FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF ECONOMICS

THE EFFECTS OF FINANCIAL INNOVATIONS ON DEMAND FOR MONEY IN BOTSWANA

RELETILE PHOMOLO MOTSEWAKGOSI

201703370

A RESEARCH PROPOSAL SUBMITTED TO THE DEPARTMENT OF ECONOMICS IN PARTIAL FULFILLMENT OF THE REQUIREMENT OF THE MASTERS OF ARTS DEGREE IN ECONOMICS

DECLARATION

I declare that the contents of this paper are my original work, where other people's work has been used, reference has been made.

Name: Reletile Phomolo Motsewakgosi

Signature:…… Date:……..

APPROVAL

This dissertation has been examined and approved as meeting the requirements for the partial fulfilment of the Master of Arts Degree in Economics.

…… ……

Supervisor Date

……... …….

Head of Department Date

DEDICATION

I dedicate this study to my late grandparent, Simele Mmelebele, my parents, my late sister Lesego Motsewakgosi and my siblings.

ACKNOWLEDGEMENTS

I would love to thank my parents, siblings and my friend, Othusitse Manji for the support and the comfort they provided me with during my studies.

My sincere gratitude is highly indebted to my Sponsor Northern Trust for their generosity for giving me Scholarship for my Master of Arts Degree in Economics. The scholarship has allowed me to be one step closer to my goal and has inspired me to help others by giving back to the community.

I would like to acknowledge my supervisors, Dr L.Setlhare and Mr Rathedi for their highly contribution to my work. I shall forever appreciate them.

TABLE OF CONTENTS

List of Tables

List of Figures

ABBREVIATIONS AND ACRONYMS

ARDL	Autoregressive Distributed Lag
ADF	Augmented Dickey-Fuller
ATM	Automated Teller Machine
CUSUMQ	Cumulative Sum of recursive residual square
EFTPOS	Electronic Transfer Point of Sale
ECM	Error Correction Model
GDP	Gross Domestic Product
IMF	International Monetary Fund
PP	Phillips-Peron

ABSTRACT

The study investigates the effects of financial innovation on demand for money in Botswana using annual data series for the period 1982-2017. The study uses the ARDL bounds testing approach to find the effects of financial innovation on demand for real narrow money and real broad money in Botswana. The ARDL approach integrates both the short run relationship and long run relationship. The study also estimates the demand for money function excluding the financial innovation proxy. The study also analyses the indirect effects through interactions of explanatory variables (GDP, exchange rate, inflation and interest rate with the financial innovation proxy).

The results of co-integration showed that there existed a long run relationship between the demand for real narrow money and explanatory variables but no long run relationship when including financial innovation proxy. When including financial innovation proxy to the demand for real broad money model, there was co-integration of real broad money and explanatory variables.

The results also showed that the financial innovation affect the real narrow money positively only in the short-run but not in the long run. Even though a long run relationship existed in real broad money when financial innovation proxy was included, the financial innovation affected the demand for real broad money negatively in the short run only. The overall net effects of financial innovation on demand for real money balances is negative. The results obtained support the theoretical and empirical studies that financial innovations do affect real money balances negatively. The interaction terms of financial innovation and macroeconomic variables showed that the effect of financial innovation depends on GDP, inflation, exchange rate and interest rate on real money balances. The marginal effect depicts a negative relationship between the financial innovation and demand for money.

The study recommends that policy makers should always be thorough when estimating the demand for money. Especially that since financial innovation is an ongoing process, the unpredictable changes and uncertainties of it, could lead to misspecification of demand for money

Key words: ARDL, Financial innovation, demand for money

CHAPTER ONE: INTRODUCTION

1.1 Background

The study investigates the nexus between financial innovation and the demand for money in a market economy of Botswana. Financial innovation is a process where new financial products, services and procedures are created resulting in transformation and restructuring of banking services widely. According to Bilyk (2006) financial innovation is the result of the desire of market participants to establish new, efficient ways of increasing profits when providing goods and services. It is simply technological progress in transaction and policy changes such as financial regulation or deregulation. The consensus definition of financial innovation is the introduction and development of financial markets, payment structures and technological advancement aimed at increasing the efficiency of the financial sector.

Most empirical studies have been attempting to investigate the demand for money given its importance on policies for monetary arena. Studies in developed countries have been able to find the stability of the demand money function. According to Nelson (2008) central banks make a set of objectives towards the growth and stability of economy, by making sure that there is availability of money in the economy. The monetary authority can alter the money supply by influencing the interest rate to achieve policy goals.

The instability of the money demand hinders proper monitoring of prices. Studies of Hamori (2008) found a stable money demand function in developing countries. It is vitally important to know the relationship between money demand and its determinants as it has been of great important research focus because of its implication to monetary policy (Dunne & Kasekende, 2016). However many studies did not consider the financial

innovation proxy when estimating the demand for money. There are mixed results regarding the stability of demand for money due to excluding the financial innovations in specification of the demand for money function.

Financial innovation has an effect on economies, which can be positive or negative. Financial innovation can make progress towards improved access to financial services and increased competition in the banking industry. Financial innovation can assist in capital accumulation, a technological innovation that leads to a sustainable economic growth by encouraging productive investment and savings decisions (Motsatsi, 2016).

Botswana has undergone significant changes against the background of general trends towards globalization, development of internet and the expansion of e-commerce after liberalization and reform measures of 1986. The banking sector consist mainly of commercial banks in Botswana. The competition amongst banks led to improved services and products. As a result, competition has encouraged banks to be innovative (Setlhare, 2002). This effect is shown by evolution of bank technological innovations and financial instruments. These include the use of electronic payments system and automated teller machines through the use of debit cards, credit cards and smart cards. There is e-banking where customers access their bank accounts through cell phones and online banking. There are also mobile payments through mobile network operators such as e-wallets, my-Zaka and Orange money (explained in Chapter 2). These technological innovations provide payments systems that are efficient and cost effective (Ogbuji, Onuoha, & Izogo, 2012).

Botswana's banking sector has experienced some significant improvement in terms of technological innovation in the form of automated teller machines (ATMs) installation.

This is indicated by the drop in the amount of currency circulating in the economy of Botswana, showing that electronic funds transfer at point of sale (EFTPOS) and ATMs are increasingly substituting cash in terms of payments (Motsatsi, 2016). Both credit cards and ATM machines have helped reduce money demand, making it possible to carry out a given level of transactions while carrying less cash.

Several empirical studies in Nigeria, Uganda, Kenya, Namibia and Pakistan started including financial innovation when specifying the demand for money function. Botswana as a developing country is growing in terms of financial innovation. The question is how this financial innovation affects the demand for money in Botswana. These financial innovations can complicate the conduct of monetary policy because of the instability of the demand for money function.

Most studies by Mosweu (2003), Masalila (1990) and Mhoya (1992) done in Botswana on demand for money did not include variables to capture financial innovations. This study will introduce the financial innovation variable when estimating the demand for money in Botswana. The study will focus on, the effects of financial innovations on demand for money in Botswana using data of 1982 to 2017. The financial innovations that make Botswana a particularly interesting case to study are use of credit cards, ATMs, online banking, e-wallets and mobile payments (my Zaka and Orange Money). The study will also re-estimating the demand for money in Botswana.

1.2 Statement of the problem

The government launched the 2012-2016 Financial Sector Development strategy in 2012. It was aimed at introducing financial reforms, improving technological developments such as mobile financial services, online and mobile banking, which subsequently led to

the transformation and development of the financial sector in Botswana. The aim of Bank of Botswana is to achieve macro-economic stability through monetary policy management since the economic performance depends on it (Motsatsi, 2016). If these financial innovations change the financial system, to what extent will these financial innovations affect the demand for money. How does this affect the execution of the monetary policy?

Firstly, financial innovation is a challenge for the interpretation of developments in the monetary aggregates. With new products and financial instruments, the definitions of broader monetary aggregates may require updating which is a concern to central bank forecasting models (Dabrowski, 2017). Dunne & Kasekende (2016) contend that financial innovation might be one of the reasons for money demand instability ascertaining that it is a shifter in the demand for money function. Secondly, financial innovation is a challenge for monetary policy. The increase in use of these financial innovations e.g. electronic banking can substitute the traditional form of money. This can increase the highly illiquid assets and replace the liquid assets hence weakening the monetary transmission mechanism.

The development of technological innovation is of great importance in this period more especially on the financial sector. Financial innovation adds an element of uncertainty to the economic environment, which banks operate. Introductions of new financial products, processes and markets, institutions affect the way monetary policy is conducted (Odularu & Okunrinboye, 2009). While most of research focused on demand for money because of its importance to monetary policy, it is vitally important to investigate whether the demand for money is still stable considering the financial developments in Botswana. The

study will focus on how the increasing financial innovations in the financial sector affect the demand for money in Botswana.

1.3 Research Objectives

The broad objective of this study is to examine the effects of financial innovation on the demand for money in Botswana. The specific objectives are;

- To re-estimate the demand for money function in Botswana
- To examine the long run and short run relationship between financial innovation and demand for money
- To analyze the indirect effects of financial innovation on demand for money.

1.4 Hypothesis

H_0: Financial innovation has an effect on demand for money in Botswana

H_1: Financial innovation has no effect on demand for money in Botswana

1.5 Significance of the study

This study is of great importance, as it will examine if the demand for money is stable or unstable considering financial innovations in Botswana. Financial innovation alters the mechanisms of monetary policy on the economy; it is a shifter in the demand for money function resulting in the instability of the demand function. Knowing the extent which financial innovation has on demand for money will help in stabilizing macroeconomic variables for monetary policy. If financial innovation has an effect on demand for money, then it imposes a threat to the conduct of monetary policy more especially regulating the growth of money supply and interest rate changes.

The findings on the impact of financial innovations on demand for money could provide a useful guidance for monetary authorities in Botswana. It is important for central banks to monitor the developments in financial innovation in order to understand the behavior of the rapid financial innovations and to formulate the uncertainty of demand for money due to financial innovations. This study will be useful to the Bank of Botswana to reinforce the stability of the demand for money.

The study will also contribute to the relevant literature on financial innovations and the money demand in Botswana as so far little has done. The paper also contributes to literature by also re-estimating the money demand function including financial innovations.

1.5 Organization of the Study

The structure of this paper is as follows; Chapter 2 gives an overview of Botswana's financial sector, Chapter 3 discusses the literature review, Chapter 4 discusses the methodology. Chapter 5 presents the empirical results and Chapter 6 concludes the study and offers some policy suggestions.

CHAPTER TWO: OVERVIEW OF BOTSWANAS FINANCIAL SECTOR

2.1 Introduction

This chapter gives a brief overview of Botswana financial structure, monetary policy framework and financial innovations used. It is imperative to understand the structure of the financial sector as it has an impact on how stable the demand for money is.

2.2 Structure of the Financial Sector

The Bank of Botswana regulates and supervises the financial sector in Botswana. Botswana has a thriving financial sector that is open and experiencing significant growth (Bank of Botswana, 2016). The financial sector consist of many commercial banks. The commercial banks and pension funds dominate the Botswana's financial institution. Commercial banks own 39.6% of assets as shown below in Table 2.1. In 2016, there were 10 commercial banks and 2 small government statutory banks, with 10 banks holding about 80 percent of the banking system's assets. All commercial banks are foreign-owned, including subsidiaries of pan-African groups (Bank of Botswana, 2016).

The commercial banks accept deposits and make loans to borrowers. There are also several Non-Banking Financial Institutions, which account for about one-half of the financial system as shown by Table 2.1.

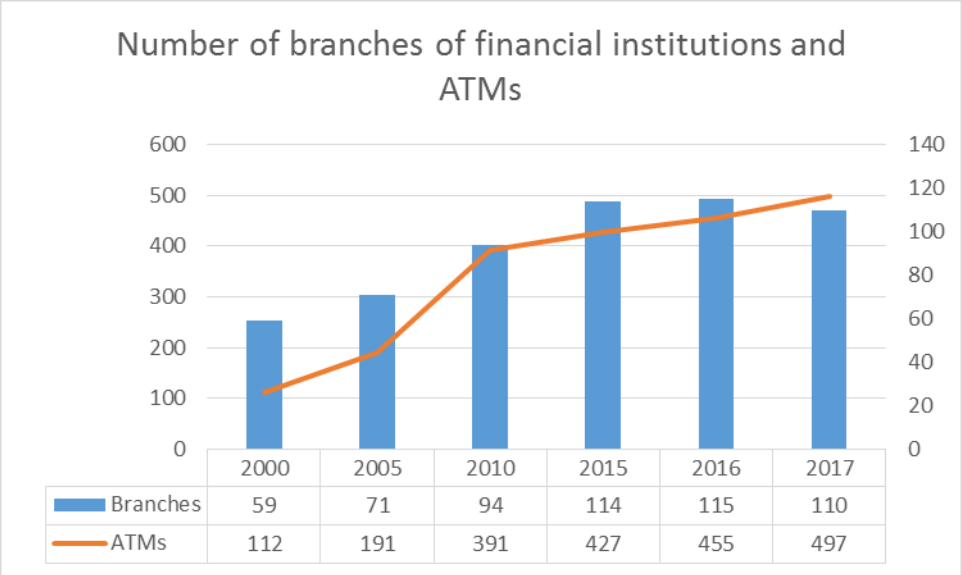
Table 2.1: Botswana's Financial System Structure Of 2016

Institutions		Number	Assets	
			In Billios of Pula	In % of Assets
	Commercial Banks	10	80.7	39.6
	statutory banks	2	3.9	1.9
	Building Society	1	3.8	1.9
Banks		**13**	**88.4**	**43.4**
Non-bank financial institutions		**202**	**115.5**	**56.4**
	Life insurance	9	19.7	9.7
	General Insurance	12	1.9	0.9
	Reinsurers	3	0.3	0.1
	Pension Funds	87	75.1	36.8
	Asset Managers	12	5.5	2.6
	Non-Bank Lenders	7	8.6	4.2
	Micro Lenders	20	3.9	1.9
	SACCOS	52	0.5	0.2

Source*; IMF report 2017*

Botswana is a developed country in the Sub-Saharan Africa, ranked 65 out of 138 countries with a score of 4.04 on the financial markets (Schwab, 2017) . The government is actively supporting growth and development of the financial sector, to promote and diversify the economy. This is evident by increase in number of branches between 2012 and 2016 shown by figure 2.1. The government launched the financial sector development, which was addressing issues of financial inclusion and enhancing service delivery by banking systems and improving access to financial services.

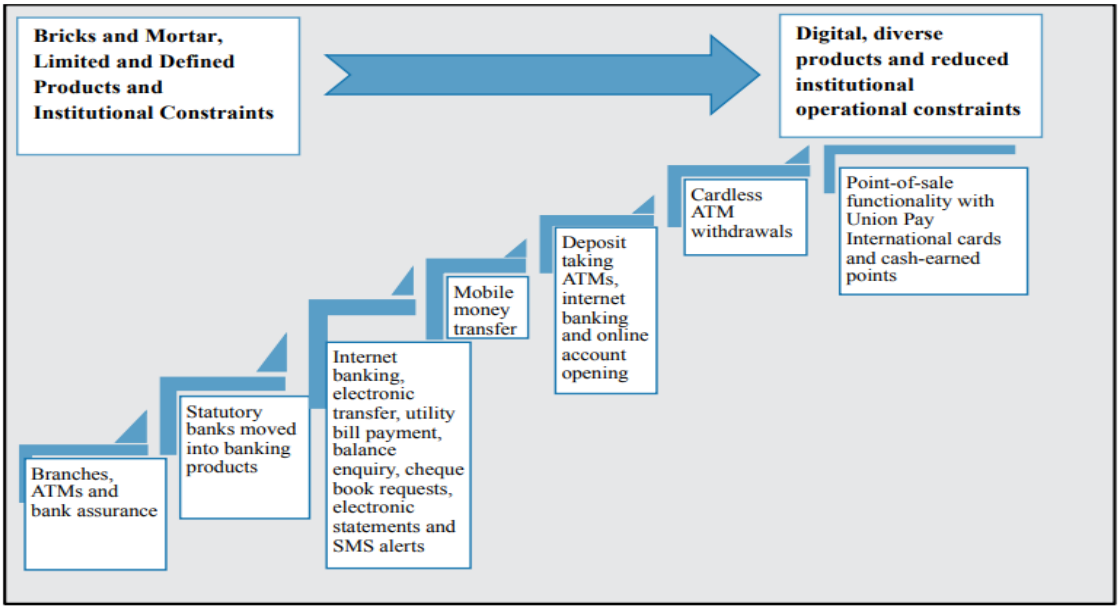
Figure 2.1: The total number of financial institutions branches and ATMs from 2000 to 2017.



Source*: Bank of Botswana: Banking Supervision Annual Report 2017*

Figure 2.1 shows the number of branches of banks and statuary banks and automated teller machines from (2000 to 2017). According to the figure 2.1 some banks restructured their operations; some increased their branches during the period. The banks increased their delivery channels (financial innovation) by increasing the installation of automated teller machines. It is evident that the number of financial institution branches increased from 59 to 110 in a period of 2000-2017. The total number of ATMs increased from 112 to 497 in the same period.

Figure 1.2: Trends in New banking Services and Delivery Channels



Source: Bank of Botswana.

The Figure 2.2 shows how the technological advancement led to more adoption channels to commercial banks. This shows that the development of financial innovations is important in the banking sector. These financial innovations are as follows;

Internet banking: The improved banking sector in Botswana has increased the efficiency of commercial banks by introducing internet banking also known as online banking. Online banking has increased the financial performance of commercial banks in Botswana. It is beneficial to customers as they can access their bank accounts 24 hours a day.

Automated Teller Machines (ATM): Banks have introduced automated teller machines (ATM) in areas of service provision to give ease of access of customers to withdraw, deposit and transfer cash anytime. The installation of ATMs is with security cameras. The commercial banks in Botswana issued visa electronic cards for their customers so that they withdraw the money from the ATMs.

Cell phone banking and mobile banking is the use of the cellphone to do services such as prepaid bills and money transfer. Mobile banking uses mobile communication infrastructure, which reaches those who do not even have bank accounts. Mobile banking has increased the efficiency in commercial banks in Botswana. According to several studies, cell phone banking has a considerable potential market in Botswana evident from the FinScope™ survey with 75% of respondents who were ready to adapt to new technology (Motsatsi, 2016).

Money transfer services through mobile network operators (My Zaka and Orange Money)-Orange network and Mascom network introduced their mobile money transfer services with the aim of providing technologically advanced solutions to non-bankers. The use of these network operators allow users to electronically send and withdraw funds. These services have continued to expand as the number of these mobile agents has increased in the country for example Choppies stores, post offices and small shops in rural areas. The adoption of these mobile payment systems makes transactions cheaper, easier and safer.

2.3 Monetary Policy

Bank of Botswana act as the financial advisor to the government. The bank of Botswana also manages foreign exchange reserves, administration of exchange rate and monetary policies. Monetary policy is the process by which central bank of a country controls the supply of money. It also focuses on the relationship between the rates of interests and the economy by controlling the price which money can be borrowed and total money supply. Under the Bank of Botswana Act (Cap 55.01, section 4), the Bank has the foremost statutory objective of maintaining monetary stability and safeguard the stability of the

financial system. A conducive financial environment enhances savings, initiates investment and encourages international competitiveness of local producers with other countries. This encourages sustainable economic development. The exchange rate of Botswana is maintained with a stable inflation rate of 3 to 6 percent (Pelaelo, 2018).

CHAPTER THREE: LITERATURE REVIEW

3.0 Introduction

The chapter discusses the theoretical and empirical literature review upon which the study is based on. Section 3.1 provides the theoretical literature review on the demand for money theories. Section 3.2 provides an empirical review from different studies on the effects of financial innovation and demand for money.

3.1 Theoretical Literature Review

Fisher (1911) proposed the theory of demand for money. The theory has undergone several refinements and modification over time. Other theories include Keynes (1936), Baumol-Tobin (1952, 1956), Friedman (1956) McCallum and Goodfriend (1987). The theories explain different motives for holding money in the economy.

3.1.1 Classical Theory of Money Demand

The classical school theory of money demand forms its basis on the equation of exchange. The theory highlighted the demand for money on the velocity of circulation of money. Hence, money is the medium of exchange for goods and services. The equation specification is as follows:

$$MV = PT \quad (1)$$

Where M is money supply in circulation, V is velocity of money (i.e. the number of times money changing hands), P is the price level and T is the volume of transactions. Fisher's quantity theory further modified to the following equation;

$$MV = PQ \quad (2)$$

Where *V, P* are already defined above, and *Q* is the output level. The velocity of money and the output level are constant in the long run. Hence, a change in the nominal money supply *(M)* is directly proportional to a change in the price level *(P*).

The classical economists contend that monetary forces do not change real variables such as output and employment. Money acts only as medium of exchange and it eases transactions. Income, which is assumed to be at full employment level determine the theory of demand for money because their argument is built based on Say's Law of supply that creates its own demand.

3.1.2 Milton Friedman Theory of demand for Money

According to Friedman (1956), the quantity theory of money is a restatement of demand for money by the classical economist. Friedman outlines that money is the income earned from holding bonds, equity, and human wealth. The rates of return of these assets determine the demand for money. Assuming bond and equity capital are perfect substitutes, with equal rates of return, Friedman's money demand function is;

$$M_D = M_D(i, r_{d,}\ {}^{\Delta p}/_{p}, y, w) \qquad (3)$$

Where M_D = money demand; p = price level; i = interest rate; y= income; w = wealth; r_d= deposit rate.

Price level is directly proportional to demand for money. A decrease in interest rate increases demand for money. Income and wealth are directly proportional to the demand for money and deposit rate has a negative effect on demand for money.

According to Friedman, all things being equal, an increase in the expected rate of inflation increases the demand for commodities and reduces the demand for money. Friedman's

analysis of the demand for money highlights that the more money is held, the lesser the valuable services are demanded.

3.1.3 Keynesian Theory of Demand for Money

Keynes proposed the expression of demand for money as liquidity preference after reviewing the Cambridge equation that did not include the interest rate in the money demand function. According to Laidler (1993), Keynes explained three motives why people demand money, which are transactions motive, precautionary motive and speculative motive. According to the Keynesians, the transaction motive describes the need for cash for current personal or business expenditure therefore, the higher the level of income of an economic unit, the higher will be the transactions demand for money. According to him, people hold some cash for unplanned activities, such as paying unexpected bills, known as the precautionary motive of holding money. The Keynesians suggested that both transaction and precautionary motives depend on the level of income. The last motive of holding money recognized by Keynes is the speculative motive, of which individuals demand money if they expect the market value of alternative assets to fall.

Hence, the speculative motive for holding money arises from the desire to maximize wealth and it depends on the rate of interest (Laidler, 1993). Keynes specified the demand for money as;

$$M_D = \mathrm{kY} + \mathrm{L(r)} \qquad (4)$$

Where M_D , is demand for money, kY is the transaction and the precautionary motive which depends on the level of income (Y), L (r) is the speculative motive which depends on interest rate (r).

Keynesians highlight that the demand for real money balances has a negative relation on interest rates. The demand for real money balances is directly proportional to real income, as a result, the demand for real money balance increases with an increase in real income.

3.1.4 The Baumol-Tobin Theory of Transaction Demand for Money

Baumol and Tobin (1956) theoretical work on the transaction demand for money emphasized more on the implications of variables that determine the demand for money (Laidler, 1993). The theory explains the opportunity cost of holding money. According to Baumol (1956), people hold less money if the opportunity cost of holding money increases, however an increase in income will increase investment to bonds. Baumol (1956) assumed that the individual agent receives an income payment once per period. The agent will hold some assets at every period, except the final period of the last expenditure. According to Laidler (1993), the agents incur a brokerage fee every time wealth is switched between assets (money and bond only). The aim of the individual is to determine the level of bond holdings, which will reduce brokerage cost and make the most of the returns from interest income.

The Baumol theory of demand specify the average demand for money as;

$$\frac{Md}{p} = \sqrt{cy \,/\, 2r} \qquad (5)$$

Where c is the cost of converting interest to money, r nominal interest rate, p price level and y income. The demand for money has a positive relationship with income. An increase in nominal interest rate leads to a decrease in money demand.

The theory of transaction demand for money form the basis of this study. Transaction costs influence the demand for money. Innovation can reduce transaction costs that affect

the demand for money. The introduction of ATMs has allowed agents to hold less cash. Mobile payments and ATMs have led to a reduction in the costs of holding money, which increase in the share of demand deposits, so this forms the Baumol-Tobin s framework.

3.1.5 Financial Innovation and Demand for Money

Lewis & Mizen (2000) accentuated the major sources of financial innovation, which are a result of technology, policy changes, market completeness and environmental changes. They explained the effects of financial innovation on the demand for money depending on the kind of innovation. Several economists faced a problem on how they can measure the financial innovations in the economy. Milbourne (1986) advocates that capturing financial innovation in the model while estimating the demand for money is imperative. Since there is no quantitative measurement of financial innovation on demand for money, different proxies of financial innovation have been used in several studies, for example, financial index, broad money ratios, credit extended to private sector, ATMs and mobile money payments. Lewis, et al., (2000) provided evidence on how financial innovation impacts money demand. Lewis, et al., (2000) suggested that financial innovations make the supply of money to be more exogenous and this is insignificance on the stability of money demand in the long run. Financial innovation increases the cost of holding financial assets and reduces the cost of trading financial asset for the other. Financial innovation has eroded the difference between banks and other financial intermediaries.

3.2 Empirical Literature Review

This chapter represents discussion of empirical studies about financial innovation and demand for money in developing countries and emerging economies. There is no study about the effects of financial innovation and demand for money in Botswana. However

there are several related studies that have been carried out on demand for money in Botswana, such as Mosweu (2003), Masalila (1990), Mhozya (1992) and Setlhare (2002).

Studies done in Botswana on demand for money

Masalila (1990) estimated the demand for money equation in Botswana from 1977-1990. He estimated both the long run equation and partial adjustment equation for the narrow money and broad money. Rates on call deposits and fixed deposits were used as proxy for interest rate measures. Real income, rate of inflation were explanatory variables. For the narrow money, the dominant determinant of demand for money that is the real income had a positive impact on transaction money balances in both the long run and short run. Interest rate was negative and significant.

Mhozya (1992) estimated the demand for money equation for cash balances in Botswana from 1976-1988. The study used the OLS estimation to determine the demand for money in Botswana in the long-run. Commercial bank interest rates, real income and inflation were statistically significant.

Anyangah (1995) investigated the dynamic behavior of the demand for money function in the economy of Botswana from 1982 to 1993. He used the M1, M2 and M3 as monetary aggregates when estimating the demand function. He used the Engle-granger test to establish the existence of long run relationship among variables. The study concluded that real income, domestic rate of interest and inflation and foreign interest rate are important determinants for demand for money in Botswana.

Setlhare (2002) estimated the demand for money function both in the long run and short run equation in the economy of Botswana using the narrow money M1 and M2 and M3 in the analysis. The study used data from 1977:1 to 1995: 4 using the VAR and single

equation frameworks. GDP, South Africa treasury bill rates, bank interest rate, domestic interest rate and foreign interest rates are variables used in the model. According to the Johansen maximum likelihood method, the narrow money was stable for the domestic interest rate. Whereas M2 and M3 there was a stable function of real income (for model with trend) and South Africa T-bill rate (for model without trend). There was evidence of temporal stability in the short run for M1.

Kganetsano (2001) estimated the demand for money function using the error correction mechanism. He used the real money balances, price level, nominal interest, real income and exchange rate as variables in the model. He found the existence of co-integrating relationship for M1 and M2. The co-integration relationship showed high-income elasticity, which indicates the strong transaction motive for holding real money balances in Botswana.

Mosweu (2003) investigated the long run demand for money function (M1) for Botswana from 1975 to 2002. He used the real GDP, inflation and real interest rate as the explanatory variables. He estimated his model by the Johansen maximum likelihood technique. According to his results, a stable co-integration relationship exists among money, income, interest rates on bank deposit and inflation that can be interpreted as a demand for money function in Botswana. The co-integration relationship showed high-income elasticity, which indicates the strong transaction motive for holding real money balances in Botswana. The results are consistent with (Kganetsano, 2001) who used the VECM approach.

Thapelo (2007) aslo estimated the demand for broad money in Botswana from 1977 to 2005. The study applied the multivariate analysis. Real income, interest rate, South

African treasury bill rate, inflation rate and US/Dollar exchange were used as variables in the model. The results showed a long run relationship between broad money and real income, interest rate, South African treasury bill rate, inflation rate and US/Dollar exchange. These variables had a positive effect on broad money in the long run. And concluded that targeting monetary aggregates can be viable to monetary policy.

Studies on financial innovations and demand for money on other countries

Mannah-Blankson & Belyne (2004) investigated the impact of financial innovation on the demand for money in Ghana using the co-integration and error correction modelling. The study used the broad money ratio (M2/M1) as a proxy for financial innovations. The results showed that the Ghana economy transaction technology that developed over time has an impact on the demand for real money balances. The results showed the long run demand for real money balances in Ghana is influenced by income, inflation, exchange rate and financial innovation. There is a long run positive relationship of financial innovations in Ghana on the money demand. Short-run results showed changes in income, inflation and financial innovation having a significant impact on money demand. A rise in financial innovation lead to an increase and a decrease in the demand for narrow (M1) and broad money (M2) respectively. The M1 and M2 are stable in long run and short run despite changes in financial growth in Ghana. The study concluded that monetary policy is effective when the demand for money is stable.

Bilyk (2006) investigated the impact of financial innovations on the demand for money from 1997 to 2005 in Ukraine. The study applied the Vector Error Correction model to investigate the impact of financial innovation on real volume of industrial production, expected depreciation, nominal interest rate, the level of dollarization in the economy,

expected inflation and real money balances. The index of financial innovation was used as proxy for financial innovations. The study applied different functional relationship to determine the long run relationship of demand for money. Results showed that within 10% significance level, financial innovation has a positive impact on the demand for money in the long run. The impulse response analysis showed that financial innovation was stronger with the narrow demand for money specifications. However, the relationship between financial innovation and the demand for money in the short run was negative.

Odularu & Okunrinboye (2009) examined the role of financial innovation on money demand in Nigerian economy arising from the Structural Adjustment Program (SAP) of 1986. The study used the data from 1970 to 2004. Nominal rate on treasury bills was used as a proxy for financial innovations, income, nominal rate of interest on time deposits, dummy variable to capture financial innovations because of SAP and consumer price level was used in the model. The study used co-integration and error-correction modelling to examine the effect of demand for money in Nigeria and its effectiveness on monetary policy. The results showed that, financial innovations have no effect on demand for money, hence accepting the null hypothesis. SAP era program had no direct impact on demand for money as well.

Hye (2009) examined the nexus between money demand and financial innovation in Pakistan. Robust time series techniques were used to study the relationship from the period of 1995-1 to 2007-12. The study used M1/M2 as a proxy for financial innovation. The interest rate, economic activity, inflation, financial innovation, and exchange rate were used in the model. According to the results, financial innovation has a statistically positive effect on the money demand in the long run and short run. However, the long run elasticity was less than the short run elasticity.

Malik & Qais (2010) examined the relationship between financial innovation and demand for money in Pakistan. The study used the data from 1957-2008. ARDL was used to determine the long run relationship and ECM was used to determine the short run dynamics. The study used the broad money ratio (M2/M1). Call money rate, income and consumer price index were used for modelling the effects of financial innovation on demand for money. Financial innovation had a positive effect on demand for money in the long run but it was not significant. In the short run, financial innovation had a positive relationship and the effect was significant.

Mwangi (2014) determined whether financial innovations have a measurable effect on demand for money in Kenya using data from period of 2000 to 2012. Johansen Maximum-Likelihood test was used to establish the existence of co-integration among variables. Error-correction model was used to establish the short run dynamics among variables. The results showed that mobile money transfer and ATM usage had a positive impact on the demand for money in Kenya and there exists a long relationship between money and other variables shown by the Johansen co-integration test. Error-correction model showed that GDP, inflation, Treasure Bill rate, mobile money transfer and ATM usage had an impact on the demand money. However, mobile money transfer and ATM usage had a positive impact on the demand for money in Kenya in both the short run and long run.

Shidhika (2015) examined the effects of financial innovation on the demand for money from the first quarter of 2000 to the fourth quarter of 2013 using secondary data. Real gross domestic product was used as a proxy for income; the study also included inflation and repo rate. Credit extended to the private sector was used as a proxy for financial innovation. The study used the vector autoregressive technique. The results of co-integration showed that there exists no long run relationship among variables. Credit

extension to private sector was insignificant which concludes that the financial innovation may not have an impact on the demand for money in Namibia though the demand for money was stable.

Dunne & Kasekende (2016) examined the development of financial innovation and its impact on the demand for money in Sub-Saharan African countries. Panel data technique was used for 34 countries from 1980-2013. The broad money ratio was used as a proxy for financial innovations. The results showed a negative relationship between financial innovation and money demand both in the long run and short run. The opportunity cost of holding money and income did not show any effect on demand for money. However, the study concluded that financial innovation plays a crucial role in analyzing money demand in Sub-Saharan African countries. It is important to study the effect of specific type of financial innovation on money demand rather than broader measures of financial innovation on money demand, and given innovations such as mobile money could have important implications on future policy design.

3.3 Overview of Literature review

Studies carried out in Botswana on demand for money did not include the financial innovation proxy in specifying the demand for money function (Masalila, 1990; Mhozya, 1992; Anyanga, 1995 and Mosweu, 2003). This study attempts to correct those inadequacies by re-estimating the demand for money including the financial innovation proxy in Botswana. It is important to include the role of financial innovations in order to avoid misspecification in the demand for money function. According to the empirical literature review, it is vitally imperative to examine the relationship between the financial innovation and the demand for money. Dunne & Kasekende (2016) investigated the

effects of financial innovation on the demand money in developing countries using Sub-Saharan countries. The impact of financial innovations differ according to the financial innovations and economic development of a country, for example M-Pesa used in Kenya, credit cards and mobile payments (My zaka and Orange money used in Botswana). These financial innovations can influence the nature and stability of demand for money function. Hence, this paper investigates the effects of financial innovation on demand for money in Botswana, as a case of a developing country. The study will also contribute to the literature by capturing the indirect effects of financial innovations.

CHAPTER FOUR: RESEARCH METHODOLOGY

4.0 Introduction

This chapter discusses the methodology, the data used and explanation of variables considered when modelling the effects of financial innovation on demand for money. The chapter includes the theoretical framework based on the literature in Section 4.1 It also includes model specification in Section 4.2 and estimation techniques used in analyzing the effects of financial innovation on demand for money in Botswana.

4.1 Theoretical Frame Work

Different approaches for demand for money motivated the theoretical literature. The formulated money demand is;

$$MD = f(oc, sc, x) \qquad (1)$$

Where $MD = {}^{m}/_{p}$ where m denotes the nominal money, p denotes the price level. The money balances are a function of scale variable(sc), which represent economic activity, (oc) is the opportunity cost of holding the money and (x) is the technological innovations.

The scale variable (sc) is proxied by the real GDP/ income, the elements of vector of opportunity cost of holding money (oc) is proxied by the interest rate, exchange rate and inflation rate. The technological advancements (x) is proxied by financial innovations.

4.2 Model specification

The standard empirical specification of the demand for money function is based on the above theoretical framework in equation 1. The gross domestic product represent the scale

variable, exchange rate and inflation represent the opportunity cost of holding money and financial innovation represent technological advancements. The study employs the following equation 2.

$$MD = f(GDP, INF, EXT, INT, FIN) \quad (2)$$

Where;

MD=money demand

GDP=Gross Domestic Product

INF=Inflation Rate

EXT= Exchange Rate

INT= Interest Rate

FIN=Financial innovation proxy

DU=Financial Crisis

ε_t=Error term

To examine the effects of financial innovation on the demand for money the study will use equation (3) for Botswana. The econometric model is formulated from the equation (2) as follows;

$$Ln(MD)_t = \alpha_0 + \alpha_1 Ln(GDP)_t + \alpha_2 (INF)_t + \alpha_3 Ln(EXT)_t + \alpha_4 (INT)_t + \alpha_5 Ln(FIN)_t + \delta DU + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

All variables are in logarithms except the interest rate and the inflation rate. According to Ericsson (1998) the interest rates can enter in either logs or levels. In the equation (3),

interest rate and inflation rate variables are not in logarithms as this result in a semi-log demand for money specification. As a result, the coefficients on the interest rates are not elasticities. The error term is assumed to be white noise and α's are the parameter estimates.

4.3 Description of Variables

The factors that are likely to influence the demand for money are as follows;

Money Demand

The study uses narrow money (M1) as the dependent variable used by Dunne & Kasekende (2016). Narrow money (M1) is currency outside the banks and demand deposit in national currency other than those of central government. The study also uses the broad money (M2) as the dependent variable. The broad money comprises of M1 plus savings deposits. The definition for M2 in Botswana changed in 2006. The study will use the dummy variable to account for the change of the broad money. M1 and M2 deflated by the price level.

Gross Domestic Product

Gross domestic product is the measure of all final goods and services produced within country's borders within a year in monetary values. GDP has been used as a proxy for the level of income. An increase in level of income leads to an increase in demand for money. The expected sign is positive.

Inflation Rate

Inflation is a rise in the price level. When inflation rises, economic agents reduce holding money balances in favor of real assets. Hence, the real value of money falls with an

increase in inflation. The value of assets is maintained, these leads to economic agents switching out of money to real assets when the inflation is expected to rise (Mwangi, 2014). Hence, the expected sign is negative.

Exchange Rate

The exchange rate is also an important variable in determining the demand for money specifically in open economies. The exchange rate is Rand per Pula as Botswana and South Africa are the main trading partners (Monetary Policy Report, 2018). The sign of the exchange rate coefficient is ambiguous with studies such as Narayan *et al* (2009) on South Asian countries finding a positive relationship between the exchange rate and money demand. It is positive if depreciation is seen as an increase in wealth by increasing the value of foreign assets leading to a rise in level of income (Nnyanzi, 2018).

Interest Rate

Interest rates are often used to capture the of opportunity cost of holding money. Normally it represents the nominal interest rate on time deposits kept in commercial banks. It reflects the degree of switching from the bonds, and other financial assets. According to the literature on money demand, this relationship is expected to be negative.

Broad Money Ratio

Financial innovation is measured using a broad measure (M2/M1). Most literature assumes that is difficult to measure the financial innovation. Several proxies are often used to measure the financial innovation for example credit extended to private sector, mobile money, ratio of broad money to narrow money and number of ATMs. ATMs, mobile money and credit extended to private sector will not be used as proxies for

financial innovation because of data unavailability for the period of the study, as used by Kasekende & Nikolaidou (2015). So, using broad money ratio as proxy for financial innovation is appropriate for use of this study. An increase in financial innovation economic agents will move away from liquid assets such as M1 to less liquid assets such as M2 (Dunne & Kasekende, 2016). The broad money ratio will be used to capture the financial innovations in Botswana as used by Hye (2009) in Pakistan. According to the empirical literature the results is expected to be either positive or negative.

Dummy Variable

The dummy variable represent the global economic financial crisis of 2008 which might have affected the monetary aggregates or any shock. The global economic crisis of 2008/2009 had several negative consequences on Botswana's economy. Overall, real GDP contracted by 6% following a revised growth rate of 3.1% in 2008 (Central Statistics Office, 2010). The dummy also account for the change or unpredictable effect in the economy for example, change of the definition of real broad money from 2006. The dummy takes the value of 1 to represent the period of the crisis or any shock and for any other period is 0.

Table 4.1: Summary of Variables and Predicted Effects

VARIABLE	NOTATION	FORMULA/UNITS	PREDICTED EFFECT Long run and short run
Money Demand	M1or M2	M1 or M2 deflated	
Gross Domestic Product	GDP	Pulas	Positive
Inflation Rate	INF	%	Negative
Exchange Rate	EXT	Rand Per Pula deflated	Positive/negative
Financial innovation	M2/M1	M2/M1	Negative /positive
Interest Rate	INT	%	Negative
Dummy Variable	DU	1 unit	Negative

4.4 Data Analysis

The study uses time series data that is analyzed using E-views statistical package of version 10. The data sources are Bank of Botswana and Statistics Botswana reports from 1982-2017 as annual data. The 1980s and 1990s were periods where financial reforms and liberalization rose sharply. The policies of these financial reforms and liberalization fostered economic growth, which initiated financial innovations in developing countries. The choice of this estimation period is based on the desire to compare this study with other developing countries as Botswana on this topic.

4.5 Data Estimation Techniques

4.5.1 Unit Root Test

The study conducts the unit root test to establish the time series characteristics of the data. The test provide justification of the ARDL bound test approach as co-integration

approach. A stationary time series is the one which mean and variance are constant over time, they are not time specific (Gujarati & Porter, 2009). To determine the degree of integration of the variables, Augmented Dicky Fuller (ADF) and the Phillips-Perron test (PP) are employed in this matter.

4.5.2 Autoregressive Distribution Lag Model

The study uses the autoregressive distribution lag model (ARDL). Used by Kasekende & Nikolaidou (2015) and Nnyanzi (2018) to find the effects of financial innovation on demand for money in Kenya and Uganda. It is preferred over other co-integration methods because of its flexibility for different orders of variables that are integrated (Pesaran, Shin, & Smith, 2000b). Modelling the ARDL with appropriate lags corrects for serial correlation problems found in macroeconomic variables. Long run and short run dynamics (in terms of error correction model) simultaneously can be estimated, in the context of ARDL modelling (Narayan, 2004). The model provides unbiased estimation as it integrates the long run and short run dynamics.

Using the ARDL approach of Pesaran and Shin (2000b), this study estimates the ARDL version of equation (3), which is specified as follows.

$$\Delta LnMD_t = \alpha_0 + \sum_{k=1}^{p}\alpha_{1k}\Delta LnMD_{t-k} + \sum_{k=0}^{p}\alpha_{2k}\Delta LnGDP_{t-k} + \sum_{k=0}^{p}\alpha_{3k}\Delta INF_{t-k} + \sum_{k=0}^{p}\alpha_{4k}\Delta LnEX_{t-k} + \sum_{k=0}^{p}\alpha_{5k}\Delta INT_{t-k} + \beta_{11}LnMD_{t-1} + \beta_{12}LnGDP_{t-1} + \beta_{13}INF_{t-1} + \beta_{14}LnEX_{t-1} + \beta_{15}INT_{t-1} + \delta DU + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where Δ is the first difference operator, α_0 is the constant term, the parameters $\alpha_{1k}, \alpha_{2k}, \alpha_{3k}, \alpha_{4k}, \alpha_{5k},$ are the short-run coefficients and $\beta_{11}, \beta_{12}, \beta_{13}, \beta_{14}, \beta_{15},$ represent the long-run coefficients. ε_t is the error term, $t-1$ is the lagged period for variables and p indicate the lag order of the equation.

The lags of the ARDL model are estimated using Akaike Information Criterion AIC to the six variables.

The Wald test/ F-statistic is employed to test for the co-integration among the variables. It also tests the existence of the long run relationship on explanatory variables. The null hypothesis of no long run relationship is formulated as $\beta_{11} = \beta_{12} = \beta_{13} = \beta_{14} = \beta_{15} = 0$ against the alternative hypothesis $\beta_{11} \neq \beta_{12} \neq \beta_{13} \neq \beta_{14} \neq \beta_{15} \neq 0$ which indicate the existence of the long run relationship.

There are two sets of critical values according to Pesaran et al.., (2001). These critical values are based on the assumption that all values included in the model are I(0), and the other critical value is estimated under the assumption that all variables included in the model are I(1).

When the calculated test-statistic is higher than the upper bound value we reject the null hypothesis of no long run relationship among variables. When the test-statistic falls below the lower critical bound value then we fail to reject the null hypothesis of no long relationship among variables.

If the long run relationship among variables exist, the long run coefficients will be estimated. This would mean that the money demand function is stable without the financial innovation proxy. The long run model is estimated using the following ARDL equation as:

$$LnMD_t = \gamma_0 + \gamma_{12} LnGDP_t + \gamma_{13} INF_t + \gamma_{14} LnEX_t + \gamma_{15} INT_t + \varepsilon_t \ldots\ldots\ldots \quad (5)$$

Where, $\gamma_0 = \frac{-\beta_0}{\beta_{11}}$; $\gamma_{12} = \frac{-\beta_{12}}{\beta_{11}}$; $\gamma_{13} = \frac{-\beta_{13}}{\beta_{11}}$; $\gamma_{14} = \frac{-\beta_{14}}{\beta_{11}}$; $\gamma_{15} = \frac{-\beta_{15}}{\beta_{11}}$; are long run elasticities[1]. All variables are defined before.

Based on the existence of the long run coefficients above, the error correction is estimated using the formulations of the above equation. The error correction model incorporates the short run dynamics of money demand and its determinants. The error correction term measures the speed of adjustment of short run equilibrium to long run equilibrium. The error correction model is formulated as:

$$\Delta LnMD_t = \alpha_0 + \sum_{k=1}^{p}\alpha_{1k}\Delta LnMD_{t-k} + \sum_{k=0}^{p}\alpha_{2k}\Delta LnGDP_{t-k} + \sum_{k=0}^{p}\alpha_{3k}\Delta INF_{t-k} + \sum_{k=0}^{p}\alpha_{4k}\Delta LnEX_{t-k} + \sum_{k=0}^{p}\alpha_{5k}\Delta INT_{t-k} + \emptyset ECT_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

The coefficient of the error correction term is indicated by $\emptyset$ which represents the speed of adjustment to equilibrium. The larger the coefficient of the error term the more the speed adjustment of the model from the short run to the long run equilibrium. The error correction term ECT_{t-1} coefficient it is expected to be negative and significant to explain the speed of adjustment to equilibrium.In order to investigate the effects of financial innovations on demand for money the following ARDL model is specified with inclusion of financial innovation proxy as follows;

$$\Delta LnMD_t = \alpha_0 + \sum_{k=1}^{p}\alpha_{1k}\Delta LnMD_{t-k} + \sum_{k=0}^{p}\alpha_{2k}\Delta LnGDP_{t-k} + \sum_{k=0}^{p}\alpha_{3k}\Delta INF_{t-k} + \sum_{k=0}^{p}\alpha_{4k}\Delta LnEX_{t-k} + \sum_{k=0}^{p}\alpha_{5k}\Delta INT_{t-k} + \sum_{k=0}^{p}\alpha_{6k}\Delta LnFIN_{t-k} + \beta_{11}LnMD_{t-1} + \beta_{12}LnGDP_{t-1} + \beta_{13}INF_{t-1} + \beta_{14}LnEX_{t-1} + \beta_{15}INT_{t-1} + \beta_{16}LnFIN_{t-1} + \delta DU + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

[1] The long run elasticities are generated through running the ARDL model using the Eviews statistical software version 10.

All variables in this model are defined before.

The Wald test/ F-statistic is employed to test for the co-integration among the variables. The null hypothesis of no long run relationship exist is formulated as $\beta_{11} = \beta_{12} = \beta_{13} = \beta_{14} = \beta_{15} = \beta_{16} = 0$ against the alternative hypothesis $\beta_{11} \neq \beta_{12} \neq \beta_{13} \neq \beta_{14} \neq \beta_{15} \neq \beta_{16} \neq 0$ which indicate the existence of the long run relationship.

If the long run relationship among variables exist, this would mean that the demand for money is stable with the inclusion of financial innovation proxy. The long run model is estimated using the following ARDL equation as follows;

$$LnMD_t = \gamma_0 + \gamma_{12} LnGDP_t + \gamma_{13} INF_t + \gamma_{14} LnEX_t + \gamma_{15} INT_t + \gamma_{16} LnFIN_t + \varepsilon_t \ldots\ldots (8)$$

Where, $\gamma_0 = \frac{-\beta_0}{\beta_{11}}$; $\gamma_{12} = \frac{-\beta_{12}}{\beta_{11}}$; $\gamma_{13} = \frac{-\beta_{13}}{\beta_{11}}$; $\gamma_{14} = \frac{-\beta_{14}}{\beta_{11}}$; $\gamma_{15} = \frac{-\beta_{15}}{\beta_{11}}$; $\gamma_{16} = \frac{-\beta_{16}}{\beta_{11}}$

Based on the existence of the long run coefficients above, the error correction is estimated using the formulations of equation (8). The error correction model incorporates whether the short run dynamics of money demand are also influenced by the financial innovation. The short run equilibrium model is specified as;

$$\Delta Ln(MD)_t = \alpha_{10} + \sum_{k=1}^{p} \alpha_{1k} \Delta Ln(MD)_{t-k} + \sum_{k=0}^{p} \alpha_{2k} \Delta Ln\,(GDP)_{t-k} + \sum_{k=0}^{p} \alpha_{3k} \Delta(INF)_{t-k} + \sum_{k=0}^{p} \alpha_{4k} \Delta Ln(EX)_{t-k} + \sum_{k=0}^{p} \alpha_{15} \Delta(INT)_{t-k} + \sum_{k=0}^{p} \alpha_{6k} \Delta Ln\,(FIN)_{t-k} + \emptyset ECT_{t-1} + \varepsilon_t \ldots\ldots (9)$$

The coefficient of the error correction term is indicated by $\emptyset$ which represent the speed of adjustment to equilibrium. The larger the coefficient of the error term the more the speed adjustment of the model from the short run to the long run equilibrium. The error

correction term, ECT_{t-1} coefficient is expected to be negative and significant to explain the speed adjustment to equilibrium.

The ARDL is based on the single equation approach and it may not correct for the problem of endogeneity of the independent variables (McNown, Sam, & Goh, 2016).There is evidence that the endogeneity problem has only minor effects on the size and power properties of the ARDL bounds testing framework using the asymptotic critical values. In this study the independent variables are assumed to be weakly exogenous.

4.5.3 Interaction Effects

To analyze the indirect effects of financial innovation on demand for money in Botswana, the interaction terms are introduced in line with Kasekende & Nikolaidou (2015). Specified as;

$$LnMD_t = \beta_0 + \beta_{12}LGDP_t + \beta_{13}INF_t + \beta_{14}LEXT_t + \beta_{15}INT_t + \beta_{16}LFIN_t + \beta_{17}(LGDP * LFIN)_t + \beta_{18}(INF * LFIN)_t + \beta_{19}(LEXT * LFIN)_t + \beta_{20}(INT * LFIN)_t + \varepsilon_t \quad (10)$$

This study estimates the indirect impact of financial innovations using the ARDL[2] approach of Pesaran and Shin (2000b). When estimating the indirect impact of financial

[2] The Wald test/ F-statistic is employed to test for the co-integration among the variables. The null hypothesis of no long run relationship exist is formulated as $\beta_{11} = \beta_{12} = \beta_{13} = \beta_{14} = \beta_{15} = \beta_{17} = \beta_{18} = \beta_{19} = \beta_{20} = 0$ against the alternative hypothesis $\beta_{11} \neq \beta_{12} \neq \beta_{13} \neq \beta_{14} \neq \beta_{15} \neq \beta_{16} \neq \beta_{17} \neq \beta_{18} \neq \beta_{19} \neq \beta_{20} \neq 0$ which indicate the existence of the long run relationship.

innovations, the interactions $\alpha_6, \alpha_7, \alpha_8, \alpha_9$, are the main important focus only in the long run. The long run ARDL estimates are as follows;

$$LnMD_t = \alpha_0 + \alpha_1 LGDP_t + \alpha_2 INF_t + \alpha_3 LEXT_t + \alpha_4 INT_t + \alpha_5 LFIN_t + \alpha_6 (LGDP * LFIN)_t + \alpha_7 (INF * LFIN)_t + \alpha_8 (LEXT * LFIN)_t + \alpha_9 (INT * LFIN)_t + \varepsilon_t \quad (11)$$

Where, $\alpha_0 = \frac{-\beta_0}{\beta_{11}}; \alpha_1 = \frac{-\beta_{12}}{\beta_{11}}; \alpha_2 = \frac{-\beta_{13}}{\beta_{11}}; \alpha_3 = \frac{-\beta_{14}}{\beta_{11}}; \alpha_4 = \frac{-\beta_{15}}{\beta_{11}}; \alpha_5 = \frac{-\beta_{16}}{\beta_{11}}; \alpha_6 = \frac{-\beta_{17}}{\beta_{11}}; \alpha_7 = \frac{-\beta_{18}}{\beta_{11}}; \alpha_8 = \frac{-\beta_{19}}{\beta_{11}}; \alpha_9 = \frac{-\beta_{20}}{\beta_{11}}$ are long run elasticities[3]. All variables are defined before. The marginal effects are also derived. For example, the marginal effect of demand for money with respect to exchange rate is $\frac{\partial LM_t}{\partial LEXT} = 14.3472 + (-21.3571 * 0.017298) = 13.98$ generated from $\frac{\partial LM_t}{\partial LEXT} = \alpha_3 + \alpha_8 * LEXT$ where $LEXT$ is the mean value of the variable shown by Table A4 in the Appendix section.

[3] The long run elasticities are generated through running the ARDL model using the Eviews statistical software version 10.

CHAPTER FIVE: EMPIRICAL ANALYSIS

5.0 Introduction

This chapter presents the empirical results obtained from estimating the models in chapter 4. The chapter starts by investigating the time series properties of the variables used in the model, unit root test in Section 5.1. Co-integration analysis is represented by Section 5.2.

5.1 Unit Root

Unit root test is used to test for the stationarity of data, even though is not a necessity for the Bounds test for co-integration. This section provides the results for the unit root test for the variables. The results of the Augmented Dicker Fuller and PP for unit root are shown in Table 3.

Table 5.1: Unit Root Test for Model Variables

	AGUMENTED DICKEY-FULLER(ADF)		**PHILIPS-PERRON (PP)**	
Variable	**levels**	**first difference**	**Levels**	**First Difference**
	t-statistic	**t-statistic**	**t-statistic**	**t-statistic**
LM1	0.48899	-4.635549***	-1.64206	-4.411902***
LM2	-1.89622	-3.574109***	-1.81417	-3.639519***
LGDP	-3.36146***	-4.598968***	-3.46955**	-4.587155***
LEXT	-1.44678	-6.285738***	-1.42886	-6.795432***
INF	-2.09752	-6.14652***	-2.14121	-8.572719***
INT	-4.32554***	-4.993982***	-4.38175***	-15.93264***
LFIN	-1.3967	-5.208310***	-1.41674	-5.208598***

Source*: Author's Computation*

**** Significant at 1%; ** Significant at 5%; * Significant at 10%*

To examine whether a variable has unit root, the Augmented Dicker Fuller and Philips Perron tests were used. The inflation rate (LINF), financial innovation proxy (LFIN) and

real money balances (LM1), real broad money (LM2) and exchange rate (LEXT) as shown in Table 5.1 are variables tested for unit root. The INF, LM1, LM2 and LEXT variables are not stationary at levels but only at first difference. Interest rate (INT), LGDP and LFIN are stationary at levels. No variables are integrated of order 2, this is the justification of using the ARDL model. On the other hand, the PP unit root results are also presented in Table 5.1. The results show that the LGDP and INT are stationary at levels whereas other variables are stationary at first difference. The null hypothesis of non-stationarity is rejected at 5% critical value for all the variables.

5.2 Co-integration Analysis

The study applied the bounds testing co-integration by testing the existence of the long run relationship on explanatory variables. The null hypothesis of no long run relationship exist is formulated as $\beta_{11} = \beta_{12} = \beta_{13} = \beta_{14} = \beta_{15} = \beta_{16} = 0$ against the alternative hypothesis $\beta_{11} \neq \beta_{12} \neq \beta_{13} \neq \beta_{14} \neq \beta_{15} \neq \beta_{16} \neq 0$ which indicate the existence of the long run relationship. The results are shown in Table 5.2.

Table 5.2: ARDL Bounds Test Co-integration Results

Monetary Aggregate	**Selected model optimal lag[4]**	**Co-integration**	**Calculated F-statistic**	**95% Lower Bound (0)**	**95% Upper Bound (1)**	**90% lower Bound (0)**	**90% Upper Bound (1)**
M1 excluding financial innovation proxy	(2, 1, 2, 2, 1)	Existed	5.77	2.56	3.49	2.2	3.09
M1including financial innovation proxy	(2, 1, 2, 2, 1, 2)	Absent	1.742510	2.39	3.38	2.08	3
M2 excluding financial innovation proxy	*(1,0,0,2,0)*	Existed	6.887044	2.56	3.49	2.2	3.09
M2 including financial innovation proxy	1, 0, 2, 2, 0, 2)	Existed	7.10852	2.39	3.38	2.08	3

Source; *Author's computation*

Table 5.2 shows the ARDL bounds co-integration results for monetary aggregates, including and excluding financial innovation proxy. According to the table, the calculated F statistic (5.77) is significant for the model of real narrow money excluding financial innovations. The F statistic is greater than the lower critical bounds and the upper critical bounds of 95% level and 90% level, implying that the null hypothesis of no co-integration is rejected when the financial innovation variable is excluded from the model. Hence, long run relationship exists between the dependent variable and the explanatory variables.

[4] relate to the once differenced variables (LMD, LGDP, LEXT, INT, INF,LFIN)

When the financial innovation proxy is included in the model, the co-integration test results show that the computed F-statistic is less than the 95% and 90% critical upper bounds. This shows that the variables are not co-integrated and there exists no relationship between the dependent variable and explanatory variable. The results show that financial innovation does not affect the real narrow money in the long run.

The co-integration test shows that the computed F-statistic is greater than the 95% and the 90% critical upper bounds when the financial innovation proxy is excluded in the model for real broad money. This is an indication that the variables are co-integrated; it is strange that the test indicates co-integration and yet none of the regressors is significant. The long run model and short run model are estimated. When the financial innovation proxy is included in the model where real broad money balance is the dependent variable there is long run relationship among the variables. Then the short run and long run ARDL models are estimated to establish the short run and long run relationships between the real broad money and explanatory variables. Table 5.3 shows the estimated models for both real money balances both the short run and long run relationships and even diagnostic tests for the models without the financial innovation proxy.

Table 5.3: ARDL Estimates of the demand for real narrow and broad money excluding financial innovation proxy

DEPENDENT VARIABLE					
LM1			**LM2**		
Short run Estimates	**coefficients**	**T-statistics**	**Short run Estimates**	**coefficients**	**T-statistics**
D(LM1(-1))	0.756779	5.780254	D(INF)	0.002898	0.385299
D(LGDP)	2.996419	4.989881	D(INF(-1))	0.015563	2.036156
D(LEXT)	1.124709	3.139748	DUM03	0.503827	5.295121
D(LEXT(-1))	-1.122427	-2.934329	ECM	-0.106064	-7.041784
D(INT)	-0.016855	-3.613995			
D(INT(-1))	0.007344	1.755513			
D(INF)	0.018029	1.362569			
DUM02	1.004597	7.128469			
ECM	-0.436784	-6.580870			
Long run estimates					
LGDP	0.82838	3.494229		0.328099	0.245704
LEXT	7.343706	4.966996		0.144329	0.071659
INT	-0.106926	-4.93985		-0.223893	-0.878603
INF	0.245509	3.911665		-0.022732	-0.640487
C	-18.84693	-3.126498		-0.293847	-0.008321
diagnostic test	**LM version**	**F Version**		**LM Version**	**F Version**
Serial Correlation	CHSQ(2)_0.5727	F (2,18)-0.5750		CHSQ(2)_0.4618	F (2,23)-0.5857
Heteroscedasticity	CHSQ(2)-0.3238	F(11,22)-0.3592		CHSQ(8)-0.3149	F(8,20)-0.3481
Normality Test		Not applicable		Jaque Bera 1.35997 Probability 0.506625	Not applicable
Adjusted R-squared	0.672			0.5597	

Source*: Author's Computation*

5.3 Discussion of Results

Real narrow money excluding financial innovation

The diagnostic test was performed for model of real narrow money as shown by Table 5.3 for normality, heteroscedasticity and serial correlation. The results of the heteroskedasticity tests show that the errors of the ARDL model 1 are not heteroscedastic. The model also passes the Jarque-Bera normality test as summarized on Table 5.3. We fail to reject the null hypothesis of misspecification as the model is correctly specified and is serially uncorrelated. The adjusted R-squared shows that 67.2% of the systematic variation in the real narrow money demand is explained by the inflation, exchange rate, income, and interest rate hence the model has a high goodness of fit. The error correction term carries an expected negative sign, which is highly significant at 1% indicating that, M1, real income, inflation rate, and nominal exchange rate are co-integrated. The absolute value of the coefficient of the error-correction term indicates that about 43.7% of the disequilibrium in the real M1 demand is offset by short-run adjustment yearly. This means that excess money is followed in the next period by a reduction in the level of money balances, which people would desire to hold. Thus, it is important to reduce the existing disequilibrium over time in order to maintain long-run equilibrium.

According to Table 5.3 on short run estimates of real narrow money demand, the growth in GDP has a positive impact on the real narrow money demand and it is statistically significant at 1% level. The sign of the coefficient is consistent with our prior expectations. This shows that the demand for money in the economy is determined by the GDP growth. The greater the GDP growth the greater the demand for real narrow money (Kipsang, 2003). The results are consistent with findings of (Mosweu, 2003) who found out GDP has a positive effect on demand for real narrow money in Botswana. The lag of

exchange rate has a negative effect on demand for real narrow money. The exchange rate is defined as Rand per Pula adjusted to both consumer prices of South Africa and Botswana. A rise in the exchange rate would mean that the pula is appreciating. Local goods become expensive while foreign goods become cheaper. The demand for foreign currency increases and local producers become less competitive. According to Table 5.3 the exchange rate has a positive effect on demand for real narrow money and the result is significant at 1% level in the short run. These results are consistent with the findings of Mwangi (2014). The overall net effect of interest rate is negatively related to the real narrow money and the effect is significant. The significance of the interest rate implies that when the interest rate increases the demand for real narrow money decreases. The results are in line with that of Akinlo (2012) and Nnyanzi (2018). The inflation rate from the model has a positive effect on the real narrow money demand but the results are not significant in the short run. The inflation rate during the period under review was insignificant. This could be the fact that the bank of Botswana has been maintaining the lowest inflation in the economy. The results are inconsistent with our prior expectations and differ from Kganetsano (2001) who found a negative effect of inflation on real narrow money provided he used Engle-Granger estimation and quartely data as opposed to annual data. The dummy variable which represent the financial crisis of 2007/2008 has a positive effect on demand for real narrow money in the short run. The results are not what we expected.

For the long run estimates, the coefficient of the GDP is positive and significant according to Table 5.3. The results indicate that the GDP has a positive effect on the demand for real narrow money in the long run. The results are consistent with our prior expectations.

An increase of 1% GDP will lead to an increase demand for real narrow money by 0.83%. This is consistent with the economic theory and the findings of Kganetsano (2001). The results also show that an increase of 1% of exchange rate will lead to an increase of real narrow money 7.3% in the long run. The results are consistent with our prior expectation and the findings of Dunne & Kasekende (2016) for SADC countries, who indicated that depreciation of the exchange rate leads to an increase in real narrow money in the long run. Furthermore, the results show a negative relation between real narrow money and interest rate. The coefficient of the interest rate is negative with respect to real narrow money in Botswana and the effect is significant. The results are consistent with the findings of Mwangi (2014). The study found a negative relationship between real narrow money and interest rate in the long run. The results of inflation rate show a positive effect on in real narrow money in the long run. These results are inconsistent with our prior expectations that shows that inflation has a negative effect on real narrow money.

Real broad money excluding financial innovation

The diagnostic tests were performed for the selected model of real broad money as shown by Table 5.3. The results of the heteroskedasticity tests show that the errors of the ARDL model does not suffer from heteroscedastic disturbances. The model does not suffer from problems of serial correlation and normality test; hence, we fail to reject the null hypothesis as the model is correctly specified. The adjusted R-squared shows that 56% of the systematic variation in real broad money is explained by the explanatory variables.

In the long run, the coefficient of the income is positive, this means that income has a positive relationship with real broad money which is consistent with prior expectations and theory, ceteris paribus. The exchange rate is positively related to real broad money in

Botswana in the long run. Inflation and interest rates magnitude are negatively related to real broad money demand but the effect is insignificant. We then consider the short run dynamics.

In the short run the overall net effect of inflation is negative effect broad money demand. The results are consistent with the findings of Mwangi (2014). The error correction is negative and significant. The error correction term in specification is -0.106064 which implies that 10.6% of discrepancy is eliminated in the current year. The overall results suggest that interest rate, exchange rate, and income failed to provide evidence on impact of real broad money in the short run because they are not significant.

Table 5.4: ARDL Estimates of real narrow demand and real broad money including financial innovation proxy

DEPENDENT VARIABLE					
LM1			**LM2**		
Short run Estimates	**coefficients**	**T-statistics**	**Short run Estimates**	**coefficients**	**T-statistics**
D(LM1(-1))	0.491598	3.105305	D(LFIN)	-0.212028	-2.692415
D(LGDP)	1.42994	3.783318	D(LFIN(-1))	-0.192828	-2.310304
D(LFIN)	-1.08624	-10.46974	D(LEXT)	0.219372	1.20424
D(LFIN(-1))	0.673529	3.28682	D(LEXT(-1))	-0.526914	-2.874486
D(LEXT)	-0.083841	-0.39552	D(INT)	-0.003725	-1.655528
D(LEXT(-1))	-0.440456	-1.894815	D(INT(-1))	0.004119	1.785358
D(INT)	0.001279	0.438002	DUM03	0.580194	6.656123
D(INF)	-0.015033	-1.669438	ECM	-0.185524	-8.04280
D(INF(-1))	0.020365	2.37511			
DUM01	-0.298332	-2.752779			
ECM	-0.33362	-4.062338			
LongRun Estimates					
			LGDP	1.150927	1.571445
			LFIN	-0.056207	-0.106695
			LEXT	2.376125	1.330557
			INF	0.064069	1.060999
			INT	-0.056215	-1.339828
			C	-23.11301	-1.311049
diagnostic test	**LM version**	**F Version**		**LM Version**	**F Version**
Serial Correlation	CHSQ(2)_0.3635	F (2,15)-0.6311		CHSQ(2)_0.1722	F (2,18)-0.3741
Heteroscedasticity	CHSQ(2)- 0.5707	F(11,22)-0.6549		CHSQ(13)- 0.8024	F(13,20)-0.8850
Normality Test	Jaque Bera 0.940032 Probability -0.624992	Not applicable		Jaque Bera 2.1138 Probability 0.347519	Not applicable
Adjusted R-squared	0.8586			0.65	

Source*: Author's Computation using Eviews*

Real narrow money inclusion of financial innovation proxy

The diagnostic tests were performed for model of real narrow money with inclusion of financial innovation proxy as shown by Table 5.4. The results of the heteroscedasticity tests show that the errors of the ARDL model are not- heteroscedastic, the model also passes the Jarque-Bera normality test and we fail to reject the null hypothesis as the model is correctly specified. The adjusted R-squared shows that 86% of the systematic variation in the dependent variable are explained by the explanatory variables, hence the model has a high goodness of fit. Some variables can jointly explain the variation of real narrow money of Botswana in the short run.

In the short run estimated model, the coefficient of the error term is negative. The error correction term is statistically significant at 1% and the speed of adjustment is 33.36% to equilibrium in the event of short run deviation from there.

A positive relationship exists between real narrow money (M1) and GDP, inflation rate is negatively related to real narrow money balances but the effect is not significant. The inflation rate at lag one is positively related to the real narrow demand and the effect is significant. The overall net effect of inflation is negative. These results are consistent with our prior expectations and Nnyanzi (2018). These results are the same as from Table 5.4 of real narrow money results without financial innovation proxy. The overall net effect of financial innovation on demand for real narrow money is negative. The results showed that a percentage increase in financial innovation leads to a decrease in demand for real narrow money. The results are consistent with the findings of Dunne and Kasekende (2016). The results are also consistent with the literature review as individuals are likely to move away from more liquid assets to less liquid assets thus leading to a decline in

demand for real narrow money. The exchange rate is negatively related to real narrow money but the effect is insignificant but at lag one it has a significant negative effect on demand for real narrow money. So, the overall net effect of exchange rate is negative. The interest rate coefficient is positive but the effect is not significant, hence we fail to find the evidence of the impact of interest rate on real narrow money in the short run when the financial innovation proxy is included in the model. The dummy variable has a negative effect on demand for real narrow money with inclusion of financial innovation. This result was expected since for the period 2007/2008, the Botswana economy was hit by global financial crisis.

Real broad money inclusion of financial innovation proxy

The diagnostic test was performed for model of real broad money with inclusion of financial innovation proxy. The results of the heteroscedasticity tests show that the errors of the ARDL model are not heteroscedastic as and the model does not suffer from any serial correlation therefore we fail to reject the null hypothesis as the model is correctly specified. The adjusted R-squared showed that 65% of the systematic variation in the dependent variable is explained by the explanatory variables, hence the model has a high goodness of fit. The results of these tests are summarized in Table 5.4.

The error correction term in specification is -0.185524 which implies that 18.55% of discrepancy is eliminated in each current period. The effect of financial innovation on real broad money demand is negative and the effect is significant. The results are consistent with our prior expectations. This implies that financial innovations in Botswana have a negative effect on real broad money demand. An increase of 1% of financial innovation will lead to a decrease in real broad money by 19% in the current

period. The findings are consistent with that of Sichei & Anne (2012) who found a negative relationship of financial innovation and real broad money using ATM as a proxy of financial innovations. The exchange rate has a positive effect the real broad money demand and the effect is not significant. The interest rate does not appear significantly to affect the real broad money. According to Table 5.4 inflation rate does not affect real broad money in the short run. The result of the dummy variable show a positive effect on demand for real broad money. The results differ from our expectations.

In the long run the results reveal that only the exchange rate, gross domestic income and inflation have the expected positive sign in the estimated long run model but the results are not significant, as shown by Table 5.4. All these variables are statistically insignificant. The increase in inflation though insignificant, underlines the fact that inflation is basically a monetary phenomenon in the long run (Mosweu, 2003).

5.4 Stability tests of the ARDL models

The stability of the model enriches its reliability for policy recommendations. Plots of cumulative sum squares of recursive residuals were used to test the stability of model of real broad money and real narrow money exclusion of financial innovation from the ARDL models as shown by Figure A0 and figure A1 in Appendix section.

When it comes to stability of the models of real narrow money and real broad money with inclusion of financial innovation. The Figures A2 in Appendix for real narrow money show that the plot of CUSUM of squares lie between straight lines representing critical bounds at 5% significance level. The parameters of the model of real narrow money are structurally stable and the model is good for policy formation. Whereas with real broad money including financial innovation proxy the model is slightly unstable hence the M2

is not good for policy formation shown by Figure A3 in Appendix.

5.5 ARDL Interaction Effects Results

The ARDL interaction effects results are presented with regard to the effect of financial innovation on real narrow money and determinants of demand for money. Firstly, the ARDL bounds test to co-integration[5] is generated to find the long run relationship between real narrow money (M1), real broad money (M2) and their explanatory variables as shown by Table 5.5.

Table 5.5: ARDL bounds test for Co-integration of interaction variables of financial innovation and macro variable on real narrow money.

Monetary Aggregate	**Selected model optimal lag[6]**	**Co-integration**	**Calculated F-statistic**	**95% Lower Bound (0)**	**95% Upper Bound (1)**	**90% lower Bound (0)**	**90% Upper Bound (1)**
M1	(2,2,2,2,2,2,2,2,1,2)	Existed	17.09	2.04	2.8	1.8	2.08
M2	(2,2,2,2,2,2,2,2,1,2)	Existed	17.09	2.04	2.8	1.8	2.08

According to the Table 5.5, the calculated F statistic (17.09) is significant for the model of real narrow money with interaction effects of financial innovation. The F statistic (17.09) is greater than the lower critical bounds and the upper critical bounds of 95% level and 90% level, implying that the null hypothesis of no co-integration is rejected when interaction terms are included in the model. Hence, long run relationship exists

[5] The same procedure for testing co-integration is used as in Chapter 4.

[6] relate to the once differenced variables (LMD, LGDP, LEXT, INT, INF,LFIN, LFIN_INF, LFIN_INT,LFIN_LEXT, LFIN_LGDP)

between the dependent variable and the explanatory variables.

For the model of real narrow money the F statistic is greater than the lower critical bounds and the upper critical bounds of 95% level and 90% level. The long run ARDL estimates with interactions for real narrow money are shown below. The results of long run ARDL estimates for real narrow money are the same as the results of the real broad money long run ARDL estimates.

Table 5.6: Long run ARDL Interaction results for real narrow money

	Real narrow money			
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP	0.121106	0.274993	0.440395	0.678
INT	0.182164	0.036698	4.963909	0.0042
INF	-0.43085	0.073964	-5.82511	0.0021
LEXT	-21.3571	4.155322	-5.13969	0.0036
LFIN	-32.5647	3.572712	-9.11483	0.0003
LFIN_INF	0.242861	0.050408	4.817882	0.0048
LFIN_INT	-0.0741	0.014833	-4.99537	0.0041
LFIN_LEXT	14.3472	2.63267	5.449675	0.0028
LFIN_LGDP	1.19174	0.137558	8.663562	0.0003
C	5.730932	7.063322	0.811365	0.454

Source: *Author's Computation*

ARDL long run results

In contrast with Table 5.3 of real narrow demand, there was no co-integration of real narrow money and explanatory variables. When the interaction terms are introduced to the model, co-integration existed as shown by Table 5.5. According to Table 5.6, the financial innovation proxy is negative and significant. The GDP is only insignificant on the real narrow money. This is not what is expected. The inflation rate and exchange rate

coefficients are negative and significant as expected. The interest rate coefficient is positive and significant. This is not what is expected. Since we have the interaction variables in the model, the direct effects are not that important. So it is imperative to find the indirect effects of financial innovation on demand for real narrow money in the long run following the study of Kasekende & Nikolaidou (2015).

The interactive effect of financial innovation and interest rate is negative and significant. This implies that the lower the interest rate elasticity, the lower the effect of financial innovation on demand for real narrow money. The results are consistent with that of Kasekende & Nikolaidou (2015) who argued that financial innovation leads to a decrease in interest rate elasticity. The marginal effect of demand for money with respect to interest rate is $\frac{\partial LM_t}{\partial INT} = 0.182164 + (-0.0741 * 1.086721) = 0.101$ generated from $\frac{\partial LM_t}{\partial INT} = \alpha_4 + \alpha_9 * LFIN$ where $LFIN$ is the mean log of financial innovations as shown by Table A4 in the Appendix section. The results show a positive marginal effect, meaning that the increasing demand for real narrow money due to changes in financial innovation is conditional on the interest rate.

The indirect effects of financial innovation on real narrow money through the exchange rate is positive and significant. The results indicate that the effect of financial innovation on real narrow money appears to be dependent on the exchange rate. The marginal of real narrow money with respect to exchange rate is $\frac{\partial LM_t}{\partial LEXT} = 14.3472 + (-21.3571 * 0.017298) = 13.98$ generated from $\frac{\partial LM_t}{\partial LEXT} = \alpha_3 + \alpha_8 * LEXT$ where $LEXT$ is the mean log of exchange rate as shown by Table A4 in the Appendix section.

The results also indicate that the effects of financial innovation on real narrow money through the inflation rate is positive and signficant. This means that, the relationship between financial innovation and real narrow money in Botswana appears to decrease once inflation rises. Therefore the effect of inflation on real narrow money will rise as financial innovation decreases, as opposed to Nnyanzi (2018). The marginal effect of real narrow money with respect to inflation rate is $\frac{\partial LM_t}{\partial INF} = -0.43085 + (0.242861 * 8.768559) = 1.699$ generated from $\frac{\partial LM_t}{\partial INF} = \alpha_2 + \alpha_7 * INF$ where INF is the mean of inflation rate elasticity as shown by Table A4 in the Appendix section. The results show a positive marginal effect, meaning that the increasing demand for real narrow money due to changes in financial innovation is dependent on the inflation rate.

Diagnostic and Stability Tests for model

According to Table 5.7, the results show that the model for real narrow money is correctly specified. The results of the heteroscedasticity tests show that the errors of the ARDL model are not heteroscedastic as and the model does not suffer from any serial correlation therefore we fail to reject the null hypothesis as the model is correctly specified. The adjusted R-squared showed that 99.4% of the systematic variation in the dependent variable is explained by the explanatory variables, hence the model has a high goodness of fit.

Table 5.7: Diagnostic Tests for real narrow money

Real narrow money		
Diagnostic	LM version	F version
Serial correlation	Prob. F(2,23) 0.5857	Prob. Chi-Square(2) 0.4618
Normality test	JB 1.958585 Prob.0.3755	Not applicable
Heterostedasticity	Prob. Chi-Square(28) 0.4693	Prob. F(28,5) 0.6751
Adjusted R squared	0.994	

Source: *Author's Computation*

The stability test was also established .The Figure A5 in Appendix show that the plot of CUSUM of squares lie between straight lines representing critical bounds at 5% significance level. The parameters of the model of real narrow money with addition of interaction variables are structurally stable and the model is good for policy formation.

5.6 Summary of Results

GDP and demand for money

The gross domestic product has a positive effect on demand for real narrow money in the long run and short run when the financial innovation proxy is excluded, as shown by Table 5.3 and Table 5.4. The results show ceteris paribus, an increase in income lead to increase in demand for money in the long run. When the financial innovation proxy is included in the model there was no long run relationship of real narrow money and independent variables however, GDP affected the real narrow demand positively in the short run. The results are consistent with our prior expectations and the findings of

Kipsang (2003) who found out that GDP is an important determinant of demand for money in the economy. The GDP has no significant effect on real broad money in the short and long run when the financial innovation proxy was excluded and included in the model. The interaction effects of GDP and financial innovation on real narrow money is insignificant in the long run.

Exchange rate and demand for money

There is a positive effect of exchange rate on real narrow money in the long run and short run when the financial innovation proxy is excluded. The results are consistent with our prior expectations and findings of Dunne & Kasekende (2016). When the financial innovation proxy was included in the model the exchange rate lag one showed a negative effect on real narrow demand in the short run. The exchange rate was insignificant in the long run and short run when the real broad money was the dependent variable. When the financial innovation was included in the model, the exchange rate at lag one had a negative effect on demand for real broad money in the short run and the effect was significant. According to Table 5.6, the exchange rate influences the financial innovation directly on real narrow money after introduction of interactive variables. The indirect effects of financial innovation on real narrow money through the exchange rate is positive and significant. The results indicate that the effect of financial innovation on real narrow money appears to be dependent on the exchange rate.

Interest rate and demand for money

A 1% increase of interest rate leads to a decline in real narrow money in the long run and also in the short run. The results are consistent with the findings of Mwangi (2014) and Mabuka (2009). Even with the speculative theory of demand an increase in interest rate

leads to a decline in real narrow money. With inclusion of the financial innovation the interest rate had no effect on demand for real narrow money in the short run. The interest rate at lag one has a positive effect on demand for real broad money when the financial innovation proxy was included in the model as shown in Table 5.4. The results are inconsistent with the theory and our prior expectations. The interactive effect of financial innovation and interest rate is negative and significant. This implies that the lower the interest rate elasticity, the lower the effect of financial innovation on demand for real narrow money.

Inflation rate and demand for money

There was a positive relationship between the inflation rate and demand for real narrow money excluding the financial innovation proxy in the long run and short run. For the long run results, they are not consistent with our prior expectations and theory. The inflation rate should have a negative effect on demand for real narrow money as attested by Mwangi (2014). The results in the short run are not significant these results are not surprising as for a low inflation country in the short run the inflation should be insignificant. Botswana is not a high inflation country. The inflation rate has a negative effect on demand for real narrow money in the short run when the financial innovation proxy was included in the model. In the short run only the inflation rate at lag and affect the real broad money demand and the effect is positive. The inflation rate at lag one when the financial innovation proxy was excluded in the model, it had a positive effect on real broad money in the short run and no relationship in the long run. The inflation rate had no effect on real broad money in the short run as shown in Table 5.4 when the financial innovation proxy was included in the model. The interaction effect of inflation and financial innovation both real narrow money and real broad money is positive and

significant. This means that, the relationship between financial innovation and real narrow money in Botswana appears to decrease once inflation rises.

Financial innovation and demand for money

The effects of financial innovation on real narrow money is negative and the effect is significant in the short run. Financial innovation at lag one has a positive effect on real narrow money and the effect is significant. The results are consistent with our prior expectations. Technological advancement in payment system increases demand for real narrow money in the short run. However, the overall net effect of financial innovation on demand for real narrow money is negative. The financial innovation does not have an effect on real broad money in the long run. The financial innovation at lag one has a negative effect on real broad money in the short run and the effect is significant as shown by Table 5.4. The overall net effect of financial innovation on demand for broad money is negative. The findings are consistent with that of Sichei & Anne(2012) who found a negative relationship of financial innovation and real broad money. It has appeared that the financial innovation does not influence the demand for money in the long run in Botswana. The marginal effect depicts a negative relationship between the financial innovation and demand for money. However, financial innovation affect the demand for money indirectly through the reduction of interest rate elasticity, increasing of exchange rate and inflation rate.

CHAPTER SIX: CONCLUSION AND POLICY RECOMMENDATIONS

6.0 Introduction

This chapter comprises the conclusions and recommendations which prove useful in informing policy. The chapter also mentions suggestions for areas that require further research.

6.1 Conclusions

The purpose of this study was to investigate the effects of financial innovation on demand for money in Botswana from period 1982-2017. The study was motivated by an increase in number of bank branches in Botswana, ATM transactions, introductions of mobile payments through mobile network operators such as E-wallets, My Zaka, Orange money as well as other payments and deposit system introduced by banks. Following these developments, the study wanted to find out the effects of financial innovation on demand for money in Botswana. The study used the ARDL bounds testing approach to find the effects of financial innovation on demand for money in Botswana. The ARDL approach integrates both the short run relationship and long run relationship. It is preferred over other methods of co-integration such as Johansen full information Maximum likelihood based approach (1988) and Engle-Granger (1987) because it can be estimated besides the level of integration of variables. The study also analyzed the indirect effects through interactions of explanatory variables (GDP, exchange rate, inflation and interest rate) with the financial innovation proxy.

Real narrow money and real broad money were used as dependent variables. The variables used as explanatory variables for the study are the GDP, exchange rate, inflation and financial innovation (M2/M1). The results of co-integration showed that there existed

a long run relationship between the demand for real narrow money and explanatory variables. When the financial innovation proxy was included in the model, there was no co-integration between the demand for real narrow money and explanatory variables, indicating that no long run relationship exist between financial innovation and demand for real narrow money. With the demand for real broad money there was co-integration of real broad money and explanatory variables even when the financial innovation proxy was included in the model. The results also showed that the financial innovation affect the real narrow money positively only in the short-run but not in the long run. The overall net effect of financial innovation on demand for real narrow money is negative. Even though a long run relationship` existed in real broad money when financial innovation proxy was included, the financial innovation affected the demand for real broad money negatively in the short run only. The overall net effects of financial innovation on demand for real broad money is negative. The results obtained support the theoretical and empirical studies that financial innovations do affect real money balances negatively. The interaction terms of financial innovation and macroeconomic variables showed that the effect of financial innovation on demand for money depend on GDP, inflation, exchange rate and interest rate in the long run. The marginal effect depicts a negative relationship between the financial innovation and demand for money. However, financial innovation affect the demand for money indirectly through the reduction of interest rate elasticity, increasing of exchange rate and inflation rate.

6.2 Policy recommendations

The main determinants of demand for money are inflation, exchange rate, income and interest rate in Botswana. Income positively affect demand for money and interest rate and inflation negatively affect the demand for money in Botswana. It was evident that the demand for money passed the stability test with inclusion of financial innovation only for narrow money. The growing financial innovations in Botswana has a negative effect on demand for money in Botswana. The study recommends that policy makers should always be thorough when estimating the demand for money. Especially that since financial innovation is an ongoing process, the unpredictable changes and uncertainties of it, could lead to misspecification of demand for money. A stable money demand function is required for monetary policy.

Financial innovation affects monetary policy mechanism via financial markets so the negative effects of financial innovation should be seriously taken into consideration. Though results showed that it decreases the demand for money it may change the technicalities of monetary policy making so these effects of financial innovations on demand for money should be accounted for.

6.3 Limitations of the study

The study is an improvement from other studies on the effects of financial innovation on demand for money in Botswana. The study considered the year from 1982-2017, these are the periods of globalization and financial liberalization, which led to introductions of financial innovations in developing countries. For Botswana the period of financial liberalization was between the 1989 and 1991. The study used the broad money measure (M2/M1) as a proxy for financial innovations in Botswana. The study was not able to use

proxies for financial innovations such as Orange Money, My zaka, Mukuru and ATMs. So, this in future should be considered individually as proxies for financial innovation. Further studies should be conducted on how these financial innovations affect the monetary policy.

REFERENCES

Akinlo, A. E. (2012). Financial Development And The Velocity Of Money In Nigeria.Empirical Analysis. *The Review Of Finance And Banking, 04*(2), 097—113.

Anyangah, J. J. (1995). The Demand For Money In Botswana;An Error Correction Approach.

Bilyk, V. (2006). Financial Innovations And The Demand For Money In Ukraine.

Botswana, B. O. (2016). *Bank Of Botswana Annual Reports.* Gaborone.

Central Statistics Office. (2010). Statistics Botswana.

Dabrowski, M. (2017). Potential Impact Of Financial Innovation On Monetary Policy. *Policy Department A:Economic And Scientific Policy*.

Dunne, J. P., & Kasekende, E. (2016). Financial Innovation And Money Demand:Evidence From Sub-Saharan Africa. *Economic Research Of Southern Africa*.

Ericsson, N. (1998). .Empirical Modeling Of Money Demand. *Empirical Economics, 23*, 295-315.

Gujarati, D., & Porter, D. (2009). *Basic Econometrics* (5 Ed.). New York: Ny:Mcgrawhill/Irwin.

Gujarati, D., & Porter, D. (2009). *Basic Econometrics* (Fifth Edition Ed.). Mcgraw-Hill International Edition.

Hafer, R. W., & Kutan, A. M. (2010). Financial Innovation And The Demand For Money ;Evidence From The Philippines. *International Economic Journal*, 17-27.

Hamori, S. (2008). Empirical Analysis Of The Money Demand Function In Sub-Saharan Africa. *Economics Bulleten, 15*(4), 1-15.

Hye, Q. M. (2009). Financial Innovation And Demand For Money In Pakistan. *The Asian, 51*, 219-228.

Ireland, P. N. (1992). Endogenous Financial Innovation And The Demand For Money. *Federal Reserve Bank Of Richmond Working Paper*, 92.

Kasekende, E., & Nikolaidou, E. (2015). Financial Innvation And Money Demand With A Focus On Mobile Money;The Case Of Kenya.

Kganetsano, A. (2001). The Demand For Money In Botswana: Cointegration And Error Correction Approach. *The Research Bulletin., 19*(1).

Kipsang, B. (2003). Determinants Of Money Demand In Kenya.

Laidler, D. E. (1993). *The Demand For Money ,Theories,Evidence And Problems* (4th Ed.). London: University Of Western Ontanario-London.

Lewis, M. K., & Mizen, D. P. (2000). *Monetary Economics.* New York: Oxford University Pres.

Malik, Q. U., & Qais, A. (2010). Effects Of Financial Innovatios On Demand For Money In Pakistan:An Ardl Approach. *A Research Journal Of Commerce,Economics And Social Sciences, 4*(1), 01-23.

Mannah-Blankson, T., & Belyne, F. (2004). The Impact Of Financial Innovation On The Demand For Money In Ghana. *Bank Of Ghana Working Paper* .

Masalila. (1990). The Demand For Money In Botswana.

Mcnown, R., Sam, C. Y., & Goh, S. K. (2016, November). Bootstrapping The Autoregressive Distributed Lag Test For Cointegration. *Discussion Papers In Economics*.

Mhozya, X. (1992). *The Specification And Estimation Of An Econometric Model Of Botswana* . Merlin Book Ltd.

Monetary Policy Report. (2018). *Monetary Policy Report.* Bank Of Botswana.

Mosweu, W. (2003, December). An Approach To Estimating The Demand For Narrow Money In Botswana. *The Research Bulletin , 21*(2).

Motsatsi, J. M. (2016). Financial Sector Innovation And Economic Growth In The Context Of Botswana. *International Journal Of Economics And Finance, 8*(6). Doi:10.5539/Ijef.V8n6p291

Mwangi, W. G. (2014). The Effects Of Financial Innovations On Money In Kenya.

Nampewo, D., & Opolot, J. (2016). Financial Innovations And Money Velocity In Uganda. *African Development Review*, *4*, 371–382.

Narayan, P. (2004). The Ardl Approach To Cointegration. *Tourism Economics*.

Nelson, E. (2008, August 8). Why Money Growth Determines Inflation In The Long Run;Answering The Woodford Critique. *Federal Reserve Bank Of St Louis*.

Nnyanzi, J. B. (2018). The Interaction Effect Of Financial Innovation And Transmission Channels On Money Demand In Uganda. *International Journal Of Economics And Finance, 10*(12).

Odularu, G. O., & Okunrinboye, O. A. (2009). Modeling The Impact Of Financial Innovation On The Demand For Money In Nigeria. *African Journal Of Business Management*, 31-51.

Ogbuji, N. C., Onuoha, B. C., & Izogo, E. E. (2012). Analysis Of The Negative Effects Of The Automated Tellermachine As A Channel For Delivering Bank Services In Nigeria. *International Journal Of Business And Management, 7*, 180.

Pelaelo, M. D. (2018). *Monetary Policy Statement.* Bank Of Botswana.

Pesaran, M., Shin, Y., & Smith, R. (2000b). Bounds Testing Approaches To The Analysis Of Level Relationships. *Journal Of Applied Economics, 16*(3), 289-326.

Schwab, K. (2017). *Global Competitiveness Report 2017-2018.* World Economic Forum.

Setlhare, L. (2002). Empirical Foudations Of Monetary Policy In Botswana.

Shidhika, A. N. (2015). Examining The Effect Of Financial Innovation On The Stability Of The Demand For Money Function In Namibia.

Sichei, M., & Anne, W. K. (2012). Demand For Money:Implications For The Conduct Of Monetary Policy In Kenya. *International Journal Of Economics And Finance*.

Thapelo, T. (2007). The Demand For Broad Money In Botswana.

APPENDIX

Figure A0: Testing the Stability of the model: The CUSUMSQ Approach; Real broad money exclusion of financial innovation

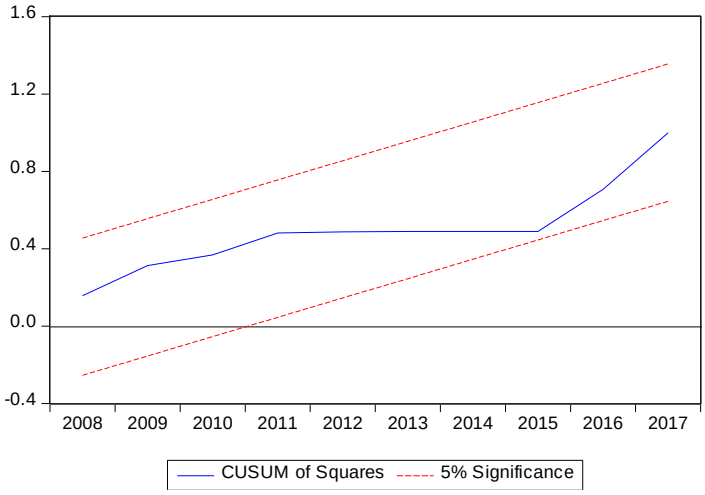


Figure A1: Testing the Stability of the model: The CUSUMSQ Approach; Real narrow money exclusion of financial innovation proxy

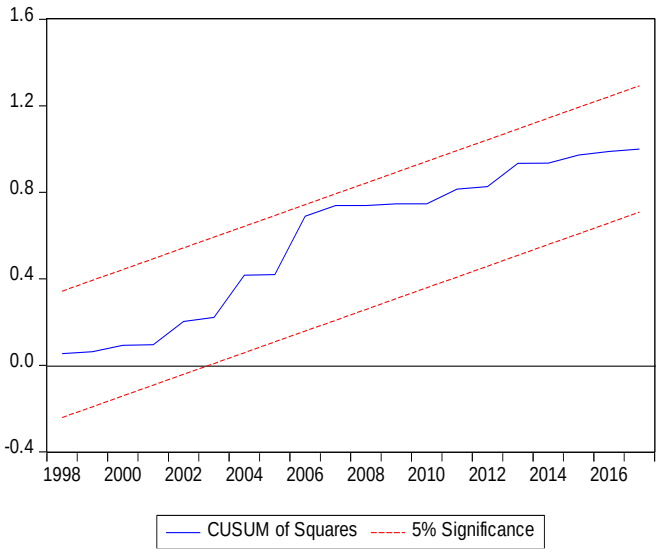


Figure A2: Testing the Stability of the model: The CUSUMSQ Approach LM1 including financial innovation proxy

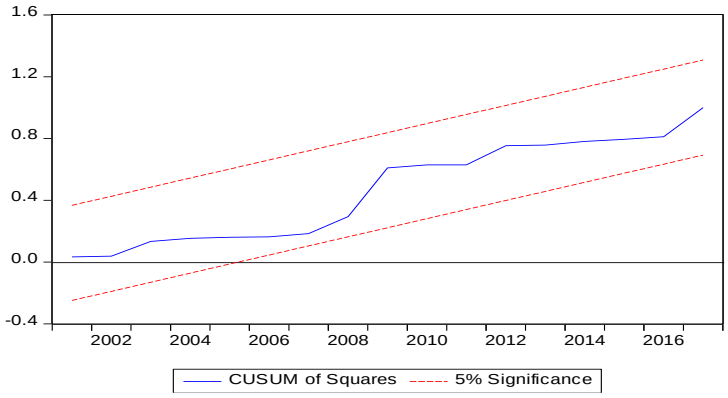


Figure A3: Testing the Stability of the model: The CUSUMSQ Approach LM2 including financial innovation proxy

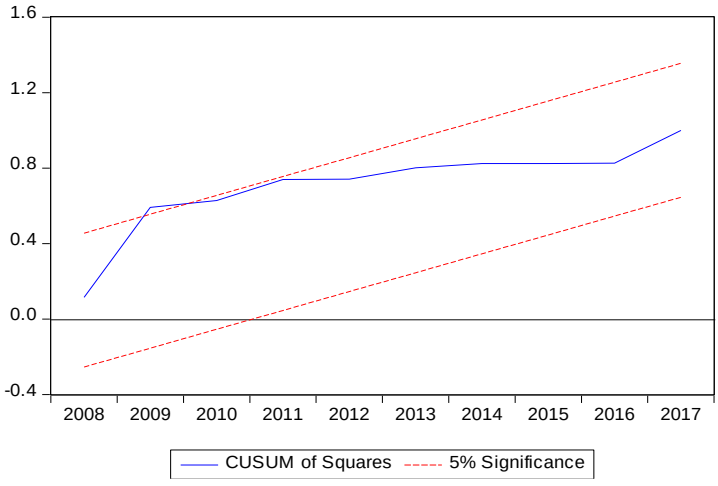


Table A4: DESCRIPTIVE STATISTICS

	LM1	LM2	LFIN	LEXT	INT	INF	LGDP
Mean	3.832467	4.919188	1.086721	0.017298	3.52171	8.768559	24.438
Median	3.943266	4.87347	1.266947	0.011388	3.840307	8.589477	24.53454
Maximum	4.752836	6.232179	1.682315	0.344122	19.78189	16.16761	25.24415
Minimum	2.733231	2.993725	0.111552	-0.1982	-12.1142	2.814958	23.23693
Std. Dev.	0.620102	0.948091	0.563599	0.147593	6.68909	2.9295	0.573437
Skewness	-0.2339	-0.23327	-0.85439	0.338927	-0.01854	0.061361	-0.46254
Kurtosis	1.806445	2.15214	2.104029	1.96608	3.0686	3.282428	2.255286
Jarque-Bera	2.465103	1.40478	5.584006	2.292715	0.00912	0.142239	2.115548
Probability	0.291548	0.4954	0.061298	0.317792	0.99545	0.93135	0.347228
Sum	137.9688	177.0908	39.12195	0.622734	126.7815	315.6681	879.7679
Sum Sq. Dev.	13.45841	31.46067	11.11755	0.762428	1566.038	300.3689	11.50903
Observations	36	36	36	36	36	36	36

Figure A5: ARDL model test for stability for real narrow money with interaction variables