

**THE IMPACT OF EXCHANGE RATE VOLATILITY ON COMMERCIAL BANK  
PROFITABILITY IN ZAMBIA (2005-2017)**

**By**

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**A dissertation submitted in partial fulfillment of the requirements for the degree of Master  
of Arts in Economics.**

**The University of Zambia**

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## APPROVAL

This dissertation of **Mark Chindumba** has been approved as a partial fulfilment of the requirements for the award of the degree of Master of Arts in Economics by the University of Zambia.

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## **ABSTRACT**

Given that empirical work has revealed that the relationship between bank profitability and exchange rate fluctuations is inconclusive. This study assessed the impact of exchange rate volatility on bank profitability in Zambia. Monthly-secondary time series data was collected from the Bank of Zambia for the period 2005 to 2017. The study employed the GARCH (1,1) model to measure real exchange rate volatility and Autoregressive Distributed Lag (ARDL) model was adopted to establish the relationship between exchange rate volatility and bank profitability. The findings from the GARCH (1,1) model revealed that the real exchange rate was volatile in Zambia for the period under consideration. Further, the ARDL model showed that real exchange rate volatility had a positive relationship with bank profitability in the short run while in the long run a negative and insignificant relationship was found. The study concluded that banks do not rely on the premium from selling foreign exchange to remain profitable and competitive in the business. The results implied that the more volatile real exchange rate becomes the lower the bank profitability hence the need to manage exchange rate volatility if bank profitability is to be improved.

**Key Words:** Real exchange rate, Volatility, bank profitability, GARCH (1,1) model, ARDL Model, Zambia.

# **DEDICATION**

TO MY MUM AND DAD

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First and foremost, I would like to thank my creator, God, for his unfailing love, mercy and grace that he has relentlessly given me. Not once has he let me down. He has been my pillar of strength and hope, my inspiration and my source of wisdom and knowledge.

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## ABBREVIATIONS

ROA	Return on Asset
ROE	Return on Equity
REXRV	Real exchange rate volatility
INTS	Interest rate Spread
INFL	Inflation rate
S	Total Assets
BOZ	Bank of Zambia
DOL	Dynamic Panel Ordinary Least Square
OLS	Ordinary Least Square
GARCH	Generalised Autoregressive Conditional Heteroscedastic
ARDL	Autoregressive Distributed Lag
SSA	Sub-Saharan Africa
GRZ	Government of Zambia
GDP	Gross Domestic Product
FSDP	Financial Sector Development Programme
ZANACO	Zambia National Commercial Bank

## **CHAPTER ONE: INTRODUCTION**

### **1.1 Introduction**

Bank profitability is essential for economic growth. Empirical literature overtime has highlighted that an efficient and profitable banking sector is a necessary prerequisite for economic growth. In this regard, bank profitability in a developing country like Zambia can play a crucial role in boosting economic growth. Banks are regarded as the bedrock of a nation's economy due to their intermediation function and the importance attached to the foreign exchange rate stability in any given economy (Lambe, 2015). However, according to Sanusi (2012), in order to achieve the aim of economic growth; the banking sector has to effectively play their actual role in intermediation and banks have to be among global players in the international financial markets. The foreign exchange market portends to be the largest financial market in the world with banks being key players in this market (Manyo et al., 2016). Banks engage in such foreign exchange activities with the objective of making substantial gains/profits. And so, the need to investigate the effect of foreign exchange transaction on bank profitability as it has remained a topical issue among researchers and practitioners alike. By endeavoring to perform their intermediary function, banks in Zambia do engage in foreign exchange transactions. These activities have attracted lucrative operating income for banks. The extent to which such transactions affect their profitability in the presence of the exchange rate movements is empirically unclear. Thus, this study attempted to empirically determine the impact of exchange rate volatility on commercial banks' profitability in Zambia. To this purpose, this chapter presents the background to the study, the statement to the problem and the objectives guiding the study.

### **1.2 Background to the study**

Exchange rate has been defined as the price of one currency in terms of another currency (Mordi, 2006). It plays an increasingly significant role in any economy. Its increase or decrease indicates strength and weakness of currency in relation to foreign currency and it is a standard for illustrating the competitiveness of domestic industries in the world market (Razazadehkarsalari, et al., 2011). Movements in exchange rates have both beneficial and adverse effects on the economy. However, it is the adverse effects of exchange rate fluctuations that make a country's exchange rate an important target for monetary policy especially in small open economies where international trade

accounts for a sizeable proportion of GDP (Chikumbi, 2017). As it was noted by Ball (2012), exchange rate fluctuations create risk for exporters and financial investors and have the potential to destabilize the economy. Given that the stability of the exchange rate is today a formidable bedrock of all economic activities; monetary policymakers and governments seek to stabilize it. As stated by Xu (2000), “exchange rate stability provides a firm anchor for domestic price stability that is conducive to sustained long-run economic growth”. Furthermore, a stable domestic currency stabilizes consumer prices and promotes certainty in the economy and makes it easy for businesses and consumers involved in international trade to plan for the future (Chikumbi, 2017). In contrast, a volatile exchange rate has the ability to cause undesirable changes in aggregate and sectoral output, the price level, the volume of international trade and foreign investment (Chipili, 2010). The degree to which a firm is affected by such volatility is called foreign exchange exposure or exchange rate risk. Exchange rate risk relates to the effect of unexpected exchange rate changes on the value of the firm (Madura, 1989). It can also be regarded as the possible direct loss (as a result of an unhedged exposure) or indirect loss in firm’s cash flows, assets and liabilities, net profit and, in turn, its stock market value from an exchange rate movement. Furthermore, foreign exchange risk exposure is the risk that an entity will be required to pay more or less than expected as a result of fluctuations in the exchange rate between its currency and the foreign currency in which payments must be made (Addae et al., 2014). Foreign exchange exposure can be measured in one of the three forms: Dohring (2008) discussed exchange rate exposure in terms of transaction risk (the risk of variations of the value of committed future cash flows), translation risk (the risk of variations of the value of assets and liabilities denominated in foreign currency) and broader economic risk (which takes into account the impact of exchange rate variations on competitiveness). However, banks often measure exchange rate exposure in relation to translational and economic risk. In this regard, this study measures the exchange rate in terms of economic risk.

Commercial banks as it well noted play a key role in the financial sector and to the whole economy in general, as they contribute to the economic growth of the country by making funds available for investors to borrow as well as financial deepening (Otuori, 2013). It is imperative that banks are profitable at any given time as profitability not only allows them to generate funds to grant more credit to the economy but also for regulators as it guarantees more flexible capital ratios, even in a riskier business environment (Abera, 2012). Banks profitability must also lead to fair returns for

their shareholders. As noted by Flamini et. al (2009), bank profits provide an important source of equity especially if re-invested into the business. This should lead to safe banks, and as such high profits could promote financial stability as a bank's profitability helps in predicting financial crises and a profitable banking sector is better able to withstand negative shocks. Furthermore, the financial strength of a banking institution is unquestionably associated to its profitability, thus, the most important need of any bank's management and leadership is to make profits on a continuous basis since this will guarantee bank's continuous existence. As such, achieving profitability goal is vital to any bank (Adeusi et al, 2014).

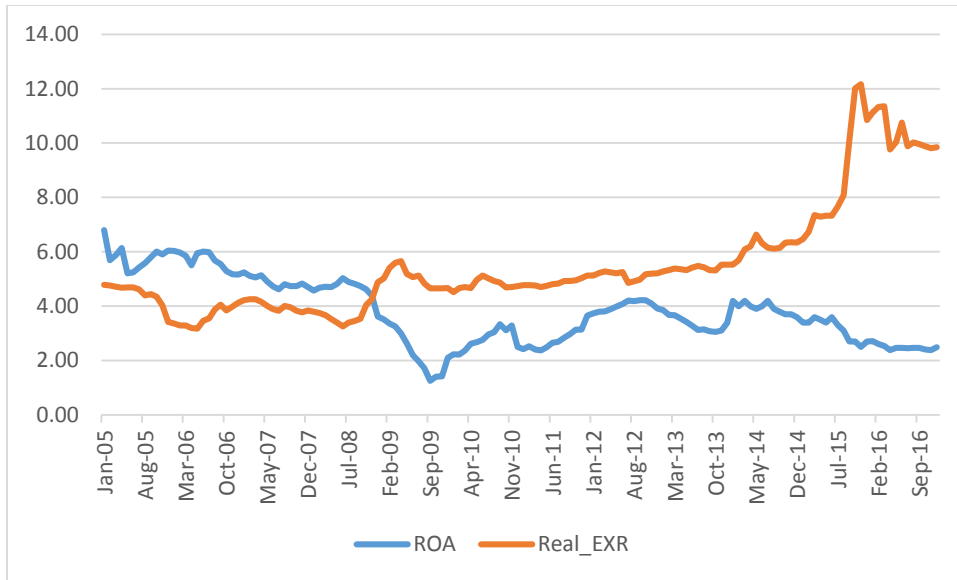
Exchange rate trading is an important factor to banks as foreign exchange income, commissions and fees from foreign exchange operations have been considered one of the major revenue sources to banks (Manyo et al., 2016). Transactions in the foreign exchange constitute an important aspect of financial sector activities and arguably it is the largest and most extensive financial market in the world (Anyafu, 1999). This is because apart from being the vehicle for settlement of international transactions, it functions as the medium of interaction between sellers and buyers of foreign exchange in a bid to negotiate a mutually acceptable price for the promotion and furtherance of international transactions (Ani et al. 2013).

Like many firms, banks can be affected by exchange rate fluctuations. Exchange rates affect most directly those banks with foreign currency transactions and foreign operations. Even without such activities, exchange rates can affect banks indirectly through their influence on the extent of foreign competition, the demand for loans, and other aspects of banking conditions (Martin and Mauer, 2001). It is for this reason several attempts have been made to particularly establish a link between exchange rate fluctuations and bank profitability. However, the empirical literature has shown mixed results with no consensus being reached as to the direction of the relationship between the former and latter. Given such contradictions, the debate on the impact of exchange rate fluctuations on banks performance remains inconclusive. Therefore, this warrants an academic investigation into the impact of exchange rate fluctuations on banks profitability in Zambia.

### **1.2.1 Exchange rate fluctuations and Financial Performance of Banks**

With the liberalization of the financial sector and especially the removal of exchange controls in 1994, there has been a tremendous increase in foreign exchange rate dealing in the banks. However, these are more developed in foreign banks than domestic banks. According to Ndulo

and Chanda (2016), almost all banks buy and sell foreign exchange and deal with other foreign transactions. It is to be noted that the foreign exchange transactions banks in Zambia have resulted in substantial gains being obtained. For instance, the banking sector had earned on average a substantial trading revenue from foreign exchange of about K 64, 929 million (BOZ, 2018). The revenue accounted for over 51% of total non-interest income. This shows how banks make a lucrative income by virtue of being active participants in foreign exchange transactions. Despite these gains, it was observed that bank profitability was on decline overtime during the study period. Figure 1.1, the better measure of bank profitability (Athanasoglou et al. (2008) and Sufian (2011) Return on assets (ROA) displayed a downward trend ranging from as high as 6.8 percent recorded in 2005 to as low as 1.26 in 2009. Conversely, exchange rate movements displayed a persistent upward trend over time. Given the interventions undertaken by BoZ to ensure the stability of the exchange rate, the exchange rate remained highly unstable. A lot of empirical work has been done in Zambia to establish the effects of exchange rate fluctuations on different sectors of the economy as seen by works of Musonda (2008), Chipili (2010) and Chipili (2014). The studies revealed that the fluctuations had been detrimental to the economy. There is little to no knowledge about the effects on the banking sector performance as the studies did not assess the impact of exchange rate movements on this sector. Lack of such empirical research raises a need for an empirical investigation to be conducted. This study, therefore, sought to fill this research gap by empirically establishing the impact of exchange rate fluctuations on the commercial bank profitability in Zambia. Furthermore, Figure 1 shows the trend between bank profitability and exchange rate movement but it is difficult to ascertain the evolution of the two variables as the figure does not show the magnitude of such a relationship. Thus, this called for a more robust econometric approach to be conducted so as to assess the relationship.



**Figure 1.1 - ROA and Exchange rate Trend lines**

**Source: BoZ data**

### **1.3 Problem Statement**

As seen from the works of Musonda (2008), Chipili (2010) and Chipili (2014), exchange rate movement in Zambia has been variable with periods of rapid depreciation of the domestic currency - Zambian Kwacha, which adversely affect the Zambian economy. The level of exchange rate fluctuations in Zambia went high in 2015 forcing the Bank of Zambia to intervene so as to ensure stability. In that year, the exchange rate against the United States Dollar (USD) had depreciated from K 6 to a low of K 12. The frequent depreciation of the Kwacha implies that fluctuation in exchange rate still prevails (Mutua, 2013). However, in light of them hedging transactions; the highly volatile nature of the exchange rate makes it difficult for the banks to predict the future rate with precision as the exchange rate had jumped by over 20 percent (Farah, 2014). Despite it going down in the year that followed the exchange rate has remained high and volatile. This greatly affects the performance of commercial banks as they seek to provide adequate currency to promote the international business (Majok, 2015). Thus, for the banks to remain competitive and thrive, it

is imperative that their external factors, which include foreign market variability. However, the extent to which exchange rate fluctuations affect bank performance is yet to be empirically determined in Zambia. This study sought to empirically establish the impact of exchange rate volatility on commercial bank profitability in Zambia.

#### **1.4 Research Objectives**

The main objective of this research is to empirically investigate Exchange rate volatility and Commercial bank profitability in Zambia

##### **1.4.1 Specific Objectives**

- i. To investigate the impact of exchange rate volatility on Commercial bank profitability.

#### **1.5 Research Questions**

- i. What is the relationship between exchange rate volatility and Commercial Bank Profitability in Zambia?

#### **1.6 Significance of the Study**

This study would be of benefit to several individuals including; For the managers of commercial banks in Zambia, the findings of this study would provide information to guide their risk management decisions following the changes in the exchange rate in Zambia. It would equip them with the necessary knowledge for taking the necessary action to protect the performance of their organizations.

For the Government of Zambia, the findings of this study would inform the formulation of policies and regulations for stronger and more resilient banking industry. The findings of this study would inform the fragile foreign currency reserves making it difficult for the banking industry to transact freely.

For future academicians and researchers, the findings of this study would be important in providing material for their reference besides suggesting areas for further research. Future scholars would find this study important because it would identify areas for further studies which future scholars can study.

### **1.7 Scope of the study**

This study will consider the entire banking sector in the financial system of the Zambian economy. It will be centered on monthly data for the period 2005 to 2016. The period was considered due to the availability of the data from the Bank of Zambia publications, reports, and website.

### **1.8 Research hypotheses**

The test hypothesis for this study is:

- $H_o$  : Exchange rate volatility has no impact on Commercial Bank Profitability in Zambia

### **1.9 Organization**

The research paper is divided into five chapters. The first chapter covers, the background to the study, statement of the problem, research aims and objectives, research questions, the significance of the study, scope and limitation of the study, the research hypothesis and the divisions of the dissertation. Chapter 2 covers the literature review which will further discuss the theoretical foundations of exchange rate movements and bank profitability, empirical literature governing the link between exchange rate fluctuations and banks profitability and ends with a summary of the literature. Chapter 3 will address the research methods that will be employed for the study and the reasons for their choice. It will include Research design, population, data sources, estimation techniques, and data analysis procedure. Chapter 4 presents the data presentation, analysis, and discussion of results. Chapter 5 covers the Conclusions, recommendations, and recommendation for further research.

## **CHAPTER TWO: OVERVIEW OF THE BANKING SECTOR DEVELOPMENT IN ZAMBIA**

### **2.1 Introduction**

This chapter focusses on highlighting the developments of the banking sector in Zambia and gives the history of the various exchange rate policies which have been employed in the economy.

### **2.2 Development of Commercial banks in Zambia**

After financial liberalization in the 1990s, the Government embarked on the Financial Sector Development Programme, a comprehensive strategy aimed at building and strengthening financial sector infrastructure to enable it to support economic diversification and sustainable growth (GRZ, 2004). The implementation of the FSDP helped address key bottlenecks in the financial system, including improving the governance of the banking sector, after the crisis of the mid-1990s. It was meant to increase the number of banks in the economy of this country. As a result of this financial measures and economic liberalization policies, by 2006 there were 13 commercial banks. Out of these, seven were subsidiaries of foreign banks; one joint venture with majority foreign ownership, four domestic private banks, and a public sector bank.

ZANACO a public sector and the second largest bank by asset size was privatized in 2007 although, by regulatory definition, it is still majority owned by Zambians with 54.41% domestic interest. This case provides a unique feature of ownership, encompassing foreign financial equity stake, domestic private sector participation, and public sector interest. Nonetheless, management rights reside with Rabo bank, the single largest foreign shareholder.

From 2008 to 2015, 6 more subsidiaries of foreign banks were registered, bringing the total number of banks with foreign ownership to 14 and 19 banks for the whole industry. The number of domestic private banks has remained unchanged. The increase in the number of banks has been accompanied by growth in nominal assets, accounting for more than 90% of total financial industry assets, which is ten times higher than other market participants (Non-bank institutions).

At the end of 2011, the banks' nominal asset size stood at K27.8 trillion (30% of GDP) which was about three times higher than the K10.7 trillion held in 2006 (27.7% of GDP). Traditional intermediation activities (loans and advances) account for the largest share of banks' assets.

Between 2006 and 2011, the share of loans in total assets increased to 43% from 36%, reflecting increased lending to the private sector on the consolidation of macroeconomic gains. Over the same period, the share of liquid assets (cash and Treasury securities) fell to 35% from 42%, mainly due to divestiture from Government securities as yield rates became less attractive. Historically, the low level of financial intermediation has been attributed to banks' purchase of Treasury securities, which offer risk-adjusted positive premiums relative to the more risky bank loans. The banks' share of foreign assets has also declined in recent years, averaging about 16% between 2006 and 2011 against 28% from 1998 to 2002. However, the Zambian banking system continues to exhibit a high level of concentration with a few large banks dominating the financial landscape. According to Soko (2014), commercial banks in Zambia have continued to show resilience, largely due to the strong capital position. A majority of banks hold capital balances above the regulatory threshold, depicting the strength and stability of the Zambian banking sector. To boost the banks' capital position and strengthen their resilience, the authorities raised regulatory capital further and introduced a tiered structure in April 2012 (GRZ, 2012). The minimum capital requirement for local banks was raised to K104 million (US\$20 million) while the requirement for foreign banks was pegged at K520 million (US\$100 million). Prior to this revision, the minimum regulatory capital was uniform across all banks at K12 million (about US\$2 million). The authorities argued that the new capital requirement was expected to boost banks' lending to the private sector.

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capital was uniform across all banks at K12 million (about US\$2 million). The authorities argue that the new capital requirement was expected to boost banks' lending to the private sector.

According to GRZ (2017) as of March 2017, the banking sector comprised 18 licensed commercial banks, of which eight were locally owned, a further eight were subsidiaries of foreign-owned banks, and two were jointly owned by the government and foreign banks. The banks mostly focus on combined retail and corporate banking, with the exception of a few that exclusively undertake corporate banking. The banks mainly operate as universal banks and cover a wide range of market segments, with loans and advances being dominated by personal loans at an average of about 27 percent. This is generally followed by advances to the agriculture, forestry, fishing and hunting sector; manufacturing sector; and wholesale and retail trade.

## **CHAPTER THREE: LITERATURE REVIEW**

### **3.1 Introduction**

This chapter presents the literature reviewed in order to provide a basis for the study and the concepts. In addition, the chapter highlights theories guiding the study, empirical studies thereby illustrating the research gap as presented in the summary of the literature.

### **3.2 Theoretical Framework**

This section identified market power theory, efficiency theory, the agency cost theory and signaling theory as the underlying theories to explain the profitability concept.

#### **3.2.1 Market Power Theory**

Market power theory emanated from Bain (1951). This theory emphasizes that an increase in market power results in a monopoly, profits (Athanasoglou, Brissimis & Delis, 2005). The theory is based on the premise that concentration of the market is the best measure for market power since more concentrated markets exhibit superior market imperfections facilitating various entities to set prices for their products and services at levels which is less favorable to their clients or customers (Punt and Rooij, 2001). The theory also affirms that companies with a large market share and sound differentiated products and services can easily earn monopolistic profits and succeed or win against their competitors (Nkegbe & Yazidu, 2015).

The market power theory assumes that extra profits result from a higher market concentration which allows commercial banks to collude and earn supernormal profits which arise due to the firms' portfolio of differentiated products that also increases the market share and market power in determining prices for products (Mirzaei, 2012). The market-power theory also affirms that market power is the major variables which make profitability to change and concentrated markets frequently involve market imperfections which arise from collusion, made possible by market concentration, and by various legislative barriers to entry or exit (Punt and Rooij, 2001).

Market power theory is applied in the banking industry, to explain a bank's profitability and how it is affected by its market share. The theory explains the positive relationship between bank's size and financial performance. Market power theory suggests that banks' profitability is as a result of the industries market structure (Onuonga, 2014). In addition, this theory posits that the market

structure of the banking industry influences banks' profitability (Ntow & Laryea, 2012). According to Obumuyi (2013), this theory assumes that banks' profitability is a function of external market factors and the theory also assumes that the industry structure which is measured using market concentration in term of the market share ratio effects the profitability of commercial banks (Fisseha, 2015).

### **3.2.2 Efficiency Theory**

The efficiency theory was formulated by Demsetz (1973) as an alternative to the market power theory. The efficiency theory presupposes that better management and scale efficiency results in higher concentration thus greater and higher profits. Accordingly, the theory posits that management efficiency not only increases profits but also results in larger market share gains and improved market concentration (Athanasoglou, Brissimis & Delis, 2005). The efficiency theory also states that a positive concentration–profitability relation may be a sign of a positive connection relating to efficiency and size. The theory postulates that positive association between the concentration and profit arise from a lower cost which is mainly achieved through production efficient practices and increased managerial process (Birhanu, 2012).

The efficiency theory supports that the most favorable production can be attained through economies of scale. Thus, maximum operational efficiency in the short run is achieved at a level of output where all economies of scale available are being employed in an efficient manner (Odunga et al., 2013). Additionally, the efficiency theory explains that attaining higher profit margins arises from efficiency which allows banks to obtain both good financial performance and market shares (Mirzaei, 2012). According to Fisseha (2015), the efficiency theory presupposes that profitability and high concentration results from efficient cost reduction practices and better management strategies across the organization. Thus, efficient firms in the market lead to an increase in their market share and the size of their firm because of aggressive production and management techniques (Birhanu, 2012).

In the banking industry, the efficient theory advocates that large commercial banks which have better and experienced management and up to date production technologies are able to reduce their operational costs, therefore, earned higher returns on investment in comparison to smaller banks (Soana, 2011). Basically, the theory is based on the premise that banks attain profits if they operate efficiently than their competitors which lower operating costs leading to good profits (Onuonga,

2014). The efficiency theory also assumes that internal efficiencies influence the profitability of commercial banks (Obumuyi, 2013). Further, the theory explains that banks which operate efficiently in comparison to their competitors increase their profits due to low operating costs. The efficiency hypothesis prevails when a positive significant correlation between profitability and the market share is signaled (Mensi & Zouari, 2010).

### **3.2.3 Agency Cost Theory**

The agency cost theory arose from the seminal contributions of Jensen & Meckling (1976). Agency cost theory assumes that a firm's financing structure can be used as a mechanism or vehicle by managers and investors solve the free cash flow problem. Agency theory explains that corporate form of organizations is illustrated by professional managers who have little ownership but are running a business on behalf of shareholders (owners) who are extensively dispersed characterizes an archetypal principal-agent problem (Gedajlovic & Shapiro, 2002). Agency costs arise from the separation of ownership and control, whereby managers maximize their own benefits or employ the firm's resources for personal gains instead of maximizing the value of the firm or the shareholders' wealth (Mian, Haris & Muhammad, 2012).

Jensen & Meckling (1976) classified agency cost into costs arising from the monitoring of managers by shareholders, cost of bonding and residual loss. Agency cost includes agency cost arising from conflict of interest between firm's managers and shareholders and agency cost arising out from conflict debt holders and of interest of shareholders (Mian, Haris & Muhammad, 2012). According to the theory, agency costs appear because of the differences of interests and actions from managers and Principals, which is likely to affect in due course the principals' benefits and the firm value and profitability (Alfadhl & Alabdullah, 2013).

### **3.2.4 Signaling Theory**

The signaling theory emanated from Arrow (1972) and Spence (1973). Signaling theory presupposes that best performing or profitable firms supply the market with positive and better information (Bini, Dainelli & Giunta, 2011). In addition, the signaling theory is one of the theories, which have a clarification for the association between profitability and capital structure (Alkhazaleh & Almsafir, 2014). This theory presupposes that a superior capital structure is an optimistic signal to the market worth of the organization (Adeusi, Kolapo & Aluko, 2014). The signaling theory further postulates that the majority of the profitable firms signal their competitive

power by communicating new and important information to the market. Thus, information is disclosed by means of specific indicators or ratios which, very often, measure specific conditions on which to enter into or renew the agency contract (Bini, Dainelli & Giunta, 2011).

According to the signaling theory, the management of bank signals good future expectation by increasing capital. This indicates that less debt ratio necessarily means those banks perform better than their identical (Alkhazaleh & Almsafir, 2014). In addition, the theory argues that managers who strongly believe that their bank can outperform other banks in the industry will want to relay such information to various stakeholders in order to attract additional investments. Thus, the signaling theory affirms that when a bank's performance is excellent, directors will signal the bank's performance to its stakeholders and market by making various disclosures which poor performing firms cannot make. By enhancing more disclosure most managers will wish to receive high benefits and a good reputation which may increase the value of the firm and profitability (Muzahem, 2011).

### **3.3 Empirical Literature**

This section reviews the empirical studies which have been done in relation to determining the influence of exchange rate movements on commercial bank profitability. It reviews studies from developed, developing and sub-Saharan African countries, including locally based studies.

#### **3.3.1 Developed countries**

In the developed economies, several studies have identified the foreign exchange exposure and explained its effect on the banking sector from different perspectives. The studies attempted to establish a model that incorporates both internal and external factors in line with the theories reviewed in section 3.1. The studies differed when it came to identifying a proxy for bank profitability. Some studies used stock returns while others used operating revenues. This came to be known as a Capital and cash flow approach respectively (Dominguez & Tesar, 2006). The studies used the two approaches in measuring foreign exchange exposure and its impacts on banks. The cash flow approach focuses on the impact of exchange rate changes on current cash flows. Dumas (1978), Hodder (1982) and Hekman (1985) are advocators of cash flow approach. This approach underscores the influence of exchange rate changes on a firm from the aspect of the firm's internal operations. Using a cash flow-based framework, Martin and Mauer (2003) showed

that significant long-term exposure is more prevalent than significant short-term exposure, reflecting the difficulty in recognizing, modeling, and managing the longer-term effects of exchange rate risk. Their findings supported the theory that domestic banks are exposed and should be concerned about the indirect impact of exchange rate risk. However, the framework is not easily applicable to multi-firm studies or large-scale cross-firm comparisons of exchange rate exposures (Bodnar & Wong, 2003) and that the analysis of exchange rate exposure is limited from the view of internal operation. In contrast, using the hypothesis that the present value of a firm's future cash flow is equal to the value of the firm as a basis, Adler and Dumas (1984) overcome the limitation of analyzing exchange rate exposure from the view of internal operation. They defined exchange rate exposure as the effect of exchange rate fluctuations on the value of an asset. This model was modified by Jorion (1990) who deviated from Adler and Dumas approach by measuring foreign exchange exposure based on the assumption that the exposure is constant over time. Jorion found that US firms with high levels of foreign sales exhibit more positive exchange rate exposure. However, the results may have been affected by the assumption set given that a firm exposure to foreign exchange can vary over time because of changes in the firms' activities or the characteristics of the industry or the nature of the structural shocks hitting the foreign exchange market. Relaxing Jorion's assumption, Bracker et al (2009) identified the change in the value of the U.S. dollar as one of the six primary sources of bank risk. The findings were not consistent however with some time periods generating positive relationships and other generating negative relationships between bank holding company returns and exchange rates. The findings could be attributed to a host of factors including economic conditions, regulatory environments, management tools and strategies, and financial crises. However, their study did identify foreign exchange risk as significant overall. Other research by Chamberlain et al (1997) and Choi et al (1992) finds that bank stock returns are impacted by foreign exchange movements. However, Chamberlain's findings not only extended to the U.S. based banking firms but also to the Japanese bank stock returns. Their results revealed that relatively few Japanese bank returns appeared to be sensitive to exchange rate changes. The difference between the exchange rate sensitivities of Japanese and U.S. banking firms may be attributable to a number of factors: differences in the structure of ownership, in securities and derivatives laws, in supervision, in the extent of foreign ownership, or in hedging policies. Choi et al. found evidence of foreign exchange exposure when they aggregated bank returns. However, their aggregation precludes them from linking the

estimated exchange rate exposure to individual firm characteristics. A later study by Elyasiani and Mansur (2005) found that all the Japanese banks in their sample were impacted by exchange rates. The findings can be attributed to the use of GARCH methodology which was an appropriate framework for modeling the U.S., Japanese, and German bank stock returns, as the use of a linear model, would distort the findings.

One study by Atindéhou and Gueyie (2001) found that that Canadian bank stock returns were sensitive to foreign currency fluctuations over the sample period. However, the sensitivity of those returns varied substantially over the sample period. Much of this variation was attributed to investor reactions. Similarly, Merikas (1999) found that stock returns of Greek banking institutions are also impacted by exchange rate fluctuations. However, this study was restrictive as it looked at only eight larger banks in Greece.

According to Chow et al (1997), most prior studies of the impact of foreign exchange risk on any firm had found little or no relationship. However, their study attributed that to using short-term time horizons. In their study, they used a 12-year time horizon and found stock returns to be responsive to fluctuations in exchange rates. The Chow et al study was not limited to bank stocks but instead looked at a broader data set that included 65 different industry groups. Their findings indicate that the short-run impact of changes in real exchange rates on earnings is negative yet turns positive when viewed over long time periods. In the same line, Chi et al (2010) found almost no significant relationships between Australian bank stock returns and foreign exchange rates, which was contrary to their expectations. The findings however raised questions as to how efficient the stock markets were in recognizing banks' foreign exchange exposures arising from their offshore assets and business. It was further seen in Bartram (2007) that regardless of the framework used the results were similar and the exchange rate exposure increased with the horizon.

In addition, Nydhal (1999), Allayannis and Ofek (2001) and Nguyen and Faff (2003), among others, establish that the use of derivatives reduces exchange rate exposure. Bodnar and Wong (2003) show that small firms are more exposed to foreign exchange movements than large firms. This evidence is consistent with the finding that large firms are more likely to hedge their foreign exchange risk exposure (Allayannis and Ofek, 2001; Hagelin and Pramborg, 2006; Bartram et al., 2010). Nance et al. (1993) show that hedging is particularly popular amongst firms with

considerable growth opportunities, high probability of financial distress and low level of liquid assets.

### **3.3.3 Developing countries**

Similar to studies in the developed economies, studies in the developing economies found the relationship between exchange rate exposure and the banking sector's performance to be inconclusive. Wong et al. (2008) and Babazadeh and Farrokhnejad (2012) found that foreign exchange exposure negatively impacts the banking sector's performance. However, Wong et al. employed the capital market approach and found a positive relationship between bank size and foreign-exchange exposure in China. This may be partly due to the fact that larger banks tend to have more significant foreign-exchange operations and trading positions. The findings revealed that foreign-exchange exposure tends to be different among Chinese banks, with negative foreign-exchange exposure more prevalent for larger banks. This may be attributed to the possibility of a lack of financial instruments in the local market to hedge their foreign exchange risk, or perhaps because they are less experienced in managing foreign exchange risk. Since larger banks constitute a major portion of assets in the Chinese banking industry, this empirical result suggested that an appreciation of the renminbi is likely to hamper the Chinese banking sector's performance. The results were consistent with the work of Wang and Jiang (2004). On the other hand, Babazadeh and Farrokhnejad (2012) employed an Error Correction Model and found that the effect of exchange rate changes on foreign exchange profit in short-run is more than the one in long-run. However, the study did not apply the Johansen test for co-integration to determine the number of co-integrating factors in the presence of more than one independent variables and was restrictive as it only focused on one bank in the Iranian economy. The result was consistent with the findings of Bagheri (2007). In contrast, Ekinci (2016) employed the generalized autoregressive conditional heteroscedastic (GARCH) approach and found that foreign exchange risk had a positive effect on banking sector profitability. The findings suggested that an increase in FX rate added with a weaker local currency may affect bank profitability in a positive way if a bank has a long position. This was in contrast with the work of Kasman et al. (2011) who found that FX rate had a negative and significant effect on the conditional bank stock return. Furthermore, Meng and Deng (2013), also employed a GARCH model and found that foreign exchange rate changes were statistically

significant in explaining banks' stock returns, despite different reactions from different bank portfolios in regard to risks.

### **3.3.4 Sub-Saharan Africa**

In Sub - Saharan Africa, empirical studies also followed the inconclusive relationship between banking sector performance and exchange rate movements. Taiwo and Adesola (2013) and Majok (2015), found a negative relationship between exchange rate movements and banking sector performance. However, Taiwo and Adesola used two proxies for bank performance, namely loan loss to total advances ratio and capital deposit ratio and established that the impact of exchange rate on bank performance is sensitive to the type of proxy being used for bank performance. Loan loss to total advance ratio showed that the fluctuating exchange rate affected the ability of lenders to manage loans resulting into the high level of bad loans while capital deposit ratio did not have a significant relationship with the exchange rate. The author employed the Ordinary Least Square (OLS) method without testing the order of integration of all the variables which may have yielded biased results and failed to measure the volatility of the exchange rate. On the other hand, Majok employed correlation analysis and used the standard deviation approach to measuring exchange rate volatility. The shortcoming of the analysis was that the approach used to measure the volatility has been proved to be flawed as it fails to take account of the time-varying variance of the exchange rate, further, the correlation analysis used to determine relationship may suggest a relationship between variables which is none existent in reality thus producing spurious results. The findings are consistent with the work of Kairu (2016). A later study by Offiong et al. (2016), using balanced panel methodology found that most banks suffer from erosion of their profit arising from their exposure to fluctuations in international currencies, especially, when proper hedging strategies are not adopted. However, the research failed to measure the volatility in exchange of the respective currencies. In contrast, Lambe (2015) and Lagat and Nyandema (2016), found a positive relationship between banking sector performance and exchange rate fluctuations. However, Lambe used Vector Autoregressive (VAR) model to determine the relationship but the study was restrictive as only one bank was used in the analysis. On the other hand, Lagat and Nyandema used correlation analysis on time series data to determine the relationship and the authors failed to measure the volatility in the exchange rate. In addition, despite using correlation analysis and failing to capture volatility Ngerebo (2012), found a positive relationship between foreign

exchange fluctuation and Commercial Bank Intermediation Index. A later study by Manyo et al. (2016) revealed that foreign exchange income had a negative and insignificant effect on the profitability of banks. The findings were in line with the work of Kiganda (2014), who found that there was no connection between banks profitability and exchange rate. Despite Manyo et al, employed a Panel Dynamic Ordinary Least square method but in their methodology failed to capture the volatility in the exchange rate. The study also failed to take into account the effect of exchange rate movements and only took ten banks in their analysis. On the other hand, Kiganda used ordinary least square without determining the order of integration of the variable which may have led to spurious results being produced but also failed to measure exchange rate risk.

Addae et al. (2014), argue that the use of financial derivatives to cover exchange rate risk can be effective. This can be seen in their findings which revealed that banks which had risk management structures in place were found to mitigate any risk that arises as a result of their operation. However, according to Salisfu et al. (2007), despite the existence of numerous derivative instruments such as balance sheet hedging, use of derivatives, leading and lagging, swaps amongst others, their applications appear to be sophisticated and difficult to implement in developing countries hence their popularity in the developed world. In that instance, it is intuitive to infer that a bank might be applying one of the techniques as shown by Abor (2005) which include the use of price adjustments to reflect balance sheet changes and the buying and holding of foreign currency.

### **3.3.6 Local studies**

In Zambia, few studies have attempted to explore the dynamics of bank performance. Simpasa (2010) using stochastic frontier analysis found that impaired loans, asset concentration, and macroeconomic instability undermined the banks' ability to operate optimally. Regulatory factors did not exacerbate cost inefficiency. However, when it comes to macroeconomic instability the author failed to take into account exchange rate volatility and its impact on bank performance. Another study by Masili (2010) found no link between exchange rate volatility and Interest rate spread. However, this result may have been affected by study's failure to employ a GARCH model in its analysis given that it's a better measure of volatility than the standard deviation method employed as it caters for the time-varying variance of the variable, the latter does not. In light of

these differences, this study is the first of its kind in investigating the impact of exchange rate risk on bank performance using plausible methods in analysis.

### **3.4 Summary of Literature review**

This chapter has reviewed the literature relevant to the study. The study explored market power theory by Bain (1951) which postulates that improved external market forces lead to increased profit and the efficiency theory by Demsetz (1973) which presupposes that managerial and production efficiency causes both high market share and high profitability of individual banks. The study also explored the agency cost theory by Jensen and Meckling (1976) which presupposes that shareholders incur certain agency costs to make sure that interests of the firm's managers are aligned to shareholders' interests. The study also explored signaling theory by Spence (1973) which states that banks can signal certain information to enhance a better reputation, which may increase profitability and the value of the firms. However, the reviewed theories emphasize on how firms can enhance their profitability and not the various factors that affect profitability.

The study further reviewed empirical studies done from the developed, developing, Sub – Saharan Africa and local perspectives. In both developed and developing economies, studies on exchange rate risk suggest only modest exposure, with the majority documenting a weak link between exchange rate changes and stock returns. The failure of most studies to establish significant exposure of firm value to changes in the foreign exchange rate is largely due to the difference in a number of areas that scholars used in their analysis, such as the time horizon, the sample selection procedures or the portfolio construction. Furthermore, the choices between the trade-weighted exchange rate and bilateral exchange rate, multiple exchange rates and single currency proxy also have an influence on the empirical testing results. In most of these studies, the researchers focused on stock returns as their performance metric. However, this study contends that a better performance metric is net income when limiting the analysis to bank stocks. In Sub – Saharan Africa, the studies major weaknesses lied in the inappropriate use of time series data in the analysis, as regards to testing for the order of integration in variables before employing models for analysis. This may have affected the outcome of the results being obtained due to spurious regressions conducted. This study will follow the appropriate procedure in handling time series data so as to use a plausible model for analysis. Thus, for this study, a methodology that uses accessible information is applied. In local studies, extensive research has been conducted to determine the

detrimental effects of foreign exchange rates on different sectors of the economy. However, the ones done focused on other aspects of foreign exchange rate fluctuations and not its influence on the profitability of commercial banks.

Given the theoretical expectations of a link between firm performance and exchange rates, one would expect empirical studies to establish the relationship but it was observed from the studies under review that it still remains an empirical question as there is little consensus regarding whether foreign exchange fluctuations impact firm performance. This study therefore sought to fill this gap by seeking to determine the effects of exchange rate fluctuations on financial profitability of commercial banks in Zambia.

## **CHAPTER FOUR: RESEARCH METHODOLOGY**

### **4.1 Introduction**

This chapter outlines the methods that will be used by the study to achieve the study objectives. It will consider the research design, sources of data, model specification, method of collection and technique to be used in the analysis of the data.

### **4.2 Research Design**

The study adopted a quantitative - correlational research design which was employed by Lambe (2015) while studying the effect of exchange rate movements on commercial banks profitability in Nigeria. Oso & Onen (2009) argued that correlation design predicts one variable from the other and determines whether, and to what degree, a relationship exists between quantifiable variables. Therefore, this research design is appropriate for this study as it sought to explore the effect of exchange rate fluctuations on the profitability of commercial banks in Zambia using statistical analyses.

### **4.3 Population**

The study focused on the entire banking sector which comprised of licensed commercial banks by the Bank of Zambia under the Banking and Financial Services Act of 1994 of the laws of Zambia amended in 2005 and the Bank of Zambia act of 1996. For this study, all the commercial banks were included because the target population was small and the data was easily accessible from the Bank of Zambia.

### **4.4 Data, Data Collection Methods and Data Analysis**

This study used monthly secondary-time series data, which was collected from banks consolidated financial statements from the Bank of Zambia publications, reports, and website pertaining to the study period 2005 to 2014. All bank-specific variables were captured as aggregated values. The study utilized E-views version 9.0 to aid the understanding and summarizing the findings through the use of tables and graphs.

### **4.5 Analytical Framework**

This paper acknowledges that there are many factors that can influence banks profitability. However, for the purpose of this study, only some of the factors are considered in the analysis. These variables include bank-specific factors such as interest rate spread and Bank size while

macroeconomic specific factors included real exchange rate and Inflation rate. This study was in line with the Analytical framework of Majok (2015) and Lambe (2015). However, the model employed had some modifications, the proxy for banks profitability used was ROA not Profit After Tax (PAT) as used by Lambe and the volatility measure was obtained from GARCH modeling. This study used ROA as it is a common measure of banks profitability. The selection of ROA as a proxy is justified by the subsequent subsection 3.5.1.

#### **4.5.1 Dependent Variables**

In the literature, there are two major alternative measures of profitability, namely ROA and ROE. ROA reflects the ability of the bank's management to generate profits from the bank's assets, although it may be biased due to off-balance-sheet activities but such activities are negligible in Sub-Saharan Africa banks. ROE shows the return to the shareholders on their equity. As highlighted by Athanasoglou et al. (2008) and Sufian (2011), many scholars suggest that ROA is the key ratio for the evaluation of bank profitability given that ROA is not distorted by high equity multipliers, while ROE disregards the risks associated with high leverage and financial leverage. In this regard, it is rare to find a paper that utilizes ROE as a single measure of profitability. Rumler and Waschiczek (2010) are one of the examples. In other papers, ROE is utilized for checking the consistency with ROA, e.g. Naceur and Omran (2011) and Sufian (2011). While a majority of studies employ ROA as profitability measure for instance, Pasiouras and Kosmidou (2007), Athanasoglou et al. (2008), Olweny and Shipho (2011) and Majok (2015). Therefore, this study attempts to measure profitability by using ROA similar to most of the aforementioned researchers. ROA is measured as profit after tax divided by the total assets similar to Majok (2015).

#### **4.5.2 Independent Variables**

This subsection describes the independent variables that are used in the econometric model to estimate the dependent variable. Following prior researches towards the factors that affect banks' profitability, the independent variables are classified into bank-specific and macroeconomic variables in line with the work of Majok (2015) and Lambe (2015). The bank-specific variables are internal factors and controllable for banks' managers while macroeconomic variables are uncontrollable and hence external. Moreover, this subsection presents the expected sign of the coefficients, based on academic literature. Further, it is to be noted that the aim of this

paper is to establish the relationship between banks' profitability and exchange rate volatility any other variable included in the model prevents bias results from being obtained.

### **Bank Specific variables**

The bank-specific variables are selected by using some key drivers of profitability like earnings, efficiency, and leverage. Profitability is driven by the ability of a bank in generating sufficient earnings or in lowering operational cost, implying being more efficient. For the purposes of this research, the variables selected from this category were control variables. Hence, the following part of this particular section clearly presents the bank-specific variables that are used in this particular study.

**Interest rate spread:** Interest rate spread (*INTS*) is the difference between the lending rate and the deposit rate. *INTS* shows the difference between the average interest rate of banks' loans given to their customers and the average interest rate banks pay on the deposits received. *INTS* defines the transaction intermediation cost of banks. Barajas et al. (1998) indicated that the high-interest rate spread associated with a lack of competition and inefficiencies in the banking sector and may have an adverse effect on the bank's profit. However, a wide interest rate spread may contribute to the incomes of commercial banks and thus enhance their profitability (Sheriff and Amoako, 2014; Obidike *et al.*, 2015). *INTS* is measured as the difference between average Lending Rates (*ALR*) and average Interest rate (*ADR*) on deposits of banks in Zambia.

**Banks size:** There is consensus in the academic literature that economies of scale and synergies arise up to a certain level of size. Beyond that level, financial organizations become too complex to manage and diseconomies of scale arise. The effect of size could, therefore, be nonlinear; meaning that profitability is likely to increase up to a certain level by achieving economies of scale and decline from a certain level in which banks become too complex and bureaucratic. Hence, the expected sign of the coefficient of bank size (*TA*) is unpredictable based on academic literature. This study used the logarithm of total banks assets to capture the potential non-linear effect of a size similar to Athanasoglou et al. (2008) and Sastroswito & Suzuki (2011).

## Macroeconomic variables

**Exchange rate:** Exchange rate used in this study was the real exchange rate in line with the work of Musonda (2008). Real exchange rate was used to derive the volatility coefficients named as real exchange rate volatility (*REXRV*), this was done in line with the argument by McKenzie and Brooks (1997) who stated that whether the volatility coefficients are estimated from real or nominal exchange rates as the volatility is sourced solely from the nominal exchange rate. According to Musonda (2008), be it of the nominal or real exchange rate, volatility creates uncertainty in macroeconomic policy formulation, investment decisions, and international trade flows. This has been seen in the work of Majok (2015) and Kairu (2016) who have reported that the exchange rate movements hamper banks profitability. In contrast, Lambe (2015) found a positive relationship existing between the latter and former.

**Inflation:** Another important macro-economic condition which may affect both the costs and revenues of banks is the inflation rate (*INFL*). In this regard, Revell (1979 cited in Ponce, 2012) introduces the issue of the relationship between bank profitability and inflation, stating that the effect of inflation on bank profitability depends on how inflation affects both salaries and the other operating costs of the bank. In this context, Staikouras & Wood (2004) points out that as inflation may have direct effects, that is, increase in the price of labor, and indirect effects, that is, changes in interest rates and asset prices, on the profitability of banks. Perry (1992) also suggests that as the effects of inflation on bank performance depend on whether inflation is anticipated or unanticipated. In the anticipated case, the interest rates are adjusted accordingly, resulting in revenues to increase faster than costs and subsequently, having a positive impact on bank profitability. On the other hand, in the unanticipated case, banks may be slow in adjusting their interest rates resulting in a faster increase of bank costs than bank revenues and consequently, having negative effects on bank profitability. Thus, the expected sign of inflation is unpredictable based on prior research. This study measured inflation by using the monthly inflation rate in (%).

Table 4.1 below summarizes variables used in this paper and their description.

**Table 4.1: Description of variables**

Variables	Description	Expected sign
Dependent		
Return On Asset ( <i>ROA</i> )	Net profits over total assets	
Independent		
<i>Bank- specific characteristics</i>		
<i>(Internal factors)</i>		
Interest rate spread ( <i>INTS</i> )	Difference between ALR and ADR	-/+
Bank Size ( <i>TA</i> )	Natural logarithm of banks total assets	-/+
<i>Macroeconomic - Specific Characteristics</i>		
<i>(External factors)</i>		
Real exchange Volatility ( <i>REXRV</i> )	As derived from GARCH (1,1) model	-/+
Inflation rate ( <i>INFL</i> )	Monthly Consumer price index	-/+

The relationship between banks profitability and exchange rate volatility, including the control variables which have been classified as internal and external factors, can be specified in the functional form as follows:

$$ROA = f( REXRV, INFL, INTS, TA) \quad (1)$$

## 4.6 Model Specification

To achieve the desired results for the mentioned objectives, this research will start by first determining the volatility of Exchange rate using the GARCH (1, 1) model. Thereafter, a regression analysis will be used to determine the effect of the independent variables on commercial banks profitability in Zambia.

### 4.6.1 Estimation Model for exchange rate volatility, GARCH (1, 1) Model.

There are different techniques in the literature addressing the question: which measure should be applied as a proxy for the volatility of a variable. One of the most commonly used measures involves the standard deviation. However, the standard deviation, a widely used measure of exchange rate volatility, is not adopted in this study on account of the fact that it tends to overstate total risk, does not distinguish between predictable and unpredictable elements of a variable and lastly assumes normality distribution of a variable which is not always the case especially for

financial variables. It also assumes constant variance and does not take into account the time-varying variance of the variable. However, Engel (1982) allowed for the variance to vary over time and the idea behind the ARCH model is to characterize how this variance changes over time.

Volatility in the kwacha/US dollar exchange rate is modeled using the GARCH approach specified in equations 2 and 3 in order to characterize its time-varying conditional variance path.

A GARCH (1,1) model specification, as opposed to higher-order GARCH specifications, is chosen as it is parsimonious and, thus, avoids over-fitting the model and violation of the non-negativity constraint. In addition, it sufficiently characterizes the behavior of the exchange rate, i.e., leptokurtic, asymmetry and volatility clustering (Brooks, 2006). However, the major drawback of Garch Models is that it assumes nonlinearity of the variable under consideration.

Before using the GARCH model of estimation, it's customary to test for the presence of the ARCH effects in the exchange rate. The appropriate test for this purpose is Lagrange Multiplier (LM) ARCH test. The exchange rate is assumed to follow a primitive first-order autoregressive (AR) process, denoted by AR (1) and the following equation is run

$$\Delta \log(\text{real exchange rate})_t = \alpha_0 + \alpha_1 \Delta \log(\text{real exchange rate})_{t-1} + v_t \quad (2)$$

Where  $v_t$ , is a disturbance term. This test allows one to generate the GARCH (1, 1) series as a measure of exchange rate volatility. Equation 2, specified in log first difference, represents the conditional mean and describes how exchange rate evolves over time. The general assumption made is that the disturbances from equation 3 are not autocorrelated. Therefore, the GARCH process of this equation will take the relationship shown in the equation below.

$$h_t^2 = w + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1}^2, \quad (3)$$

where  $h_t^2$  is the time variant conditional variance of the exchange rate,  $\varepsilon_{t-1}^2$  is the lag of the squared residuals from the mean equation and measures news about volatility in the previous period (the ARCH term) and  $\sigma_{t-1}^2$  is the last period's forecast variance (the GARCH term). Additionally,  $\alpha$  and  $\beta$  are parameters to be estimated. Equation 3 is the regression equation of exchange rate and gives the conditional variance that will generate real exchange rate volatility, a key exogenous variable in the model.

#### 4.6.2 Regression Analysis

To establish the effect of exchange rate volatility on commercial banks profitability in Zambia, the study employed the Autoregressive Distributed Lag (ARDL) model. The ARDL cointegration approach was developed by Pesaran and Shin (1999) and Pesaran et al. (2001). It has three advantages in comparison with other previous and traditional cointegration methods. The first one is that the ARDL does not need that all the variables under study must be integrated of the same order and it can be applied when the underlying variables are integrated of order one, order zero or fractionally integrated. The second advantage is that the ARDL test is relatively more efficient in the case of small and finite sample data sizes. The last and third advantage is that by applying the ARDL technique we obtain unbiased estimates of the long-run model (Harris and Sollis, 2003). However, Models of this type are likely to have difficulties in successfully identifying the ‘correct’ relationships between the variables in data which contain a unit root, as issues of spurious correlation may arise (ARUP, 2010). The ARDL model used in this study is expressed as follows:

$$\begin{aligned}
 \Delta \text{LnROA}_t = & \delta + \sum_{i=1}^n \delta_{1i} \Delta \text{LnROA}_{t-i} + \sum_{j=0}^n \delta_{2j} \Delta \text{REXRV}_{t-j} + \sum_{k=0}^n \delta_{3k} \Delta \text{LnINFL}_{t-k} \\
 & + \sum_{l=0}^n \delta_{4l} \Delta \text{LnINTS}_{t-l} + \sum_{l=0}^n \delta_{5l} \Delta \text{LnTA}_{t-l} + w_1 \text{LnROA} + w_2 \text{REXRV}_{t-1} \\
 & + w_3 \text{LnINFL}_{t-1} + w_4 \text{LnINTS}_{t-1} + w_5 \text{LnTA}_{t-1} \\
 & + \varepsilon_t
 \end{aligned} \tag{4}$$

Where  $\delta$  =intercept:  $w_1$  =information about the error correction process:  $w_1, w_2, w_3, w_4, w_5$ = long-run parameters:  $\delta_{2j}, \delta_{3k}, \delta_{4l}$  =parameters for the short-run effects of the explanatory variables LnROA:  $\delta_{1i}$ =inertial dynamic effects:  $\delta_{20}, \delta_{30}, \delta_{40}$  =contemporaneous effect of the respective explanatory variables LnROA:  $\Delta$  and  $\varepsilon_t$  = first difference operator and the white noise term.

## 4.7 Unit root tests

According to Gujarati (2003, Pg 814) when non-stationary time series data is regressed on another non-stationary time series data, the results may suffer from an economic problem called Cointegration and the results are likely to be spurious( nonsensical). Therefore, it is important for the researcher to test for stationarity. The following hypothesis is used when testing for stationarity;

Ho:  $\rho=1$  there is non-stationarity in each individual variable.

H1:  $\rho < 1$  there is stationarity in each individual variable.

The Hypotheses above is tested using the Dickey-fuller test (If  $\tau$  calculated  $> \tau$  critical then Null hypothesis will be rejected) and in an event that the null hypothesis is accepted, the error correction model will be used to correct for co-integration of variables.

The stationarity and non - stationarity of a series can strongly influence its behavior and properties - e.g. persistence of shocks will be infinite for non-stationary series.

Spurious regressions; if two variables are trending over time, a regression of one on the other could have a high R2 even if the two are totally unrelated

If the variables in the regression model are not stationary, then it can be proved that the standard assumptions for asymptotic analysis will not be valid. In other words, the usual "t-ratios" will not follow a t-distribution, so we cannot validly undertake hypothesis tests about the regression parameters. In this regard, the Dickey-Fuller test will be employed. The presence of serial correlation in the residuals of the dickey fuller test biases the results. For this reason, the Augmented Dickey-Fuller Test (ADF) was developed. To determine the order of the series, two different unit root tests were conducted augmented Dickey and Fuller (1979) (ADF) and Phillips and Perron (1988) (PP).

## 4.8 Multiple breakpoint Test

It is vital to note in time series regression analysis, that relationships among the variables may change over time or a sudden shift in the variables may occur (Hansen, 1992). Not recognizing structural breaks and non-constancy in parameter estimates may bring about severe consequences

in relation to inferences and forecasting (Glynn et al, 2007). It is crucial to note that our data covers a period when significant changes in the economy occurred. This period covers the 2007-2010 global financial crisis which may have an impact on macroeconomic performance (Chileshe & Akanbi, 2017). All these events could have led to structural breaks which could have changed the relationships among the variables.

Given the above-mentioned, this study utilizes the Bai-Peron (1998,2003) procedures to test for structural breaks as well as selecting the break dates. Once structural break dates have been identified they are included in the ARDL models as dummies to account for the regime shifts in the long-run relationships. However, only dummies are retained in the estimations unless dropping them lead to parameter instability checked using the CUSUM test and CUSUM squares test.

#### **4.9 ARDL bounds testing Approach**

To investigate the presence of the long-run relationship, a bounds test based on the Wald or F-statistics was proposed by Pesaran (2001). The asymptotic distribution of the F statistics is non-standard under the null hypothesis of no cointegration relationship between the examined variables, irrespective of whether the explanatory variables are purely I(0) or I(1). The cointegration relationship for the ROA equation is estimated using the bounds test, which is based on the following Unrestricted Error Correction Model (UECM) as seen by (4). The null hypothesis is tested by considering the unrestricted ECM for ROA in (4) excluding the lagged variables  $\Delta \ln ROA$ ,  $\Delta REXRV$ ,  $\Delta \ln INFL$ ,  $\Delta \ln INTS$  and  $\Delta \ln S$ ; more formally, we perform a joint significance test, where the null and alternative hypotheses are:

$$H_0: b_1=b_2=b_3=b_4=b_5=0$$

$$H_1: b_1 \neq b_2 \neq b_3 \neq b_4 \neq b_5 \neq 0$$

Narayan (2004) tabulated two sets of critical values – the upper bound critical values refer to the I(1) series and the lower bound critical values to the I(0) series. For some significance level, if the F-statistics falls outside the critical bound, a conclusive inference can be made without considering the order of integration of the explanatory variables. For example, if the F-statistic is higher than the critical bound the null hypothesis of no cointegration is rejected. In the case when the F-statistic falls between the upper and lower

bounds, a conclusive inference cannot be made. Here, the order of integration for the explanatory variables must be known before any conclusion drawing conclusions.

#### **4.10 Limitations of the study**

This study was restricted to the type of data at its disposal during the time it was being conducted. The data available in the public domain was aggregated bank-specific variables, which precluded us from linking the estimated exchange rate volatility to individual bank-specific characteristics.

## CHAPTER FIVE: EMPIRICAL ANALYSIS AND DISCUSSION

### 5.1 Introduction

This chapter bases its focus on the findings. It comprises of Descriptive statistics of empirical data, data presentation and detailed discussion of the Results from the estimated models.

### 5.2 Descriptive statistics

Table 5.1 shows the descriptive statistics of all the variables used in the study. The descriptive statistics revealed insights about the behavior of the variables throughout the period of study. It revealed that ROA was high on average with a mean of 3.74, minimum of 1.26 and a maximum of 6.79. This shows that banks were profitable on average during the study.

**Table 5.1: Descriptive Statistics of the Data**

	<b>ROA</b>	<b>REAL_EXR</b>	<b>CPI</b>	<b>INSTPR</b>	<b>TA (K'M)</b>
Mean	3.74	5.82	119.73	20.74	31374224
Median	3.57	5.02	115.25	21.68	26441730
Maximum	6.79	12.16	201.18	31.50	71702116
Minimum	1.25	3.17	61.39	11.82	4460828
Std. Dev.	1.20	2.23	39.91	4.76	20298866
Skewness	0.40	1.21	0.46	-0.18	0.532741
Kurtosis	2.28	3.34	2.22	2.41	1.906539
Jarque-Bera Probability	7.58 0.02	39.12 0.00	9.51 0.01	3.108822 0.211314	15.15092 0.000513
Sum	583.4	907.56	18678	3235.739	4.89E+09
Sum Sq. Dev.	224.89	773.12	246858	3506.489	6.39E+16
Observations	156	156	156	156	156

Notes; ROA= Return On Assets, EXR= real exchange rate, \*CPI = Consumer Price Index, INSTPR =Interest rate spread, TA = Total Assets.

### 5.3 Unit root tests

Before regressing, each variable has to be tested for unit root and the following results were obtained using the Augmented Dickey-Fuller test (ADF) and Philipps perron (PP) tests. The

findings of the unit root tests can be found in Table 5.2. The series in Table 5.2 is checked based on intercept and trend, and the results vary according to the level at which the variables become stationary. The series was found to be stationary at level and at first difference. LOG\_TA was found to be integrated of order zero – I(0), and LOG\_ROA, LOG\_EXR, LOG\_CPI, and INSTPR were found to be integrated of order one –I(1). Thus an appropriate and congenial method for testing for co-integration of variables integrated at different orders is the Auto Regressive Distributed Lagged (ARDL) bounds test approach as proposed by Pesaran et al (2001).

**Table 5.2: Unit Root Tests Results**

Variables	ADF Test			P-P Test		
	Level	First Difference	Lags	Level	First Difference	Result
LOG_ROA	-2.49	-6.36*	3	-2.34	-10.72*	<b>I(1)</b>
LOG_EXR	-3.03	-8.88*	3	-2.87	-8.92*	<b>I(1)</b>
LOG_CPI	-2.38	-7.18*	2	-2.14	-7.26*	<b>I(1)</b>
INSTPR	-1.82	-11.20*	2	-1.66	-11.69*	<b>I(1)</b>
LOG_TA	-5.88*		7	-6.22*		<b>I(0)</b>

The unit root equations for both ADF and P-P contain a constant and linear trend. The lag selection criteria for ADF test was AIC. \*, \*\*, \*\*\* asterisks refer to 1%, 5% and 10% significance level.

#### 5.4 GARCH Model Estimation

To justify the use of Garch (1.1) model in determining volatility in the real exchange rate, the study employed the ARCH-LM test. From Table 5.3 in Appendix 1 it can be seen that Arch LM Test statistic is significant at 1% level. This means that there is enough evidence to reject the Null hypothesis and conclude that the Arch effects are present, implying that there is volatility in the real exchange rate. This result further revealed that the variance of the real exchange rate does not follow homoscedasticity, but show a dependence on the variances of preceding periods. The test also suggests that there is a serial correlation in the squared residuals. The presence of Arch effects makes the Garch- type model a suitable class of models for measuring volatility in the exchange rate.

**Table 5.4: GARCH (1,1) MODEL ESTIMATION**

---

$$\Delta s_t = 0.00$$

(0.12)

$$h_t = 0.00 + 0.41 \varepsilon_{t-1}^2 + 0.53 h_{t-1}$$

(3.08)\*\*\* (2.69)\*\*\* (5.65)\*\*\*

Diagnostic tests

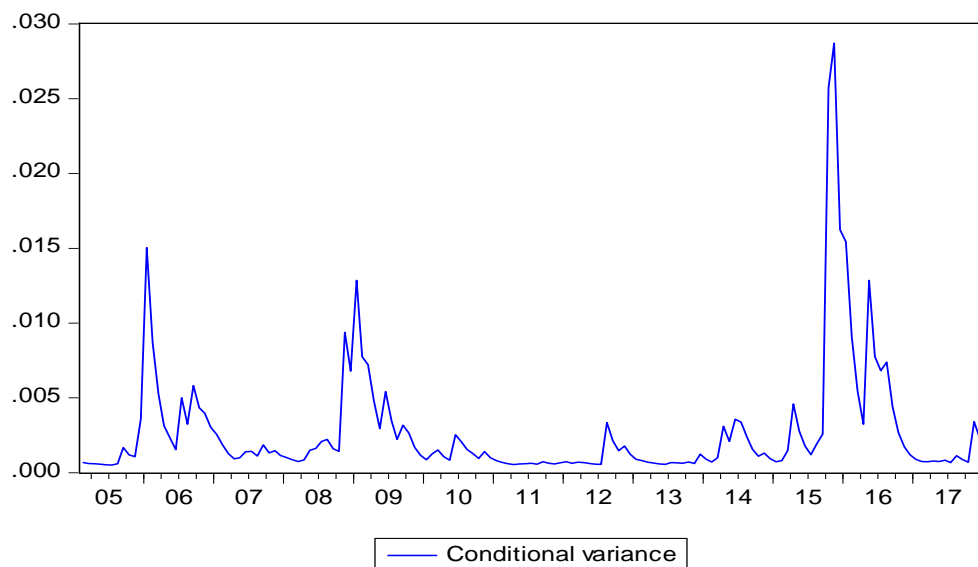
J-B = 92.76 [0.000]; ARCH LM = 0.01 [0.92]; Log L = 278.45; AIC = -3.54; SBC = -3.46

Z-statistics are reported in parenthesis while p-values are in square brackets. \*\*\*, \*\*, \* refer to statistical significance at 1%, 5% and 10%, respectively.

---

Note: The GARCH (1,1) model is well specified based on the diagnostic tests.

From Table 5.4, it can be seen that the Arch LM Test is statistically insignificant meaning that there are no arch effects remaining in the model as the null hypothesis failed to be rejected. The GARCH model is correctly specified based on the diagnostic tests. The coefficients of the Arch term and the Garch Term in the Variance equation was found to be closer to 1 ( $0.41 + 0.53 = 0.94$ ) meaning they were persistent shocks during the study period. This implies that there is stationarity in the conditional variance, meaning that the conditional variance converges to its unconditional long term variance value after every shock as it can be seen in Figure 5.1. Volatility was receding from 2005 until the global financial crisis in 2007 and persisted until the end of 2010. A spike in volatility occurred towards the end of 2012. There was another spike in 2015.



**Figure 5.1- Conditional variance**

## 5.4 ARDL Estimation

### 5.4.1 Multiple Breakpoint Test

Before estimating the ARDL model, the study tested for structural breaks using the Sequential Bai Perron Test. Table 5.5 in appendix 2, displays scaled F-statistic and the Bai-Perron critical values. F-statistic is scaled by the number of varying regressors. The dependent variable in the Test was LOG\_ROA, while the regressors were REXRV, LOG\_CPI, INSTPR, and LOG\_TA. The Assumed significance level was 0.05. The sequential Bai-Perron test showed that there were only three (3) break dates as seen in Table 5.6, one breakpoint was found in June 2009, June 2013 and January 2008. A null hypothesis of zero breakpoints is rejected in favor of an alternative of 1 breakpoint ( $m=1$ ). However, with this series, there is no evidence for a fourth break. Dummies were generated for breaks 1, 2 and 3 respectively.

**Table 5.6: Break Dates**

	Sequential	Repartition
1	2009M06	2008M01
2	2013M06	2009M12
3	2008M01	2013M06

To run the ARDL the optimal lag length was needed and as such Unrestricted VAR model was used to estimate the optimal lag length. Lag 3 was selected as it had the lowest AIC value of -21.27

as seen in Table 5.7 (Appendix 2). Once the Optimal lag was obtained **ARDL (3, 3, 0, 2, 1)** was the model selected, as seen in Appendix 3, by automatic selection and the dummy variables `dummy_02` `dummy_03` were found to be insignificant and was included because their exclusion in the model affected the stability of the model. The ARDL F-statistic was significant at 1% implying that the model was correctly specified and inference can be made from it.

#### 5.4.1 ARDL (3, 3, 0, 2, 1) Co-integration Test

As illustrated in table 5.8, the computed  $F$ - statistic is 6.95 and is statistically significant at the 1% upper critical bound. This result confirmed the existence of a long-run level relationship between the dependent variable, `LOG_ROA`, and the set of its covariates.

**Table 5.8: ARDL (3, 3, 0, 2, 1) Co-integration bounds Test**

Test Statistic	Value	k
F-statistic	6.959941	4

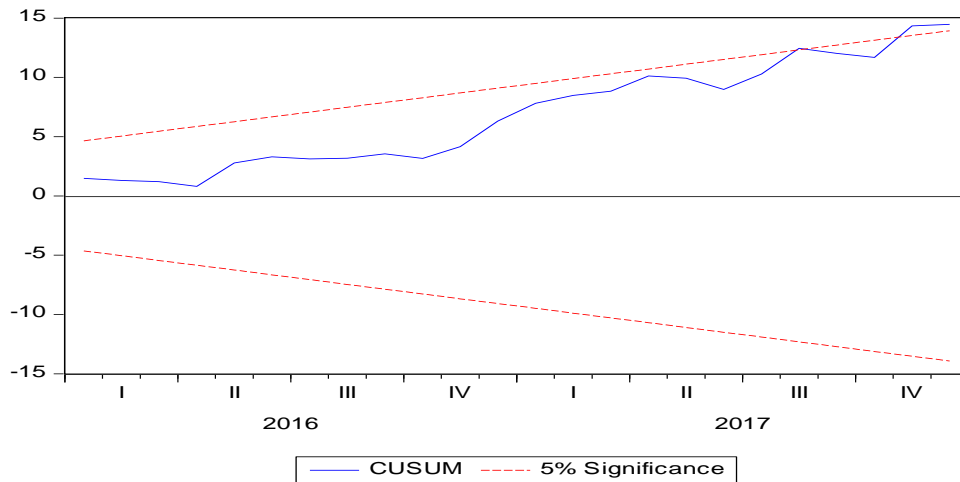
  

Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

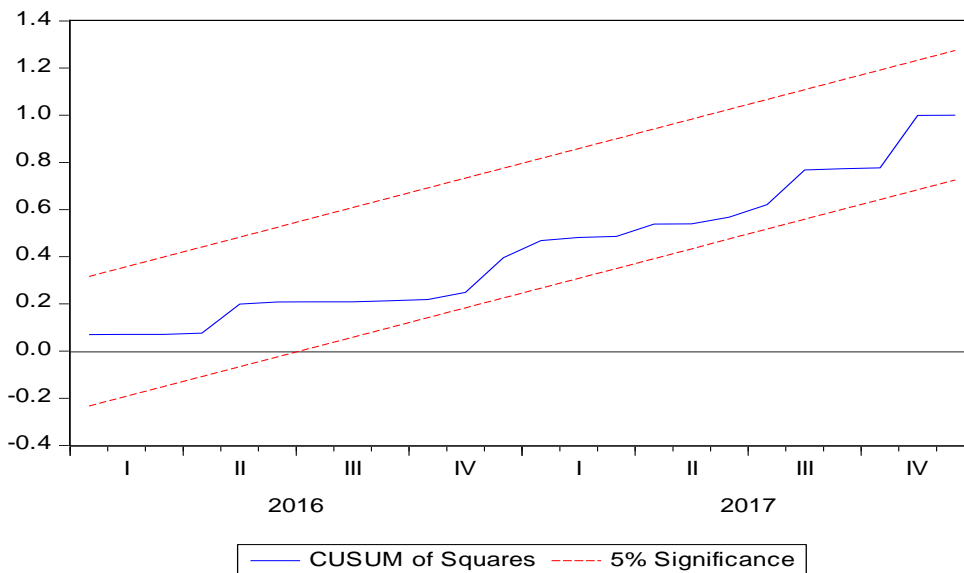
From the results reported in Table 5.9 the diagnostics indicate that the residuals are serially uncorrelated, homoskedastic, based on Breusch-Godfrey serial correlation LM test, and ARCH LM test, respectively. The model did not suffer from functional misspecification as the Ramsey RESET test was insignificant.

**Table 5.9: ARDL Estimation Diagnostic Tests**

TEST	F - STATISTIC	P-VALUE
Serial Correlation: Breusch-Godfrey serial correlation LM test	0.78	0.37
Autoregressive conditional Heteroskedasticity: White test.	0.14	0.70
Ramsey RESET Test: Functional Form	0.02	0.87



**Figure 5.2 – CUSUM TEST**



**Figure 5.3: CUSUM OF SQUARE TEST**

According to Pesaran and Pesaran(1996), the stability of the estimated coefficients of the error correction model should also be empirically investigated. A graphical representation of CUSUM and CUSUMQ statistics are shown in Figure 5.2 and Figure 5.3 respectively. Following Bahmani-Oskooee (2004) the null hypothesis (i.e. That the regression equation is correctly specified) cannot be rejected if the plot of these statistics remains within the critical bound on the 5% significance level. As it is clear from Figure 5.2 and Figure 5.3, the plots of both the CUSUM and the CUSUMQ are largely within the boundaries and hence these statistics confirm the stability of the long-run coefficients of LOG\_ROA function in the ARDL models.

As seen from Table 5.10, the Co-integration Form equation the Error correction Term (ECT) has the expected sign with the Speed of adjustment 22.6%. This implies that the bank profitability in Zambia converges monotonically towards its long-run equilibrium path at a rate of 22.6 % and confirms the long-run equilibrium relationship between bank profitability (ROA) and the regressors being studied. The first lag and Second lag of ROA was found to be statistically significant, implying that a 1 percent increase in the first lag and second lag of ROA will increase ROA by 0.13% and 0.23% respectively. REXRV and the first lag of REXRV were found to be statistically insignificant while the second lag of REXRV was found to be statistically significant at 5 percent level of significance, implying that a unit increase in the second lag of REXRV will increase ROA by 39.2%. CPI was found to be statistically significant at 1% level of significance, implying that a 1 percent increase in CPI will reduce ROA by 1.17%. INSTPR found to be statistically significant at 1% level of significance, implying that a 1-point increase in INSTPR will increase ROA by 2.48%. However, the first lag of INSTPR was statistically significant. TA was also found to be statistically insignificant. The two breaks 2 and 3 were found to be statistically insignificant while break 1 was found to be statistically significant implying that the exogenous shock at that time had a negative bearing on ROA.

The long-run results in the Long - run Coefficients equation further showed that REXRV had a negative insignificant effect on ROA. Inflation was found to be statistically significant at 1% level of significance implying that a 1 percent rise in inflation will reduce ROA by 5.22%, ceteris paribus. INSTPR was found to be statistically significant at 1 percent level of significance, implying that a per unit increase in INSTPR will reduce ROA by 3.1%. TA was found to be statistically significant at 1%, implying that a 1% increase in TA will increase ROA by 1.19%. The breaks 2 and 3 were found to be statistically insignificant while break 1. This implies that the structural break 1 negatively impacted ROA.

**Table 5.10: ARDL (3, 3, 0, 2, 1) Co-integrating and Long Run Form**

ARDL Cointegrating And Long Run Form  
 Dependent Variable: LOG\_ROA  
 Selected Model: ARDL(3, 3, 0, 2, 1)  
 Sample: 2005M01 2017M12  
 Included observations: 152

Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.

D(LOG_ROA(-1))	0.136710	0.082515	1.656784	0.0999
D(LOG_ROA(-2))	0.234479	0.083312	2.814480	0.0056
D(REXRV)	2.366203	2.009831	1.177314	0.2412
D(REXRV(-1))	0.446245	2.568816	0.173716	0.8624
D(REXRV(-2))	3.924878	1.941121	2.021965	0.0452
D(LOG_CPI)	-1.176845	0.316334	-3.720256	0.0003
D(INSTPR)	-0.024847	0.007444	-3.337934	0.0011
D(INSTPR(-1))	-0.012634	0.007781	-1.623748	0.1068
D(LOG_TA)	-0.042230	0.182385	-0.231542	0.8172
DUMMY_01	-1.070707	0.175320	-6.107170	0.0000
DUMMY_02	-0.008004	0.146168	-0.054757	0.9565
DUMMY_03	-0.230770	0.166887	-1.382788	0.1703
CointEq(-1)	-0.225641	0.039171	-5.760472	0.0000

#### Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
REXRV	-13.986141	8.565305	-1.632883	0.1049
LOG_CPI	-5.215554	1.212269	-4.302308	0.0000
INSTPR	-0.031167	0.011611	-2.684360	0.0082
LOG_TA	1.196247	0.562460	2.126813	0.0353
DUMMY_01	-1.070707	0.175320	-6.107170	0.0000
DUMMY_02	-0.008004	0.146168	-0.054757	0.9565
DUMMY_03	-0.230770	0.166887	-1.382788	0.1703
C	5.543381	4.984968	1.112019	0.2681

## 5.5 Discussion

The Zambian USD exchange rate was observed to have increased over time hence the high fluctuations. The exchange rate was therefore volatile for the entire study period and generally exhibited a depreciating and volatility trend, implying that in general, the country's international competitiveness had deteriorated over the study period. The observed Conditional volatility in the real exchange rate may be caused by the impact of some fundamental variables such as Money supply, Inflation, Terms of trade, Money supply, foreign reserves and openness (Chipili, 2010). The study found out that in the short run, volatility in the exchange rate was positive and significant while in the long run, it was negative and insignificant. The results revealed that in the short run, bank profitability increases the more volatile exchange rate becomes. This supports the notion that exchange rate volatility enhances bank profitability. Indeed, the observed volatility encourages banks to conduct speculative activities on the basis that the exchange rate will appreciate.

However, the empirical evidence suggests that such activities positively impact bank profits in the short – run not in the long run.

In the long – run the results revealed that there was an insignificant negative relationship between exchange rate volatility and bank profitability. The insignificance of this relationship could be attributed to the effectiveness of foreign exchange risk management conducted by banks that engage in foreign exchange transactions. The insignificant result may be interpreted as a balanced foreign exchange position in general and successful foreign exchange risk management (Ekinici, 2016). Banks have increasingly had to comply with regulations issued by the Pensions and Insurance Authority (PIA), and the Securities and Exchange Commission (SEC), this consolidated regulatory framework has given them an avenue to enhance risk management (Chibuye et al, 2016). Despite capital markets remaining largely underdeveloped, banks cushion their foreign exchange transactions through the use of derivatives such as options and forward contracts (GRZ, 2017). The results also found that the relationship between bank profitability and exchange rate volatility was negative though insignificant, this means that on the trading desk the volatility causes banks to lose profitable opportunity from both individual and corporate customers as they increase the premium that they earn from selling foreign exchange to their customers. As the volatility in the exchange rate increases banks increase the premium, the cost is born by the customers who purchase foreign exchange at a higher price hence negatively affecting their business which in turn affect the profit they make and as well affect the volume of deposit they make to the banks thus affecting the overall profitability of the bank by affecting banks capacity for credit creation. This finding is similar to the work of Manyo et al. (2016).

The Structural Break dummy 1 was statistically significant suggesting that the economy was affected by a shock in 2009. The shock came in the light of the global financial crisis which originated from the United States. This shock may have been caused by the climax of the global financial crisis which occurred in 2008. The results are in contrast with the work of Ndulo et al. (2012) who argued that Zambia was not significantly affected by the 2008-09 global financial crises. According to BOZ (2010), Zambia weathered the crisis relatively well, with growth in 2009 actually increasing to 6.3% from 5.7% in 2008. This growth was largely driven by increased output in the mining and quarrying, construction, agriculture, and energy sectors. Although Zambia's financial sector was not directly exposed to toxic assets, the financial crisis and the global recession

that it triggered did impact Zambia's macroeconomic environment. The Zambian economy suffered a reversal of short term capital flows and a slowing down of foreign direct investment, which had an adverse impact on the exchange rate of the Kwacha against the major currencies. The collapse in commodity prices as global demand contracted also impacted on Zambia's mining sector and its related support industries, leading to losses in output and employment that fed back into the deterioration in the loan book of commercial banks. Non-performing loans in the banking sector, for example, rose from around 6% in June 2008 to 12.6% at the end of 2009. This increase in credit risk hampered the profitability of commercial banks in Zambia.

## **CHAPTER SIX: CONCLUSION AND RECOMMENDATION**

### **6.1 Introduction**

This chapter concludes the overall research paper. This chapter comprises of Conclusion of findings, and Recommendations.

### **6.2 Conclusion**

This study investigated the effects of exchange rate volatility on commercial bank profitability in Zambia. The results showed that real exchange rate volatility had a positive relationship with bank profitability in the short run while in the long run a negative and insignificant relationship was found. It can be concluded that banks do not rely on the premium from selling foreign exchange to remain profitable and competitive in the business. Therefore, the Bank of Zambia should ensure that banks don't make outrageous premium from selling foreign exchange. The results implied that the more volatile real exchange rate is the lower the bank profitability hence the need to manage exchange rate volatility if banks profitability is to be improved. This study concludes that the government should deploy adequate measures to safeguard the domestic currency. It should promote foreign direct investments so as to spur economic growth and consequently cause the local currency to appreciate. This would translate to a more stable currency against international currencies. This would consequently lower borrowing costs thus making loans even more affordable. Some of the findings revealed that inflation had a negative relationship with bank profitability. This indicates that inflation is unanticipated by the banks in Zambia. Interest rate spread had a negative-positive relationship with bank profitability. This indicates that a higher ratio of non-performing loans leads to the deterioration of credit portfolio quality which negatively affects commercial banks. In addition, bank size was found to be positively related to bank profitability. And so banks should focus on building strong assets base as it contributes positively to the profitability of the banks under study.

### **6.3 Recommendations**

1. The government should ensure that it promotes diversification in its exports that will try to stabilize the exchange rate and should promote foreign direct investments so as to spur

economic growth and consequently cause the local currency to appreciate. This would translate to a more stable currency against international currencies.

2. This study only focused on investigating the effect of exchange rate volatility on commercial banks profitability using aggregated time series variables, which gave us an overview of indirect and direct exposure. This is just one side of the effects of exchange rate fluctuations on banks performance. There is need to itemize how this volatility affects banks, directly and indirectly, using bank-level data whose data is not available in the public domain.

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## APPENDICES

### Appendix 1

**Table 5.3: ARCH LM Test – GARCH Pre-estimation Test**

F-statistic	1740.353	Prob. F(1,153)	0.0000
Obs*R-squared	142.4746	Prob. Chi-Square(1)	0.0000

### Appendix 2

**Table 5.5: Sequential Bai-Perron test**

Sequential F-statistic determined breaks:		3	
Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	120.5835	602.9176	18.23
1 vs. 2 *	14.21111	71.05554	19.91
2 vs. 3 *	7.508266	37.54133	20.99
3 vs. 4	3.749381	18.74691	21.71

\* Significant at the 0.05 level.

\*\* Bai-Perron (Econometric Journal, 2003) critical values.

**Table 5.7: ARDL – VAR Order Selection Criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	838.6311	NA	8.43e-12	-11.30953	-10.68795	-11.05695
1	1563.229	1337.719	4.76e-16	-21.09411	-19.95456*	-20.63105*
2	1598.725	63.04883	4.12e-16	-21.24091	-19.58337	-20.56737
3	1625.832	46.25235	4.02e-16*	-21.27038*	-19.09486	-20.38635
4	1638.847	21.29695	4.81e-16	-21.10275	-18.40926	-20.00824
5	1661.766	35.90091	5.02e-16	-21.07365	-17.86217	-19.76866
6	1689.097	40.90113	4.96e-16	-21.10625	-17.37679	-19.59078
7	1702.404	18.98369	6.00e-16	-20.94271	-16.69528	-19.21676
8	1724.712	30.26340	6.46e-16	-20.90506	-16.13964	-18.96862
9	1741.706	21.86675	7.56e-16	-20.79309	-15.50969	-18.64617
10	1774.666	40.10546*	7.16e-16	-20.90442	-15.10305	-18.54702
11	1793.319	21.39191	8.39e-16	-20.81565	-14.49629	-18.24776
12	1816.382	24.83747	9.40e-16	-20.78856	-13.95123	-18.01020

\* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

**TABLE 5.11 ARDL (3, 3, 0, 2, 1)**

Method: ARDL  
Date: 05/06/19 Time: 18:18  
Sample (adjusted): 2005M05 2017M12  
Included observations: 152 after adjustments  
Maximum dependent lags: 3 (Automatic selection)  
Model selection method: Akaike info criterion (AIC)  
Dynamic regressors (3 lags, automatic): REXRV LOG\_CPI INSTPR  
LOG\_TA  
Fixed regressors: DUMMY\_01, DUMMY\_02, DUMMY\_03 C  
Number of models evaluated: 768  
Selected Model: ARDL(3, 3, 0, 2, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LOG_ROA(-1)	0.911068	0.088262	10.32233	0.0000
LOG_ROA(-2)	0.097769	0.116154	0.841721	0.4015
LOG_ROA(-3)	-0.234479	0.083312	-2.814480	0.0056
REXRV	2.366203	2.009831	1.177314	0.2412
REXRV(-1)	-1.150932	2.482805	-0.463561	0.6437
REXRV(-2)	-0.446245	2.568816	-0.173716	0.8624
REXRV(-3)	-3.924878	1.941121	-2.021965	0.0452
LOG_CPI	-1.176845	0.316334	-3.720256	0.0003
INSTPR	-0.024847	0.007444	-3.337934	0.0011
INSTPR(-1)	0.005181	0.009955	0.520451	0.6036
INSTPR(-2)	0.012634	0.007781	1.623748	0.1068
LOG_TA	-0.042230	0.182385	-0.231542	0.8172
LOG_TA(-1)	0.312153	0.192974	1.617589	0.1081
DUMMY_01	-1.070707	0.175320	-6.107170	0.0000
DUMMY_02	-0.008004	0.146168	-0.054757	0.9565
DUMMY_03	-0.230770	0.166887	-1.382788	0.1703
C	1.250816	1.159711	1.078558	0.2827
R-squared	0.967106	Mean dependent var		1.251561
Adjusted R-squared	0.962655	S.D. dependent var		0.324813
S.E. of regression	0.062770	Akaike info criterion		-2.582211
Sum squared resid	0.524030	Schwarz criterion		-2.204226
Log likelihood	215.2480	Hannan-Quinn criter.		-2.428660
F-statistic	217.2409	Durbin-Watson stat		1.981240
Prob(F-statistic)	0.000000			

\*Note: p-values and any subsequent tests do not account for model selection.