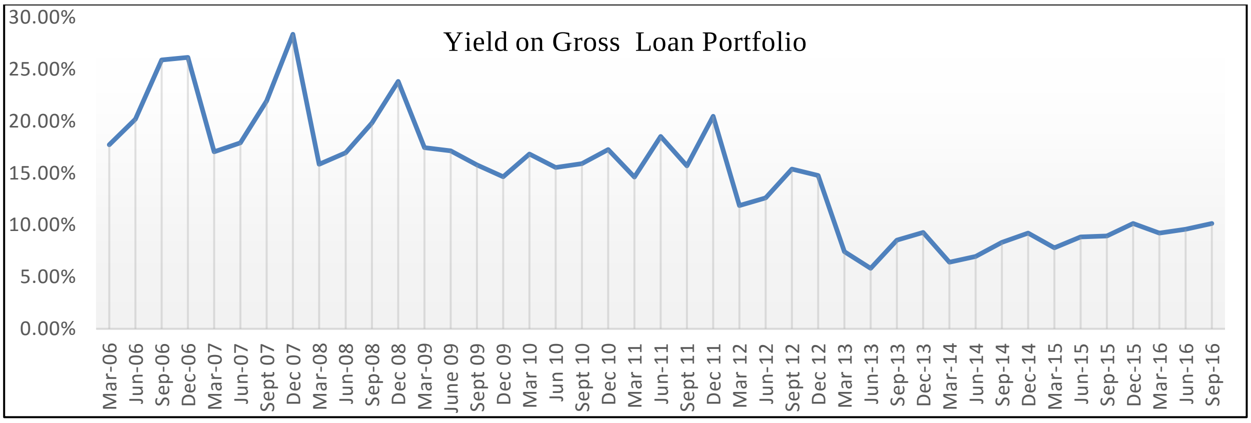
An average amount of K9,199.93 was being provided for loan losses by the MFIs, with the highest provision during the study period being K32,568.27. The mean for LL, OE and CF were K9,199.93, K58,960.52 and K38,957.68 respectively with all the 3 variables having very large differences between their highest and lowest values signifying a large range for each of them. This shows substantial changes in loan repayments, operating costs, and cost of funds during the study period. This is also in line with their high standard deviation values which signified substantial variations from the mean values. As such their mean values cannot be generalised to the individual MFIs. Their medians were also markedly different from their mean values unlike OSS and YGP.

4.2 Trend Analysis

4.2.1 Yield on Gross Portfolio Trend

Yield on Gross Portfolio (or Portfolio Yield) was the interest rate proxy in this study. The Yield on Gross Portfolio is an indication of the "ex-ante interest rate" charged by MFIs (Cull *et. al.*, 2006). Quarterly portfolio yield averaged 14.73% with a standard deviation of 5.7% as shown in table 4.1 for descriptive statistics. The trend of computed quarterly portfolio yield between March 2006 and September 2016 is shown in figure 4.1 below.

Figure 4.1: Yield on Gross Portfolio



Source: Author's computations using Bank of Zambia Data

The graph shows a minimum portfolio yield of 5.83% in June 2013 and the maximum of 28.39% in December 2007. The trend of the Yield on Gross Portfolio showed a significant decline during the period when the interest rate ceiling was introduced (January 2013 to November 2015). The yield gradually rose after the ceiling was removed at the end of 2015 but was still lower than the periods before the ceiling was introduced.

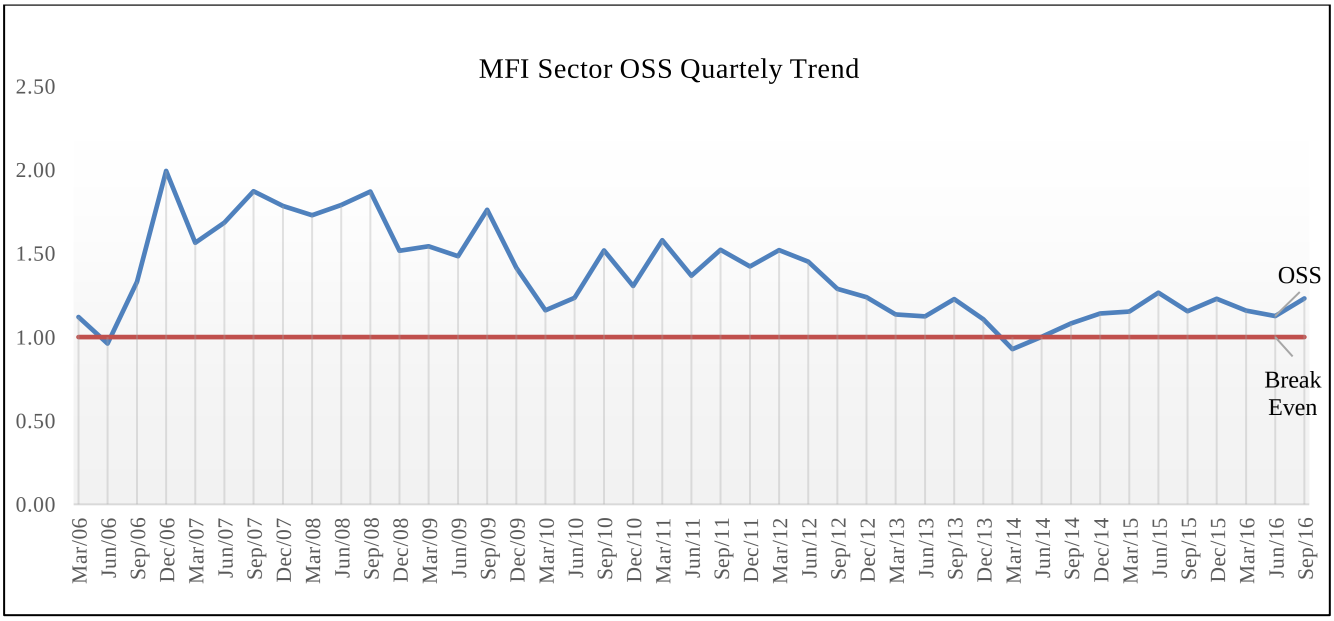
Though the portfolio yields appear low, taking into account the fact that the central bank imposed a cap on the MFI interest rates due to high interest rates, they do not necessarily imply MFIs were charging their clients low EIRs during the study period since there are many situations where the actual effective interest charged by MFIs is underestimated by portfolio yield such as loan delinquency, the sequence of loan payments, rescheduled loans or loans with grace periods, and compulsory savings (Gonzalez, 2010; Dorfleitner *et.al.*, 2013; Gutie´rrez-Nieto *et. al.*, 2016). Similarly, Waterfield (2001) noted that contrary to the earlier position adopted by the microfinance industry that the MFI's average portfolio yield was the one particular ratio which was an adequate representation of loan prices, aggregate portfolio yield does not provide detailed answers to pricing.

4.2.2 Operational Self Sufficiency Trend

Table I in the appendix provides the data used to calculate the consolidated OSS of the MFI sector in Zambia from March 2006 to September 2016.

From the descriptive statistics in table 4.1 above, the average OSS during the study was 137.40%. Figure 4.2 below gives a graphical representation of the OSS between March 2006 and September 2016.

Figure 4.2: MFI Sector OSS Quarterly Trend



Source: Author's computations using Bank of Zambia Data

4.2.2.1 Operational Self Sufficiency before Interest Rate Ceiling

The period before the interest rate ceiling is March 2006 to December 2012. The OSS trend showed that MFIs generated more than sufficient revenue to cover their operating expenses and therefore sustainable during this period despite the downward trend.

4.2.2.2 Operational Self Sufficiency during Interest Rate Ceiling

The period when interest rate ceiling was in force was January 2013 to November 2015. This period had very low levels of OSS compared to the period before the ceiling. The decline in trend was generally steeper until the OSS was below the break-even point of 1.00 during the first quarter of 2014 signifying that the MFIs were generally unsustainable around this time. OSS slightly rose from June 2014 but declined again in September 2015.

4.2.2.3 Operational Self Sufficiency after Removal of Interest Rate Ceiling

Interest rate ceiling was removed in November 2015. Despite the indication that the sector was sustainable during this period with OSS well above the breakeven point, it was still lower than the period before introducing the ceiling.

4.3 Correlation Analysis

Table 4.2 below shows the correlations among the variables used in this study. It can be seen that the variables were generally highly correlated, particularly OE and YGP, OE and CF, and LL and CF. Therefore, there is a fair amount of shared variance that is statistically removed in the model for this study due to the inclusion of these highly-correlated variables.

Table 4.2: Correlation of Variables

	OSS	**YGP**	**LL**	**OE**	**CF**
OSS	1.000000	0.661217	-0.439296	-0.615364	-0.496566
YGP	0.661217	1.000000	-0.489056	-0.759952	-0.622303
LL	-0.439296	-0.489056	1.000000	0.698570	0.736773
OE	-0.615364	-0.759952	0.698570	1.000000	0.909079
CF	-0.496566	-0.622303	0.736773	0.909079	1.000000

Note: OSS=operational self-sufficiency; YGP= Yield on Gross Portfolio; LL= Loan Loss Provision; OE= Operating Expenses CF= Cost of Funds.

Source: EViews 9.5 output

One of the CLRM assumptions is the nonexistence of exact linear relationship among regressors. Multicollinearity or collinearity exists if one or more such relationships exists

(Gujarati, 2012). According to Gujarati and Porter (2009), multicollinearity may arise due to the method of data collection, model constraints, population sample constrains, or model specification. In the case of time series data, multicollinearity could be due to including regressors with a common trend, i.e. they all increase or decrease over time.

Despite some multicollinearity concerns, Gujarati and Porter (2009) noted that it does not violate any regression assumption since unbiased, consistent estimates will still be there and their standard errors may be correctly estimated. However, OLS estimators may have large variances and covariances despite being BLUE thereby making it difficult to make precise estimation. The *t* ratio of one or more coefficients may also be statistically insignificant. In addition, OLS estimators and standard errors may be sensitive to small changes in data.

One of the options to deal with multicollinearity is to remove one of the collinear variables from the model. However, this may result into a specification bias or error. Also, simple or bivariate correlation coefficients do not hold the other variables constant when calculating the pairwise correlations. Furthermore, if CLRM assumptions are satisfied, OLS estimators of the regression estimators are BLUE (or BUE, if normality assumption is added) even if multicollinearity is very high. Moreover, collinearity is often a data deficiency problem, and there may not be alternatives regarding the choice of data. Furthermore, even if one or more regression coefficients cannot be precisely estimated, a linear combination of them can still be efficiently estimated (Gujarati & Porter, 2009). Therefore, Gujarati (2012) advised that if the model consists of several variables that legitimately belong to the model, they shouldn't be removed.

Gujarati and Porter (2009) noted that multicollinearity is often reduced by the first difference regression model. This is because there is no a priori reason to believe that the differences of variables will be highly correlated even if they are highly correlated at level.

Based on the above discussions by Gujarati (2012) and Gujarati and Porter (2009) as well as several diagnostic tests which supported the model, the high correlations among some of the variables at level as shown in table 4.2 were left as they are.

4.4 Unit Root Test Results

Results of the ADF and PP unit root tests (with trend and intercept) are presented in table 4.3 below. Both the ADF and PP test results above shows that three variables namely OSS, YGP, and LL were stationary at level, i.e. integrated of order *I*(0), since their ADF and PP test statistics absolute values were greater than corresponding absolute test critical values and their respective p-values were less than 5% (significant at 5% level). Therefore, the null hypothesis of unit root was rejected at level. On the other hand, two variables namely OE and CF were stationary at first difference and thus integrated of order *I* (1)

Table 4.3: ADF and PP Unit Root Test Results

		ADF TEST			PP TEST			
Variable	**Lag**	**ADF**	**TCV (5%)**	**Decision**	**Bandwidth**	**PP**	**TCV (5%)**	**Decision**
OSS	0	-4.097**	-3.521	Stationary	1	-4.027**	-3.521	Stationary
YGP	0	-5.120***	-3.521	Stationary	6	-5.131***	-3.521	Stationary
OE	0	-0.047	-3.530	Non-stationary	3	-4.142**	-3.521	Non-stationary
LL	0	-4.448***	-3.521	Stationary	4	-4.354***	-3.521	Stationary
CF	0	0.743	-3.521	Non-stationary	7	1.215317	-3.521	Non-stationary
		First Difference				**First Difference**		
OE	2	-8.433***	-3.530	Stationary	14	-27.183	-3.524	Stationary
CF	0	-3.524***	-7.145	Stationary	0	-7.145	-3.524	Stationary

Note: OSS=operational self-sufficiency; YGP= Yield on Gross Portfolio; LL= Loan Loss Provision; OE= Operating Expense; CF= Cost of Funds. ADF= Augmented Dickey-Fuller Test Statistic; PP=Phillip-Perron test statistic TCV = Test Critical Value. Lag length chosen was automatic - based on Schwarz Information Criterion (SIC); Bandwidth chosen was automatic based on Newey-West using the default (Bartlett kernel) spectral estimation method.

Source: Authors compilation using Eviews 9.5 output

4.5 ARDL Model Estimation

Following the unit root tests which revealed the data as comprising a combination of series integrated of order zero and of order one, the ARDL (3, 3, 4, 3, 4) model was estimated, with the maximum lags of 4 automatically selected by EViews based on the Akaike Information Criteria (AIC). Diagnostic tests were then conducted to check the model's credibility. The ARDL model is presented in table III of the appendix.

4.6 Coefficient Diagnostics Results

4.6.1 ARDL Bounds Test for Cointegration Results

The ARDL-Bounds test was applied to check the cointegration of variables in the model. There are two critical values for this cointegration test, i.e the lower bound and the upper bound. All the variables are assumed to be *I*(0) under the lower critical bound meaning that there is no cointegration among the variables. On the other hand, all the variables are assumed to be *I*(1) under the upper bound meaning that the variables are cointegrated. The computed F-statistic value which is greater than the upper bound critical value implies that H_0 must be rejected (variables are cointegrated). On the other hand, H_0 should not be rejected if the computed F-statistic is lower than the lower bound critical value (variables are not cointegrated). The cointegration test results are said to be inconclusive if the computed F-statistic falls between the lower and upper bound values.

Table 4.4: ARDL Bounds Test Results

Test Statistic	**Value**	**k**
F-statistic	5.101324	4
Critical Value Bounds		
Significance	**I (0) Bound**	**I (1) Bound**
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

Note: K=number independent variables. I (0) and I (1) are lower and upper bounds respectively.

Source: Eviews 9.5 output

From the ARDL bounds test results above, the null hypothesis that no long-run relationships exist was rejected since the computed F-statistic value of 5.101324 is greater than the critical upper bounds value (I1) of 3.49 at 5% significance level. This signified the presence of cointegration, that is, the existence of a long run (equilibrium) relationship between OSS and the independent variables. Thus, the model is free from autocorrelation.

4.6.2 Short and Long Run Estimates of OSS

Results of short run determinants of OSS are presented in table 4.5. The cointegrating equation or Error Correction Model (ECM) denoted by "CointEq (-1)" in table 4.5 has a negative coefficient of -1.243 and a significant p-value of 0.0000 at 5% level. The statistically significant and high magnitude negative ECM coefficient confirms the existence of both short run and long run relationships among the variables. The ECM coefficient implies that the previous period disequilibrium is corrected at a speed of 124.34% annually to reach the long run equilibrium steady state position.

Table 4.5: Short Run Estimates of OSS

Dependent Variable: OSS				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D (OSS(-1))	0.382	0.174	2.198**	0.043
D (OSS(-2))	0.147	0.107	1.375	0.1881
D (YGP)	1.120	0.656	1.708	0.1069
D (YGP(-1))	-4.084	0.784	-5.210***	0.0001
D (YGP(-2))	-3.245	0.588	-5.518***	0.0000
D (LL)	0.000	0.000	-1.030	0.3183
D (LL(-1))	0.000	0.000	-0.924	0.3692
D (LL(-2))	0.000	0.000	-0.801	0.4347
D (LL(-3))	0.000	0.000	1.846*	0.0834
D (DOE)	0.000	0.000	-0.869	0.3978
D (DOE(-1))	0.000	0.000	2.859**	0.0114
D (DOE(-2))	0.000	0.000	2.981***	0.0088
D (DCF)	0.000	0.000	1.703	0.1079
D (DCF(-1))	0.000	0.000	-4.472***	0.0004
D (DCF(-2))	0.000	0.000	-3.528***	0.0028
D (DCF(-3))	0.000	0.000	-2.376**	0.0303
CointEq (-1)	-1.243	0.196	-6.338***	0.0000

*Note: OSS=operational self-sufficiency; YGP= Yield on Gross Portfolio; LL= Loan Loss Provision; OE= Operating Expenses CF= Cost of Funds. CointEq (-1) = Error correction vector; *** and ** denotes significance at 1% and 5% respectively.*

Source: EViews 9.5 Output

Yield on Gross Portfolio, Operating Expenses, and Cost of Funds were found to influence OSS significantly in the short-run. Yield on Gross Portfolio and Cost of Funds had a negative significant relationship while Operating Expenses had a positive and significant relationship. Results for long run determinants of OSS are presented in table 4.6 below.

Table 4.6: Long Run Estimates of OSS

Dependent Variable: OSS				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.485	0.130	3.744***	0.0018
YGP	5.980	0.576	10.384***	0.0000
LL	0.000	0.000	-0.187	0.8537
DOE	0.000	0.000	-0.950	0.3563
DCF	0.000	0.000	2.360**	0.0313

*Note: OSS=operational self-sufficiency; YGP= Yield on Gross Portfolio; LL= Loan Loss Provision; OE= Operating Expenses CF= Cost of Funds. *** and ** denotes significance at 1% and 5% respectively.*

Source: EViews 9.5 Output

In the long run relationship, Yield on Gross Portfolio (YGP) and Cost of Funds (CF) were positively and significantly related to Operational Self-sufficiency. From the magnitude of the YGP coefficient in table 4.6, a one percent increase in the Yield on Gross Portfolio would lead to an average increase of 5.98% in the Operational Self-sufficiency ratio since the relationship between the variables is positive and statistically significant. The rationale for this relationship can be explained in terms of the definition of both OSS and Gross Portfolio Yield. Gross Portfolio Yield is the “weighted average interest rate actually received by the MFI” (Gonzalez, 2010) while OSS indicates whether or not sufficient revenue has been generated to cover operational costs (Ledgerwood, 1999) and to provide a margin for financing growth (Ayayi & Sene, 2010). Considering that that interest paid by clients is the main revenue for MFIs (De Ridder, 2010), a rise in Yield on Gross Portfolio entails a rise in interest income and hence sustainability. In Zambia, trend analysis for the study period showed that as the Yield on Gross Portfolio increased, OSS also increased. The introduction of interest rate caps led to a noticeable decline in OSS and the gradual rise was also noticed after the removal of the cap. Therefore, it can be concluded that the reduction in interest income (as represented by the Yield on Gross Portfolio) due to interest rate ceilings led to a reduction in OSS and vice versa.

These results are consistent with expectation and empirical findings from literature such as Cull *et. al.,* 2006 who found a positive and significant relationship between Gross Portfolio Yield and sustainability. De Crombrugghe *et. al.* (2008) also found that the Portfolio Yield positively affected financial self-sufficiency through interest and fees revenue. Furthermore, after comparing mean portfolio yields from their study, Campion *et. al.* (2010) found that financially self-sufficient MFIs usually charge higher interest rates than MFIs that are not financially self-sufficient. Therefore, the higher the Yield on Gross Portfolio, the higher the OSS. Other studies in which the Yield on Gross Portfolio was fpiund to be positively related to OSS include Marwa and Aziakpono (2015, Iezza (2010), Woldeyes (2012), etc.

The long run relationship between Cost of Funds and OSS showed that a 1% increase in Cost of Funds would lead to an average increase of 0.0025% in Operational Self-sufficiency. However, these results are contrary to empirical evidence and therefore requires further investigation. For instance Islam *et al*., (2014) hypothesized a significant negative relationship between cost of funds and OSS. This is because the cost of funds is an expense borne by an MFI when it borrows funds (Miller, 2013) and therefore is expected to negatively affect sustainability.

On the other hand, Operating Expenses and Loan Loss provisions were found to have a negative relationship with Operational Self-sufficiency but their coefficients were statistically insignificant, thus signifying no evidence of long-run equilibrium relationship between them and OSS. However, the negative relationship is consistent with prior findings from literature such as Islam *et al*., (2014) and Kanake (2014) respectively. Both Operating Expenses and Loan Loss Provisions are direct costs and are therefore expected to negatively affect sustainability. Thus, a rise in these costs would lead to a decline in OSS since OSS is an indication of profitability (Yaron & Manos, 2010).

4.7 Residual Diagnostics Results

The results of the diagnostics of the ARDL model is presented in Table 4.7. The diagnostics include tests for serial correlation, heteroskedasticity, omitted variables, and normality.

Table 4.7: Residual Diagnostics Results

Serial Correlation test: Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.458537	Prob. F (2,14)	0.6414
Obs*R-squared	2.336169	Prob. Chi-Square (2)	0.311
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.464894	Prob. F (21,16)	0.9495
Obs*R-squared	14.40006	Prob. Chi-Square (21)	0.8518
Scaled explained SS	2.146714	Prob. Chi-Square (21)	1.000
Omitted Variable Test: RAMSEY RESET TEST			
t-statistic	1.926506	Probability	0.0732
F-statistic	3.711425	Probability	0.0732
Normality test: Jacque-Berra			
t-statistic	0.2348490	Probability	0.8892
Skewness	-0.108456		
Kurtosis	2.681772		

Source: EViews 9.5 output

One of the common residual tests of serial correlation is the Breusch-Godfrey Langrange Multiplier (LM) test. The null hypothesis for the Breusch-Godfrey Serial Correlation LM Test is H_0 = no serial correlation. Since the Obs*R-squared probability value of 31.10%

from the above Serial Correlation LM test results is above the 5% significance level, the null hypothesis that the model has no serial correlation was accepted.

Heteroscedasticity test results showed that the probability of Obs*R-squared was 85.18% which is more than 5%. Therefore, the null hypothesis of no heteroscedasticity was accepted. In respect of the omitted variable test, a p-value of 7.32% from the Ramsey RESET test results was observed. This is not statistically significant since it is greater than the 5% level of significance. Hence, the null hypothesis for linearity could not be rejected, signifying that the model was appropriately specified.

Although Gujarati (2012) noted that the JB test is a large sample test which may be inappropriate for small samples, the JB statistic of 0.23 and a p value of 0.89 for the residuals of the regression in this study signified that the assumption of normality of the error term was appropriate for the model despite having 43 observations. According to Gujarati (2012), the closer the JB value to zero, the better the normality assumption.

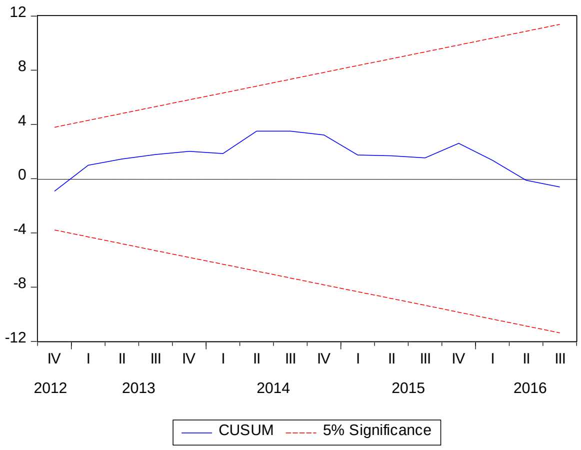
According to Garson (2012), Skewness (the tilt or lack of it in the distribution) should be within the +2 to -2 range while Kurtosis (peakedness of the distribution) should be within the +3 to -3 range for normally distributed data. From table 4.7, the skewness value of -0.11 and kurtosis value of 2.68 are very close to 0 and 3 respectively which further gives an indication that the data was normally distributed.

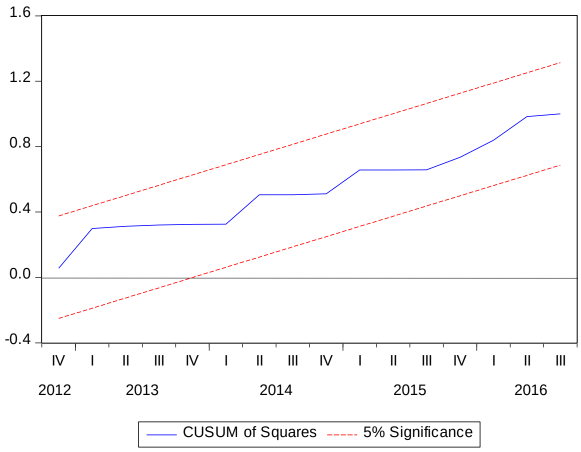
4.8 Stability Diagnostics Results

4.8.1 Cumulative Sum of Recursive Residuals Results

Both the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) of recursive residuals tests were performed on the ECM to test the stability of short-run and long-run coefficient estimates. Figures 4.4 depicts both the CUSUM and CUSUMQ plots. The estimated coefficients are said to be stable if the CUSUM and CUSUMQ plots (blue line) stays within the bounds of the red lines (5% critical bounds). Both the CUSUM and CUSMQ plots shows that the model parameters are stable over the study period since the plots are located within the critical bounds at 5% significance level.

Figure 4.4: CUSUM and CUSUMQ plot





Source: EViews 9.5 output

4.9 Summary of Research Findings

Trend analysis of the YGP showed a downward trend and consequently the OSS during the study period. The lowest YGP was recorded during the time ceilings were introduced. However, the low OSS prior to December 2006 requires investigation.

The existence of a long run relationship between OSS and the independent variables was established through the ARDL bounds test. The ECM also indicated the presence of both short and long run relationships among the variables. In the short-run, Yield on Gross Portfolio, Operating Expenses, and Cost of Funds were found to influence OSS significantly. Yield on Gross Portfolio and Cost of Funds had a negative but significant relationship while Operating Expenses had a positive and significant relationship. In the long run relationship, Yield on Gross Portfolio and Cost of Funds were positively and significantly related to Operational Self-sufficiency. On the other hand, Operating Expenses and Loan Loss provisions were found to have a negative relationship with Operational Self-sufficiency albeit statistically insignificant.

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter concludes the study on the Interest Rate Ceiling and Financial Sustainability of Microfinance Institutions in Zambia and gives policy and future research recommendations

5.1 Conclusions

The trend analysis of consolidated OSS showed that the MFIs were generally sustainable except between March 2014 and June 2014 when the sector became financially unsustainable following a gradual decline in OSS in the preceding months. This followed the introduction of interest rate ceiling and therefore can be attributed to inadequate revenue generated by the MFIs due to the ceiling. Among all the variables examined, the Yield on Gross Portfolio had the greatest influence on OSS. The positive and significant effect of Yield on Gross Portfolio on OSS in the long run confirmed the significance of interest income in relation to the sustainability of MFIs and also confirms findings from prior studies such as the findings of Cull *et al*. (2006), Iezza (2010), Marwa and Aziakpono (2015), and Nyamsogoro (2010) among others. The negative effect of Yield on Gross Portfolio in the short run could be attributed to the sensitivity of borrowers to interest rate increases (Karlan & Zinman, 2008; Dehejia *et. al.*,2012; Karlan & Zinman, 2016). According to Karlan and Zinman (2016), long-run elasticities may be different from short-run elasticities. On the borrower side, it may take time for clients to learn about new rates and adjust their choice sets or production functions. Consequently, MFIs may not be able to generate enough revenue to cover costs in the short run. However, loan demand may recover in the long run (Dehejia *et. al.*,2012).

The effect of direct costs (Operating Expenses, Cost of Funds, and Loan Loss Provision) on OSS in the short run were mixed, with Cost of Funds having a negative effect while Operating Expenses and Loan Loss had a positive effect contrary to expectation and thus required further investigation. However, the positive impact of Operating Expenses could be that high Operational Expenses resulted in increased operational revenue.

In the long run relationship, Cost of Funds was found to have a positive influence while Operating Expenses and Loan Loss provisions were found to have a negative influence on OSS. The long run findings were in line with findings from prior studies except for the positive relationship between Cost of Funds and OSS which requires further investigation.

Overall, the results of this study indicates that the Zambian microfinance sector was negatively impacted by the interest rate ceiling. This implies that interest rates must be set at levels were costs can be adequately covered. Thus, policy makers should avoid imposing interest rate ceilings in order to enable MFIs generate adequate revenue to cover their costs. This will in turn promote industry growth, microcredit supply, and financial sustainability. Authorities should consider alternative measures to stimulate lower interest rates such as controlling inflation, developing the financial infrastructure, and creating an environment that encourages entry of experienced investors to the industry thereby fostering competitiveness. Furthermore, managing costs and loan delinquency should be core priorities among Zambian MFIs to ensure financial sustainability.

5.2 Recommendations for Future Research

Based on this study, the following areas are recommended for future research

- A research on the financial sustainability of individual regulated Zambian MFIs before, during and after the interest rate ceiling
- A comparison of the financial sustainability between Consumer Lending and Enterprise lending Zambian MFIs before, during and after the interest rate ceiling
- Determinants of Yield on Gross Portfolio for Zambian MFIs

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APPENDICES

Table I: Quarterly Aggregate Revenue, Expenses, and Calculated OSS

Quarter	Financial Revenue (K'000)	Operating Expenses (K'000)	Financial Expense (K'000)	Loan Loss Provision (K'000)	OSS
Mar-06	20,286	10,787	4,648	2,674	1.12
Jun-06	22,746	10,758	5,033	7,871	0.96
Sep-06	31,883	15,428	6,607	1,917	1.33
Dec-06	35,274	13,170	4,226	297	1.99
Mar-07	40,356	17,001	5,397	3,390	1.56
Jun-07	39,451	12,010	5,678	5,734	1.68
Sep-07	52,995	16,067	7,690	4,540	1.87
Dec-07	74,040	23,731	8,407	9,353	1.78
Mar-08	61,089	21,876	9,022	4,459	1.73
Jun-08	65,603	22,721	8,579	5,347	1.79
Sep-08	74,091	22,194	9,648	7,757	1.87
Dec-08	84,709	34,035	12,653	9,196	1.52
Mar-09	86,477	38,389	13,592	4,069	1.54
Jun-09	83,644	39,703	13,097	3,579	1.48
Sep-09	80,036	31,108	14,073	281	1.76
Dec-09	78,647	32,556	12,313	10,729	1.41
Mar-10	72,904	48,472	11,853	2,509	1.16
Jun-10	68,687	34,857	12,833	7,927	1.24
Sep-10	74,468	38,962	10,220	-157	1.52
Dec-10	78,661	42,704	12,462	5,103	1.31
Mar-11	81,092	40,269	7,983	3,093	1.58
Jun-11	99,733	51,698	10,164	11,071	1.37

Quarter	Financial Revenue (K'000)	Operating Expenses (K'000)	Financial Expense (K'000)	Loan Loss Provision (K'000)	OSS
Sep-11	91,747	41,653	11,293	7,323	1.52
Dec-11	117,449	61,348	17,312	3,956	1.42
Mar-12	105,686	53,512	14,426	1,614	1.52
Jun-12	112,912	56,959	18,037	2,794	1.45
Sep-12	136,324	75,437	22,539	7,910	1.29
Dec-12	134,655	73,430	24,415	10,865	1.24
Mar-13	135,621	60,784	28,591	30,042	1.14
Jun-13	130,516	72,037	32,978	11,055	1.12
Sep-13	184,188	97,330	38,013	14,753	1.23
Dec-13	140,322	77,364	46,317	3,174	1.11
Mar-14	132,454	82,625	57,193	2,928	0.93
Jun-14	165,793	88,959	67,416	9,155	1.00
Sep-14	218,681	103,099	76,282	22,725	1.08
Dec-14	238,480	109,680	83,040	16,253	1.14
Mar-15	227,773	102,469	90,917	4,173	1.15
Jun-15	296,907	114,982	105,656	13,863	1.27
Sep-15	274,260	114,692	103,224	19,699	1.15
Dec-15	356,717	129,596	144,891	15,739	1.23
Mar-16	360,125	121,647	156,909	32,568	1.16
Jun-16	395,401	156,146	163,636	31,321	1.13
Sep-16	382,194	123,056	165,916	22,947	1.23

Table II: Calculated Quarterly Aggregate Yield on Gross Portfolio

Quarter Ending	Yield on Gross Portfolio
Mar-06	17.75%
Jun-06	20.20%
Sep-06	25.90%
Dec-06	26.15%
Mar-07	17.05%
Jun-07	17.91%
Sept 07	21.98%
Dec 07	28.39%
Mar-08	15.86%
Jun-08	16.95%
Sep-08	19.84%

Quarter Ending	Yield on Gross Portfolio
Dec 08	23.86%
Mar-09	17.47%
June 09	17.16%
Sept 09	15.79%
Dec 09	14.65%
Mar 10	16.86%
Jun 10	15.54%
Sept 10	15.93%
Dec 10	17.26%
Mar 11	14.63%
Jun-11	18.55%

Quarter Ending	Yield on Gross Portfolio
Sept 11	15.69%
Dec 11	20.50%
Mar 12	11.87%
Jun-12	12.61%
Sept 12	15.41%
Dec 12	14.77%
Mar 13	7.43%
Jun-13	5.83%
Sep-13	8.54%
Dec-13	9.29%
Mar-14	6.43%

Quarter Ending	Yield on Gross Portfolio
Jun-14	6.97%
Sep-14	8.32%
Dec-14	9.23%
Mar-15	7.80%
Jun-15	8.85%
Sep-15	8.95%
Dec-15	10.14%
Mar-16	9.22%
Jun-16	9.61%
Sep-16	10.15%

Table III: ARDL Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.603636	0.19048	3.169022	0.006
OSS(-1)	0.138619	0.195583	0.708749	0.4887
OSS(-2)	-0.235352	0.186056	-1.26496	0.224
OSS(-3)	-0.146712	0.129874	-1.12965	0.2753
YGP	1.120303	0.8261	1.356134	0.1939
YGP(-1)	2.231411	0.991223	2.251171	0.0388
YGP(-2)	0.839045	0.811733	1.033647	0.3167
YGP(-3)	3.244869	0.731679	4.434826	0.0004
LL	-2.92E-06	4.28E-06	-0.6811	0.5055
LL(-1)	-1.74E-06	3.97E-06	-0.43747	0.6676
LL(-2)	3.03E-07	3.73E-06	0.081127	0.9363
LL(-3)	7.47E-06	4.55E-06	1.642652	0.12
LL(-4)	-5.27E-06	4.72E-06	-1.11644	0.2807
DOE	-1.68E-06	3.42E-06	-0.49199	0.6294
DOE(-1)	-3.65E-06	4.16E-06	-0.87557	0.3942
DOE(-2)	-1.62E-06	4.07E-06	-0.39832	0.6957
DOE(-3)	-5.52E-06	3.13E-06	-1.76565	0.0965
DCF	4.69E-06	3.34E-06	1.404419	0.1793
DCF(-1)	1.37E-06	4.90E-06	0.278801	0.784
DCF(-2)	2.03E-06	6.09E-06	0.332934	0.7435
DCF(-3)	1.01E-05	5.33E-06	1.902026	0.0753
DCF(-4)	1.31E-05	9.56E-06	1.366112	0.1908
R-squared	0.917919	Mean dependent var		1.371387
Adjusted R-squared	0.810187	S.D. dependent var		0.256292
S.E. of regression	0.11166	Akaike info criterion		-1.253819
Sum squared resid	0.199487	Schwarz criterion		-0.305743
Log likelihood	45.82257	Hannan-Quinn criter.		-0.916501
F-statistic	8.520438	Durbin-Watson stat		2.227099
Prob(F-statistic)	0.000033	Observations		38

Note: Selected Model: ARDL (3, 3, 4, 3, 4)