FINANCIAL STRENGTH OF THE CENTRAL BANK AND MONETARY POLICY OUTCOMES IN COMMON MARKET FOR EASTERN AND SOUTHERN AFRICA REGION

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University or for any other award.

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To my love Winnie and my daughters Shirley Kimanja and Sasha Kimanja for your, encouragement and patience.

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ABBREVIATIONS AND ACRONYMS

CBC	Central Bank Capital
CBK	Central Bank of Kenya
CBFS	Central Bank Financial Strength
COMESA	Common Market for Eastern and Southern Africa
EXT	Exchange Rate
EMU	European Monetary Union
GDP	Gross Domestic Product
GMM	General Method of Moments
IMF	International Monetary Fund
INF	Inflation
OIN	Other Items Net
PPP	Purchasing Power Parity
STD	Standard Deviation
TA	Total Assets
WAEMU	West Africa Economic and Monetary Union

OPERATIONAL DEFINITION OF TERMS

Balance sheet:	It is a summary of liabilities, assets and shareholders' funds of an entity at a given point in time. It is prepared based on accounting rules.
Base money:	Bank reserves and issued currency by a central bank in circulation.
Broad money growth:	Increase in money supply composed of the currency held by public, demand deposit held with commercial banks plus time savings deposit held with commercial banks.
Capital:	It is the difference between assets and liabilities. Central banks assets mainly consists of foreign exchange reserves, the reserves are invested abroad to cushion the exchange rate. The other assets include loans and advances to government and short term loans to commercial banks. Liabilities mainly consists of currency held by public and commercial banks monies held by central bank also known as cash reserve.
Central bank independence	Use of monetary control instruments by a central bank without interference, instruction or guidance by the government.
G7:	A group of rich and industrialized countries that includes: France, Italy, Canada, Germany, the United States, Japan and United Kingdom. These seven countries control significant global wealth.
Exchange rate variability:	Short term fluctuations in exchange rate, standard deviation was used to measure exchange rate variability. Exchange rate volatility can also be used to describe variability of exchange rate.
Central bank financial strength:	Ability of a central bank to generate sufficient income to provide monetary and other services under a variety of various macroeconomic events. Other terms that can be used to describe

	financial strength include; financial position and balance sheet.
Recapitalisation:	Injection of additional funds by the shareholders or through ploughing back of profits to an entity.
Retained earnings:	A proportion of net earnings reserved by an entity reinvested in its operation. It is captured under equity section of the balance sheet.
Policy insolvency:	It is a condition in which programs of a central bank is affected by weak finances.
Seigniorage:	It is the difference between the value of currency and its total cost production. It is essentially the profit earned by the central bank from printing currency.

ABSTRACT

The Common Market for Eastern and Southern Africa monetary union co-operation programme was signed in 2005 by member countries and was aimed at establishing a regional Monetary Union by the year 2018. The set convergence criteria were aimed at removing macroeconomic disharmonies as a result of pursuing different economic policies by member states. The convergence criteria set include; achieve inflation target of three percent and also achieve and maintain stable exchange rates and interest rates amongst others. From monetary economics, central banks are modelled more often than not as maximizers of some objectives which include promoting stability of prices amongst other objectives. However, this viewpoint disregards the point that central bank tasks are inevitably deployed on its balance sheet and therefore affect the financial strength of the central bank. Weak central banks finances have brought to the fore the issue of financial ability of a central bank and whether a central bank is able to conduct monetary policy optimally and achieve its mandate of policy formulation. The average central bank financial strength in the region over the study period stood at 0.03, which was considered weak when compared with other regions such as European Union. The set convergence criteria were largely not achieved over the study period; average annual inflation rate stood at nine percent, exchange rate volatility and interest rate volatility stood at 25.5 and 1.05 respectively which was high when compared to other regions. This study therefore sought to empirically analyse central bank financial strength and how it affects key monetary policy outcomes namely; price stability, interest rate variability and exchange rate variability in the Common Market for Eastern and Southern Africa region using secondary country level data covering the period 2001 to 2017. Empirical studies are not conclusive on the effect of central bank financial ability on monetary policy outcomes and asserts that the relationships depends on the country or region unique characteristic, no study have been conducted in the region. The study was anchored on the theory of central bank financial strength which asserts that if the central bank financial ability, in terms of its finance, and preference are consistent, then the response of central bank will be consistent with the direction of the goals. General Method of Moment estimation technique was used to estimate the dynamic panel data regression model. Empirical results showed that inflation is inversely related to central bank financial strength. The results further indicated an inverse relationship between central bank financial strength and interest rate variability. However, the results showed that central bank financial strength has no effect on exchange rate variability. The Monetary Affairs Committee of Common Market for Eastern and Southern Africa region should consider including central bank financial strength as one of the convergence criteria, which this study has established affects monetary policy outcomes in the region. Further, the national treasuries of Common Market for Eastern and Southern Africa member countries, who are the central banks shareholders, should ensure the financial strength of central banks in Common Market for Eastern and Southern Africa region is enhanced due to its effects on monetary policy outcomes.

CHAPTER ONE
INTRODUCTION

1.1 Background

The financial strength of a central bank is defined as the ability of a central bank to achieve its goals with its own resources and make independent decision on the monetary instruments to be used. Stella (2005) defines central banks financial strength as the ability of the central bank to generate sufficient income to provide monetary and other services under various macroeconomic events. A central bank is financially strong if it can run its operations without making operating losses. Central bank financial strength (CBFS) should be strong enough not to generate sustained losses, even under severe economic shocks (Tanaka A, 2013). Therefore to boost the credibility of the central bank, the bank should possess sufficient financial strength to absorb losses and that power must be strengthened by reorganizing profit allocation and increasing capital (Kubicová., 2012; Benecká, S., T.,Holub, N. K.).

Research on CBFS has been disregarded for a long period as it was considered that central banks should generate adequate profits (Stella, 2008; Benecka *et al*., 2012 and Martínez-Resano, 2004). The predominant view is that, given the structure of their balance sheet, monetary authorities should be profitable institutions without financial problems. Conversely, literature strongly argues that a central bank could also face financial difficulties and thus weak financial situations could negatively impacts the effectiveness and sustainability on the functions of the central bank in additions to the central banks monetary policy outcomes (Klüh and Stella, 2008).

Since the 2008 financial crisis, central banks across the globe have been facing financial difficulties due to heavy market intervention, purchasing forex and mopping up excess liquidity, resulting to substantial losses that deteriorated their balance sheets (Valentina Ivanovic, 2014). The lower inflation rates in many countries has partially eroded traditional financing sources of the central bank that is, seignorage revenues. The increased attention to CBFS is also attributed to global financial crisis which weakened central banks statement of financial position. The weakened financial

position has contributed to non-attainment of the central banks primary role of maintaining price stability (Ivanovic, 2014). Increased international financial integration has also led to more focus to developing countries, where weak central bank balance sheet problems have been more predominant (Stella, 2008).

Lastly, implementation of a more transparent financial accounting standards by central banks, have increased the focus on the central bank finances (Klüh and Stella 2008). The financial difficulties have raised concerns whether a central bank is able to conduct monetary policy successfully amidst decreased level of capital (Cincibuch, M., Holub, T., and Hurník, J., 2008; Cukierman, 2011; Stella, 2008). However, there is no consensus on the role of financial strength of the central bank on monetary policy outcomes.

1.1.2 Central bank financial position

Adequate central bank capitalization and earning distribution plays a key role in financially independent central banks (Stella 2008). Sufficient capital of a credible and an independent central bank must be balanced with the risks it is exposed to and policy tasks it discharges. Failure or the success of a central bank in discharging its mandate is determined to some extent by the level of capital it possess. A central bank which is financially weak will record losses, when the losses reach certain levels, will necessitate financing through future or current money creation, thus undermining policy objective (Stella 2005). A central bank cannot achieve its policy objective and make excess amount of money at the same time and thus require a degree of financial strength to credibly attain set policy objective (Sweidan, 2011).

Central bank incomes arise mainly from monopoly rights in the issue of currency (Bindseil, 2004). The revenue from money creation is called seigniorage revenues. Interest receipts from the discharge of central bank functions is the other major source; including management of foreign exchange reserves, provision of liquidity to the financial systems and income from conducting open market

operations. Income derived when acting as principal or agent of the government or when dealing with international financial institutions. The other source of central bank income relates to fees and commissions derived from activities such as supervision of banks and national payment system (Archer and Moser-Boehm, 2013). Factors that weaken central banks finances includes; decline in inflation resulting in decline in income earned from printing money, large expenses incurred when undertaking open market operations and fiscal abuse and excessive profit transfers to the national treasury which erodes financial resources of a central bank (Sweidan and Widner, 2008).

Instances where capital of a central bank was increased in Common Market for Eastern and Southern Africa (COMESA) region include: central bank of Kenya which increased its share capital from Ksh.1.5 billion to Ksh.5 billion in 2009 (Central Bank Annual Report, 2009). Central bank of Kenya further increased its capital from Ksh.5 billion to Ksh.35 billion in 2019. Bank of Uganda was recapitalized in June 2013 by adding USh. 410 billion to its share capital to boost its deteriorating financial strength (Bank of Uganda annual report, 2013). The reason given for enhanced capital levels include: strengthening financial position of the central banks, which would enable the bank pursue its functions even in times of stress and sustains its financial independence. More importantly, central bank would be better placed to absorb losses that may arise from discharge of its mandate; provide confidence that it will meet its domestic obligations and further cushion the central bank against shocks that may arise from price and exchange rate movements.

From empirical review, CBFS is measured by considering capital and Other Items Net (OIN) as a ratio of total assets, that is:

CBFS= (Capital + Other Items Net)/Total Assets.

If the summation of capital and OIN is negative, it would be an indication that the respective central bank is financially weak (Benecka *et al*.,2012; Perera *et al*., 2013; Pinter, 2015 and Stella 2008). Figure 1.2 shows the financial strength of the central bank in COMESA member states,

European Monetary Union (EMU) and in West Africa Economic and Monetary Union (WAEMU) central banks for the period 2001 to 2017.

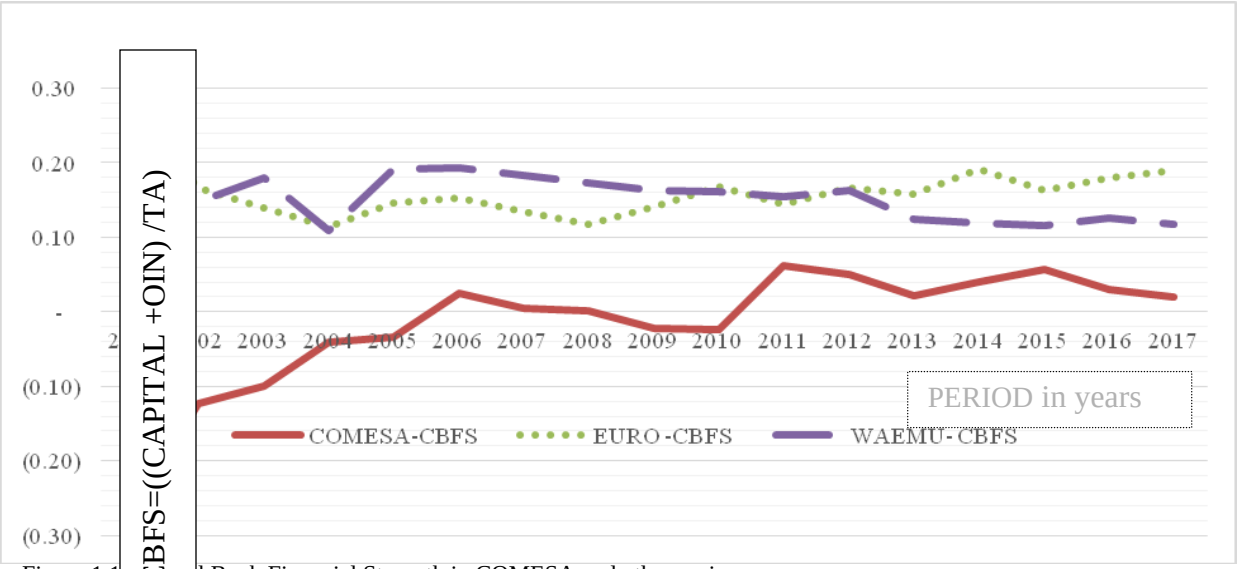

Figure 1.1 l Bank Financial Strength in COMESA and other regions.

Source: International Monetary Fund statistics database, 2018 and authors computations

Figure 1.1 shows COMESA member countries CBFS is weak compared to WAEMU and EMU regions. For the period 2001 to 2010, most COMESA countries posted negative CBFS implying weak central bank financial position. Figure 1.1 further indicate that from the year 2005, CBFS in COMESA region was positive largely due to injection of capital and ploughing back of generated profit from operations. Instances where capital of a central bank was increased include central bank of Kenya which increased its share capital from Ksh.1.5 billion to Ksh.5 billion in 2009 (Central Bank Annual Report, 2009) and Bank of Uganda which recapitalized in 2013 by adding USh. 410 billion to its share capital to boost its deteriorating financial strength (Bank of Uganda annual report, 2013).

Central bank independence is the freedom or the ability of the central bank to pursue its objectives without interference or pressure from the government. The central bank is owned by the government implying that the treasury is the central banks bank shareholder and thus its financial backstop of the last resort. If a financially weak central bank approaches the government for financial support, the

government may require the bank to ease policy in order to contribute to higher level of economic activity (Stella, 2005). The treasury can also require a non independent central bank to contribute in financing of government budget deficit. A financially weak central bank is likely to attract attention from government and which may erode their independence over time (Jeanne and Svensson, 2007). Table 1.1 indicates a listing of COMESA member countries and the average of various economic indicators for the period 2001 to 2017. It shows that majority of the countries did not achieve COMESA monetary convergence criteria set in 2005, specifically with regards to inflation target of 3 percent per annum, and the target of maintaining stable interest rate and stable exchange rate.

Table 1.1: List of COMESA Member Countries and various Economic Indicators

Year	Average Annual Central Bank Financial Strength (Ratio)	Average Annual Inflation (%)	Average Annual Exchange Rate variability (standard deviation)	Average Annual Interest rate variability (standard deviation)
Burundi	0.10	9.4	48.65	0.68
Comoros	0.18	2.9	16.91	0.13
Djibouti	0.06	3.1	0.00	0.28
DR Congo	-0.70	11.3	22.55	4.40
Egypt	-0.03	10.3	0.66	0.49
Kenya	0.08	9.4	2.71	1.06
Madagascar	-0.09	9.0	133.47	1.87
Mauritius	0.28	4.8	1.18	0.61
Rwanda	0.07	7.0	20.92	0.13
Seychelles	0.07	6.28	0.63	0.55
Sudan	-0.50	15.8	0.22	0.00
Swaziland	0.07	6.9	0.83	0.84
Uganda	0.11	7.0	107.80	1.08
Zambia	0.06	12.8	0.47	2.47

Source: International Monetary Fund statistics database, 2018 and authors computation.

From table 1.1, the average inflation rate for most COMESA member countries was way above the target rate, only Comoros in the region consistently met the inflation target. Correlation exists between countries with weak central bank financial strength and high inflation for instance; DR Congo and Sudan. Most central banks in the region have weak CBFS, central bank with negative

CBFS includes; DR Congo, Egypt and Sudan. High exchange rate variability as measured by the standard deviation was recorded compared to EMU region, Uganda and Madagascar posted high variability of 106 and 144 respectively. Most countries are net importers except mineral endowed countries (DR Congo) piling pressure on exchange rate and may require central bank to maintain sufficient foreign reserves for intervention in the forex markets to minimize exchange rate variability.

COMESA member countries are 19 in number and include: Libya, Burundi, Mauritius, Dr Congo, Djibouti, Egypt, Kenya, Madagascar, Malawi, Rwanda, Seychelles, Sudan, Swaziland, Comoros, Zambia, Ethiopia, Uganda, Eritrea , , and Zimbabwe. The study however focused on 14 countries. Data for the following countries were either not available or were incomplete: Zimbabwe, Libya, Eritrea, Malawi and Ethiopia.

1.1.3 Monetary Policy, Macroeconomic Outcomes and Central Bank Financial Strength

A financially weak central bank adversely impacts on inflation, interest rates and exchange rate outcomes; high inflation is an instrument to increase revenues of the central bank through seigniorage revenues. If economic agents are of the view that the central bank is depending on money creation to fund its operations, they will consider exchanging their monetary holdings for other assets which are likely to maintain their real value, leading to rise in inflation and loss of currency value (Leone 1993). Expansionary monetary policy is considered the most straightforward means to increase the financial strength of the central bank in common practice. High monetary growth results to higher expected future inflation and to higher nominal interest rate expected through the Fisher effect.

Ueda (2004) states that if the insolvency of the central bank was to be cured solely by earning seigniorage income in the short run, then a central bank has to aim for a high inflation rate. Weak central bank finances constraints ability of central bank in undertaking open market operations.

Mopping up extra liquidity in the financial system can be an expensive undertaking, intervention of central banks in the foreign exchange market so as to dampen volatility (Moreno, 2005). Intervention involves high operating costs since developing countries assets normally have higher yields than those of developed economies.

The monetary policy performance is reflected in macroeconomic outcomes, particularly in terms of price stability that enables the conducive environment for growth and stability of the economy. Key measures of macroeconomic outcomes include; price stability, exchange rate, output growth and interest rates. This study focussed on three measures of macroeconomic outcomes namely inflation, interest rate and exchange rate, which are key focus of a central bank. The three measures are set out as convergence criteria for COMESA region. The primary objective of monetary policy is the price stability; high inflation is therefore an indication of failure in policy. Many countries are adopting inflation targeting as the main goal of monetary policy.

Objectives of the central banks monetary policy have always included promoting stability of prices, growth promotion, attaining full employment, stabilising interest rates and the exchange rates (Maturu et al., 2006). Monetary policy has evolved over time, policymakers are gravitating towards an approach based mostly on rules rather than discretion, choosing a suitable target for policy has become key concern for central banks. Inflation targeting is an example of rule based policy and has become popular for monetary policy regime both in developing and developed economies. Inflation targeting explicitly describes how the policy maker should adjust interest rate in the short term to respond to movements in forecasted inflation relative to the target. Monetary policy frameworks for many countries are continuously being challenged by financial development and increased exposure to global capital markets. Monetary policy should also include financial stability; pre-crisis consensus was that the focus of monetary policy was to bring about stability on the prices.

In small countries with open economies, exchange rate and interest rate stability becomes a major concern of the central bank because they are highly correlated with price stability. The exchange rate affects consumer prices via the domestic price of imported goods and services. Purchasing power parity theory asserts that domestic currency will depreciate if the level of domestic inflation is high. The prices of the imported intermediate goods is affected by exchange rate, which in turn affect the pricing decisions of domestic firms. It therefore seems usual to include the exchange rate and interest rates as monetary policy indicators (Al-Mashat & Billmeier 2007).

1.1.4 Inflation in COMESA Region

Stability of prices remains the primary objective of monetary policy for many countries in the world at the moment. Inflation is defined as the economic condition where money supply rises at a faster rate than the production of goods and services in an economy (Hamilton, 2001). Figure 1.2 shows COMESA member states average inflation rate.

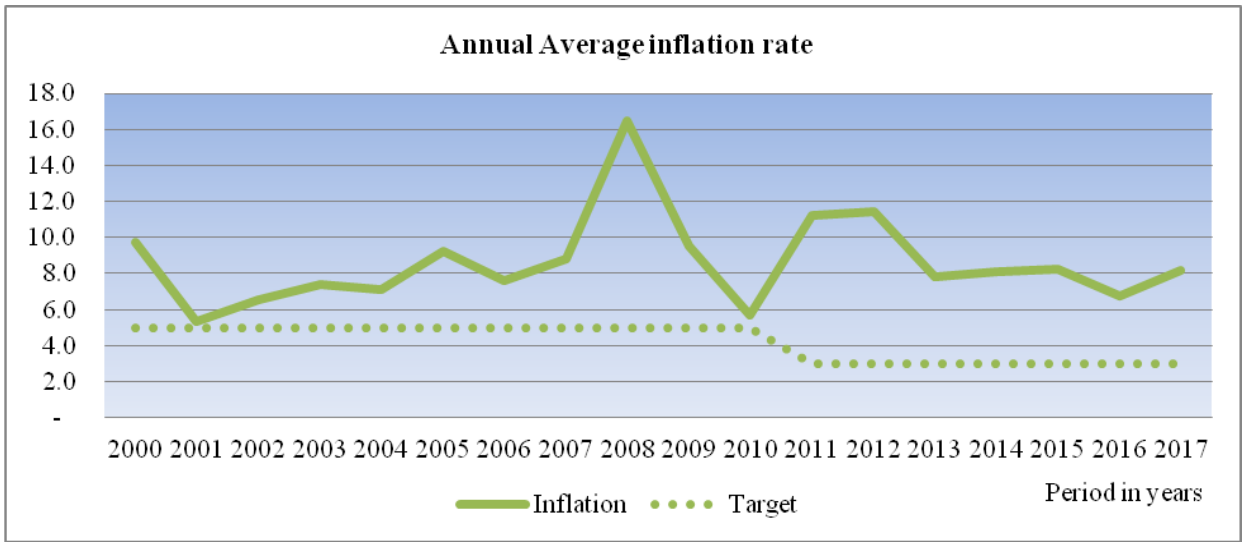

Figure 1.2: Annual Inflation Rate for COMESA Member Countries.
Source: World Bank Global Development Finance, 2018 and authors computation

Figure 1.2 shows the average inflation rate for COMESA member countries was way above the COMESA inflation target rate of 3 percent. Under COMESA Monetary Union Protocol (primary convergence criteria 2005 to 2018) the inflation target was set at 3 percent (Central bank of Kenya annual report, 2017). High inflation in the region is partly attributed to; excess liquidity, lower

output specifically in agriculture sector due unfavorable weather, and high depreciation of currency in some countries in COMESA region (Central bank of Kenya annual report, 2017).

An inverse relationship is expected as per the CBFS theory between weak central bank finances and inflation, seigniorage revenue is an increasing function of inflation.

1.1.5 Exchange Rate in COMESA Region

In a fixed exchange rate system, the central bank sets the exchange rates of the domestic currency against the foreign currencies and the exchange rate fixed by the central bank is used by market participants for transactions. In a free floating exchange rate system, the market forces of demand and supply of a particular currency determines the exchange rate. Therefore, the exchange rate is free to fluctuate in response to changes in demand and supply factors. On the other hand, if the exchange rate variability is high, the central bank will intervene in the market by selling or buying foreign currency so as to maintain exchange rate stability (Moreno, 2005).

The key target is to limit exchange rate variability rather than to achieve a specific level of exchange rate. When intervening a central bank can either use direct or indirect method. The indirect method involves central bank raising or lowering the exchange rate by changing the supply of domestic currency. The direct intervention involves purchases or sales of foreign currencies, mostly in the spot market, with the intention to affect the exchange rate of the domestic currency (Moreno, 2005). A central bank intervenes in the forex market to achieve multiple monetary policy objectives. The intention of central bank to intervene in the forex market could be to influence the level of foreign exchange reserves. The goal of influencing the amount of reserves is to reduce the volatility of exchange rates. Secondly the central bank targets exchange rates so as to enhance competitiveness and boost growth or achieving external balance. The exchange rate targets have been used in the past to achieve external equilibrium and to prevent exchange rate misalignment (Mihaljek, 2005). In situations where the threat of disorderly markets is more immediate, the primary objective of inventions would be to supply liquidity so that market continues operating (Moreno, 2005).

Exchange rates can be influenced by monetary policy via the interest rate differentials between interest rates at home and abroad. Changes in interest rate differentials as a result of monetary policy actions tend to influence exchange rate, more so if unexpected (Moreno, 2005). Figure 1.3 below shows exchange rate variability for COMESA Member Countries as well as for EMU and WAEMU regions.

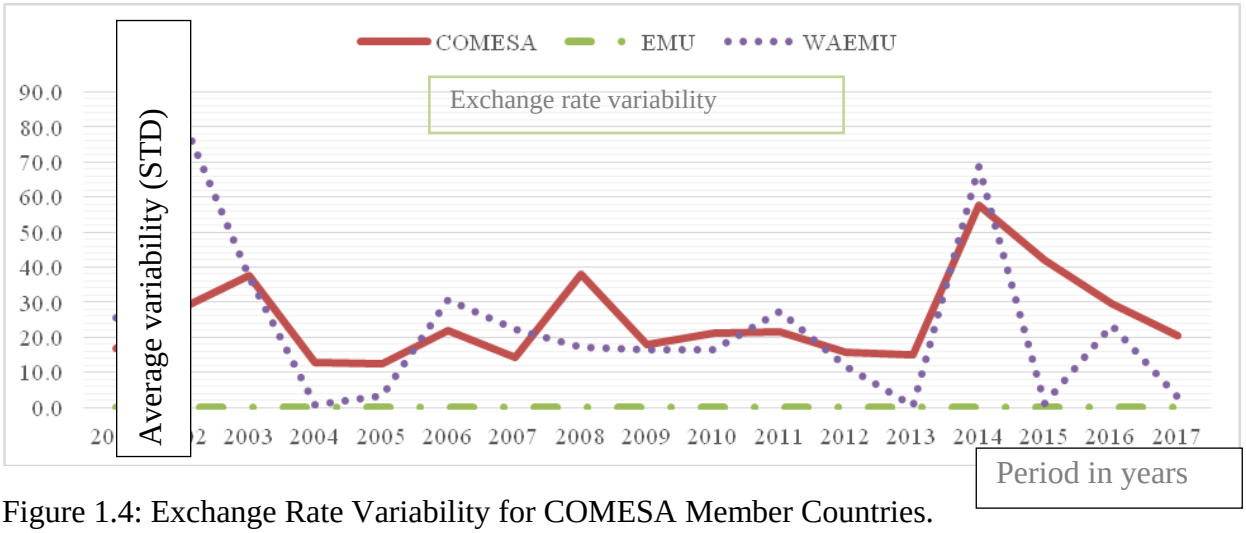

Figure 1.4: Exchange Rate Variability for COMESA Member Countries.
Source: International Monetary Fund statistics database, 2018 and authors computation

Figure 1.5 indicate that currencies for COMESA member countries have experienced high volatility to the dollar. Countries that have experienced high volatility include; Zambia 66%, Malawi 38%, Swaziland 30%, Madagascar 22% Uganda 18% and Kenya 12%. Figure 1.3 also shows high variability of exchange rate in COMESA region especially for the period 2002 to 2004 and 2013 to 2014, the highest variability of 60 is observed in 2014. In contrast, low variability was noted for EMU as shown in figure1.3. The high volatility may be attributed to huge import-export mismatches in developing countries and lack of financial muscle by a central bank to intervene effectively in the forex market to dampen exchange rate volatility. An inverse relationship is expected between exchange rate variability and central bank financial position. Central banks engage in foreign exchange operations with a view to stabilise the exchange rate.

1.1.6 Interest Rate in COMESA Region

According to Keynes (1930), the price at which a central bank supplies its reserves to the banking system is through the interest rate that it charges in the financial system. A central bank pronounces its rate of interest then move to conduct monetary policy to maintain interest rate at the desired level. Most central banks in conducting monetary policy uses open market operations or the discount window. More often than not the discount window demonstrates the desired liquidity level targeted by monetary policy. On the other hand, open market operations is commonly employed to manage interest rate in an economy. The aggregate of the central banks assets is a function of its bank rate, so that by appropriate variations of the latter the whole situation can be controlled (Keynes, 1930). Figure 1.4 shows interest rate variability for COMESA Member Countries as well as for EMU and WAEMU regions.

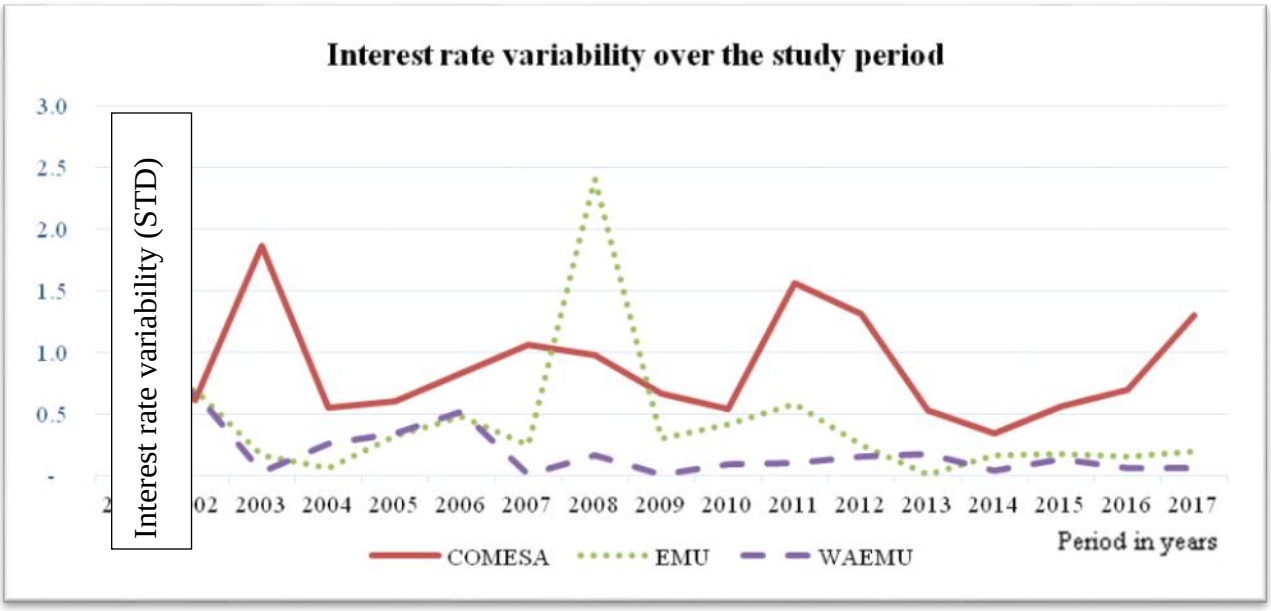

Figure 1.6:Annual Interest Rate variability for COMESA Member Countries.
Source: World Bank Global Development Finance, 2018 and authors computation

Figure 1.4 indicate that interest rate variability in COMESA member countries were higher compared with interest rate variability in EMU and WAEMU region except in 2007 and 2008. The mean interest rate variability posted for COMESA region stood at 1.26, with the lowest and highest variability standing at zero and 35.65 respectively. Zero interest rate variability was posted in Sudan

where interest rate is regulated by the central bank. The highest variability was posted in DR Congo where there is less development of the financial sector and has also been facing political instability. An inverse relationship is expected between interest rate volatility and CBFS. A financially weak central bank may opt not to raise bank rate so as to increase money issuance to generate seigniorage revenues to boost its financial position.

1.2 Statement of the Problem

The COMESA monetary union convergence criteria have set the inflation target at three percent and also set the target of achieving and maintaining stable interest & exchange rates amongst other policy objectives (central bank of Kenya annual report, 2018). COMESA countries except Comoros, Mauritius and Djibouti have persistently missed the inflation target rate of three percent, the region posted an average inflation rate of nine percent for the period 2001 to 2017.

In small open economies, exchange rate stability and interest rate variability are key concerns of a central bank since they are highly correlated with price stability (Al-Mashat & Billmeier, 2007). COMESA member countries currencies have experienced high volatility to the dollar over the years. Average volatility in COMESA region stood at 25.5 compared with European Monetary Union and West Africa Economic Monetary Union which stood at 0.04 and 24.0 respectively over the same period. Further, in 2015 various currencies lost significantly to the dollar (Zambia 66%, Malawi 38%, Swaziland 30%, Madagascar 22%, Uganda 18% and Kenya 12%).

Interest rates in COMESA member countries have not been stable, the region posted an average variability of 1.05 compared with European Monetary Union and West Africa Economic Monetary Union which posted volatility of 0.5 and 0.4 respectively over the same period. Some countries that posted high interest rate variability include: DR Congo (35.65), Madagascar (8.57) and Zambia (7).

The predominant assessment of central bank financial health is that, it will always have adequate financial strength given their power of money creation and the structure of their balance sheet

(Sweidan, 2011). A central bank cannot achieve its policy objectives and at the same time create an excess quantity of money and thus require a degree of financial strength to credibly commit to its policy objectives (Stella, 2005). Focusing on the CBFS in the COMESA region, central banks of some member countries especially DR Congo, Sudan, Swaziland, Malawi and Zambia had negative capital which is a key indicator of CBFS. CBK was recapitalised in 2009 and 2019 while BOU was recapitalised in 2013 to build their deteriorating financial strength (Central Bank of Kenya Annual Report, 2009; Bank of Uganda Annual Report, 2013; Central Bank of Kenya Annual Report, 2019).

Empirical studies show that central banks require to maintain adequate degree of financial strength for them to achieve their objectives (Adler *et al*., 2012; Berriel and Bhattarai, 2009; Perera *et al*., 2013 and Stella, 2008). However, some studies (Benecka *et al*.,2012; Pinter, 2015) find no robust relationship between financial strength of a central bank and inflation, and suggest that the relationship may be conditional to countrys unique characteristics. Previous studies have not focused on developing country context. Finally, this study extended and assessed the effects between CBFS and its effect on interest rate variability and exchange rate variability in COMESA region. These variables are highly correlated with price stability and are key monetary policy variables in small open economies (Al-Mashat & Billmeier, 2007).

1.3 Research Questions

The study sought answers to the following questions:

i. What is the effect of central bank financial strength on inflation in COMESA region?
ii. What is the effect of central bank financial strength on exchange rate variability in COMESA region?
iii. What is the effect of central bank financial strength on interest rate variability in COMESA region?

1.4 Objectives of the Study

The general objective of the study was to investigate the effect of central bank financial strength on monetary policy outcomes in COMESA member countries.

Specific objectives

i. Investigate the effect of central bank financial strength on inflation in COMESA region.
ii. Determine the effect of central bank financial strength on exchange rate variability in COMESA region.
iii. Investigate the effect of central bank financial strength on interest rate variability in COMESA region.

1.5 Significance of the Study

This study sought to make contributions to the existing literature on central bank financial strength (CBFS) concerns of central banks. Particularly, this study contributed to the limited available literature on CBFS and its implications for monetary policy outcomes in the context of developing economies. Results and policy implications of this study will be useful for various authorities in particular to COMESA countries central banks and their national treasuries. The study will provide empirical evidence of the importance of CBFS in meeting the set convergence criteria and enhancing effectiveness of monetary policy. Further, the results of the study will aid in assessing whether CBFS affected achievement of set convergence criteria which is a precondition of establishing a regional Monetary Union in COMESA.

1.6 Scope of the Study

This study sought to empirically analyse CBFS and how it affects key monetary policy outcomes in the Common Market for Eastern and Southern Africa region using secondary country level panel data. The study focused on 14 COMESA countries covering the period 2001 to 2017. The period of the study was selected based on availability of data and period where most central banks in the region adopted international financial reporting standards in reporting their financial position. COMESA

member countries are 19 in number and include: Kenya Burundi, Dr Congo, Djibouti, Egypt, Uganda, Eritrea, Zambia, Ethiopia, Libya, Madagascar, Malawi, Rwanda, Mauritius, Seychelles, Comoros, Sudan, Swaziland and Zimbabwe. Data for the following five countries were either not available or were incomplete: Zimbabwe, Libya, Eritrea, Malawi and Ethiopia.

1.7 Organization of the Study

This study is arranged in five chapters. Chapter one discusses study background, the problem statement, general and specific objectives, research questions, the significance of the study, the scope and organization of the study. Review of literature is covered in chapter two, chapter three presents the study methodology, study design, theoretical framework and estimation methodology. Chapter four covers the study findings while chapter five presents the conclusions of the study with the summary, policy implications and areas for further research.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

Chapter two covers theoretical and empirical literature review. Section one reviews the theory of central bank financial strength and macroeconomic outcomes and other theories that affects key monetary outcomes. Section two reviews the empirical literature and the last section documents overview of the literature.

2.2 Theoretical Literature

The central bank uses monetary policy tools to attain the goals of economic management. Therefore, monetary policy is used as a tool to control or influence monetary aggregate such as money supply, interest rates and exchange rate with a view of achieving set policy targets such as dealing with inflation and economic growth. Therefore, in this respect monetary policy plays a critical role in attaining the economic objectives of price stability, sustainable growth, healthy balance of payments and the objective of full employment. In pursuing these goals, the central bank sets intermediary objectives. These objectives relate to using money supply, interest rates and the exchange rate to accomplish the final objective of monetary management. Intermediate objectives are viewed as channels via which monetary policy is transmitted to the economy with the purpose of affecting the ultimate objectives. The monetary authority will not target the final objective but rather the intermediate objectives as shown in figure 2.1.

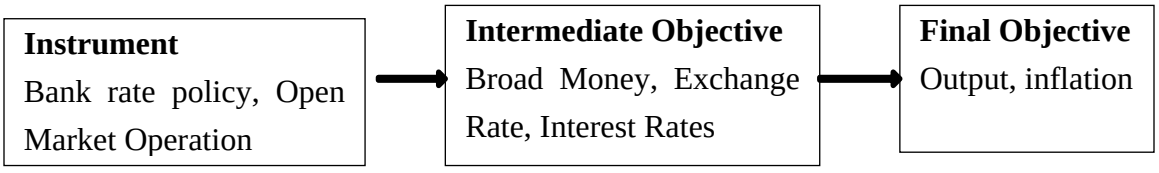

Figure 2.1 Monetary policy frameworks

2.2.1 Theory of Central Bank Financial Strength

According to the theory of central bank financial strength as advanced by Stella (2005), success or failure of monetary policy can be determined by the financial ability of the central bank. A financially weak central bank will generate losses, which, if they rise to certain levels, will require financing through future or current money creation, thus undermining policy targets (Stella 2005). Central bank must possess adequate financial strength proportionate to policy tasks and the attendant risks. If the central bank ability, in terms of its finance, and preference are consistent, then the response of central bank will be consistent with the direction of its goals. However, if the central bank financial ability and preference are in contradiction, then the outcomes of the monetary policy will be in opposite direction of the desired policy or targets (Stella, 2005).

Theory of central bank financial strength (CBFS) was later advanced by Klüh and Stella (2008). The Advancement provided theoretical linkage between financial strength of the central bank and monetary policy outcomes. First, summarizing the available options that a loss making central bank has. As a first option central bank can revert to treasury for financial support, the support could be by recapitalization or changing profits distribution rules. However, support from treasury is not a reliable and appropriate solution, the theory asserts that treasuries do not intervene timely and in a regular manner and additionally central bank financial challenges is to a great extent connected with fiscal distress. Central bank might also place reliance on measures intended to reduce the cost of conducting Open Market Operations. In numerous instances, this is achieved using the organizations ability to vary minimum reserve requirements. Conversely, selecting this option involves economic costs, specifically regarding financial development.

The most straightforward procedure available to a central bank is to increase issuance of base money to generate more seigniorage income or, in the same way, not to reduce issuance of base money when conditions dictates so. Implying easing, or not tightening when it is necessary to do so. Easing monetary conditions is considered the most straightforward means to increase CBFS in common practice. The theory further argues that if the central bank intends to reverse insolvency in the short

run by exclusively generating seigniorage incomes, it is definite that it would aim for a high inflation rate, thus forgoing its primary goal of bringing stability in prices.

Additionally, the theory asserts that high inflation is a tool used by monetary authorities to increase their revenues by collecting more seigniorage income. seigniorage income being a key component of central bank financial ability, the functional relationship could be expressed as follows; CBFS is an increasing function of inflation. Seigniorage income being a key component of central bank financial ability, the functional relationship could be expressed as follows; Central bank financial strength is an increasing function of inflation.

The CBFS theory was further advanced by Buiter (2008), the advancements provided theoretical insights linking weak central bank finances to policy insolvency. Given the risk that the central bank is exposed to, insolvency risk, it is important to define theoretically a threshold level below which policy insolvency could crystalize. The variables that are important for this purpose are the effective equity (E), that is the excess of assets over liabilities and the net present value of future income (W), the two variables constituting the net worth. If the net worth is higher it means lower probability of policy insolvency, and thus the higher the CBFS. If the effective equity is higher then less income will be required for the central bank to meet its financial obligations in the current and future periods. Net present value of future income is defined as the present value of likely future income subtract the present value of likely future spending. It is common to conceptualize future income as expected future seigniorage income (Stella, 1997). The theory further asserts that high inflation is a tool used by monetary authorities to increase their revenues by collecting more seigniorage income.

Once the net present value of future income (W) and effective equity (E) are defined and considering the framework suggested by Buiter (2008), in the long run the effective equity and net present value of future income should have their summation positive, $E+W > 0$. If the summation of the two variables is negative $E+W < 0$, then it is imperative that the central bank

find means to improve its net worth. This makes it clear that central bank financial position can lead to a rise in inflation (Buiter, 2008).

When defining CBFS, it is important to consider operations of the central bank that results to balances posted in its opaque accounts. To that end, it is important to understand other items net (OIN) an element of the central bank balance sheet so as to comprehend the true condition of the balance sheet (Stella 2008). OIN is the remaining item after considering significant assets and liabilities of a central bank (Cargill 2006). Assets of a central bank mainly consist of balances due to the banking institutions, securities and advances to commercial banks, Funds held with IMF and reserve money invested. Similarly, liabilities of a central bank mainly consist of currency in circulation, deposits from banks and government and monies due to IMF.

The monetarists agreed approach in studying how central bank behaves and how its actions effect various economic variables, is by use of central bank loss function model. Central bankers widely use asymmetric loss function model to appreciate the behavior of the central bank and to come up with optimal policy rates. To accomplish study objectives, central bank asymmetric loss function model as advanced by Sweidan, (2008) was used. The model comprises of two sections that is the private sectors forming rational expectations and secondly, a central banker whose responsibility is to conduct the monetary policy. The private sector knows the central banker who constructs monetary policy (optimization) for each period. The mathematical behavioral form of the two players is discussed in Chapter 3.

The theory of CBFS is relevant to this study since it provides theoretical linkage between CBFS and monetary policy outcomes. The theory further provides theoretical insights linking weak central bank finances to policy insolvency. The theory postulates that high inflation is an instrument to boost central bank revenues through seigniorage income which is a key component of CBFS. In addition, the theory asserts that if agents perceive that a central bank is relying excessively on

seignorage to finance its operations, they will seek to exchange their holdings for assets more likely to maintain their real value, which will lead to rise in inflation and depreciation of the currency.

The theory of CBFS can therefore be stated as follows;

Monetary policy outcomes = f(CBFS), where monetary policy outcomes include inflation, interest rate, exchange rate amongst others. Key measures of monetary policy outcomes are; price stability, exchange rate, and interest rates. This study investigated the effect of CBFS on the highlighted monetary policy outcomes.

2.2.2 Monetary Theory of Inflation

The monetary theory of inflation as advanced by Milton Friedman and his followers (1912-2006) asserts that "inflation is always and everywhere a monetary phenomenon that arises from a more rapid expansion in the quantity of money than in total output". From the monetarists view, an expansionary monetary policy stance increases the individuals money balances encouraging them to spend more as individuals maintain a stable relationship between money balances they hold and spending. A contractionary monetary policy stance decreases money balances and reduce spending directly. Adopting an expansionary monetary policy stance is considered the most straightforward means to improve CBFS. In the monetarist theoretical framework, the transmission mechanism of inflation works as shown in figure 2.2.

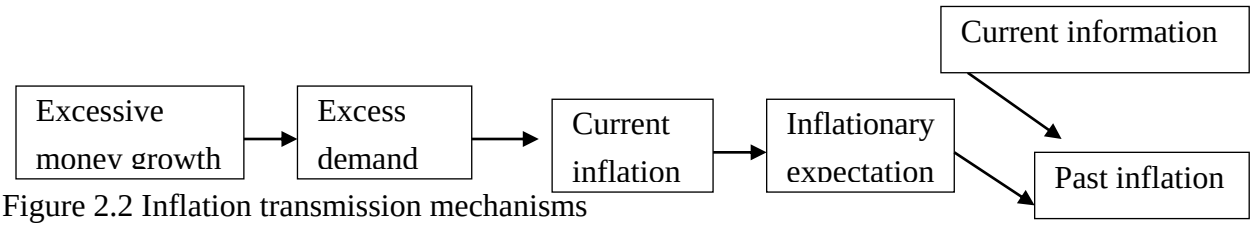

Figure 2.2 Inflation transmission mechanisms

Excessive monetary growth has effects on demand and the present inflation. The influence on inflation starts from past inflation to current information leading to inflationary expectation and then to current inflation. The current inflation rate is affected by inflationary expectations of the prior periods. The lag is because individuals cannot predict the future with certainty.

The functional form of the theory is given by Fischer Version

MV=PT, where

M is the money supply

V is the velocity of circulation

P is the price level and

T is the transactions

T is not easy to measure thus it is substituted by Y which is the national income.

Monetarists are of the view that in the short term velocity (V) is fixed since the rate at which money circulates is determined largely by institutional factors. Monetarists also belief that Y is fixed in the short run. Consequently, rise in the money supply will results to increase in inflation.

The monetary theory of inflation is relevant to this study at it provides a theoretical linkage between weak CBFS and inflation. Ueda (2004) states that if the monetary authority intends to improve its financial position in the short run by relying only on seignorage revenues, then it will have to target high rate of inflation. Inadequate finances of the central bank have a negative impact on inflation; high inflation is an instrument to improve revenues of the central bank through earning of seigniorage. Secondly, the theory provides a basis for the econometric approach to be employed in chapter 3 to cater for the dependent variable lag in the specification model.

2.2.3 Keynesian Theory of Interest Rates

The theory as advanced by Keynes (1960) asserts that the market interest rate is influenced by money demand and money supply. Interest rate according to Keynes is defined as the reward of parting with liquidity for a given time period. Cash money balances demand is determined by either transactionary motives or money kept by households to reduce the gap between receipt of cash inflows and cash outflows. Furthermore, precautionary motives refers to money balances held for unforeseen and uncertainty contingencies. Lastly, for speculative motive which is the money held to take advantage of changes in interest rate in the securities market (Mishkin, 2010).

The rate of interest is the price that brings willingness to hold wealth in the form of cash with the supply of cash. The theory argues that changes in money supply affect aggregate demand via changes in interest rates. Rise in money supply causes the interest rate to reduce. The lower rate of interest leads to more investment. According to Keynes, money supply maybe endogenously driven by interest rate but can also be fixed by the central bank in the short run. The demand and the supply of money determine the short term interest rate. Keynes liquidity theory forms the basis of interest rate channel of monetary policy transmission (Mishkin, 2010).

Monetary authority on noting that inflationary pressures have started emerging in the economy it raises the central bank rate. Financial institutions borrowing from the monetary authority becomes more expensive and commercial banks borrowings reduces. Lending rate by commercial banks rises making individuals to borrow less from the banks causing credit contraction in the economy. Keynes differentiates three motives for holding wealth in cash; the precautionary motive, and the transaction motive. In his argument Keynes asserts that the money demand to satisfy the precautionary motives responds to interest rate changes while changes in income affects demand for money to satisfy transactional motives. By incorporating the liquidity preference concept into demand for money theory. Keynes asserts that money supply together with liquidity preference defines the interest rate.

Keynesian theory strength lies in how the theory integrates of monetary theory and the theory of output and employment through interest rates on the other side. When the money supply rises, the interest rate reduces, causing increase in investment and the aggregate demand, leading to output and employment levels. The rise in the investment causes a rise in aggregate expenditure which has a multiplier effect. Contractionary monetary policy stance works in the reverse direction. Liquidity preference theory has been criticized because the theory is inconclusive as it presupposes that the level of income is known and the fact that it presupposes that interest rates are a purely monetary phenomena. Empirical evidence indicates factors such as investments and savings affects interest rates.

The relevance of Keynesian theory of interest rate to this study is that it provides a theoretical linkage between monetary policy induced rate of interest and the financial strength of the central bank. When the central bank financial position is weak it may opt not to raise bank rate so as to increase money issuance to generate seigniorage revenues to boost its financial position. Mopping up surplus liquidity in the banking system through increase in interest rate can be an expensive undertaking and weak central bank may prefer to avoid such costs thus compromising on the desired monetary policy outcomes.

2.2.4 Monetary Approach of Exchange Rate Theory

Monetary approach theory of exchange rate was advanced by Palok (1957) and later redefined by other authors (Hahn F.H. (1959), Mundell R.A. (1971) and Johnson, H.G. (1972)). The theory argues that exchange rate between two nations is given by the ratio of their values determined on the basis of money supply and money demand positions of the two nations. The theory suggests that domestic prices are flexible and are linked to global prices by theory of purchasing power parity. The balance of payment is the central focus of this theory. Rise in the real demand for money, originating from rise in real income, will lead to reduction in the level of prices so as to raise the real value of the existing nominal money stock. Reduction in prices will result in appreciation of the exchange rate.

The monetary approach is formulated in terms of the theory of monetary equilibrium and the theory of exchange rate determination. By letting V, Y, P and M be money velocity, real income, price level and nominal quantity of money. The condition of monetary equilibrium can therefore be expressed as follows;

$$M/P\ V(r, Y) = Y \qquad \text{2.13}$$

Equation 2.13 shows velocity of money can be a function of other variables in the expression, for instance; income Y and interest rates, r. Rewriting equation (2.13) by making the price level the subject yields;

$$P=V(M/Y) \quad \ldots\ldots 2.14$$

Equation 2.14 shows that for a given money velocity a rise in money leads to an equivalent increase in the level of price. A rise in the money velocity leads to a rise in level of prices while a rise in real income, by increasing real money demand, will lead to a decline in equilibrium prices level. Proceeding to the theory of the exchange rate and relying on Purchasing Power Parity strict version which asserts that price level is equal to foreign prices, P*, converted at the exchange rate, E:

$$P=P^*E \quad \ldots\ldots 2.15$$

Where E is price of foreign exchange in the domestic currency. Substituting (2.15) in (2.14) results in the equilibrium exchange expression rate as indicated in equation 2.16.

$$E= (1/P^*) (VM/Y) \quad \ldots\ldots 2.16$$

The equilibrium exchange rate is influenced by money velocity, real output and nominal money. A rise in nominal money or the velocity will lead to depreciation of the exchange rate in the same proportion. An increase in the real income will lead to currency appreciation. To complete the theory, the foreign price level, P*, is determined by foreign demand for money and the supply so that equation 2.16 can be rewritten as follows:

$$E = (M/M^*) (V/V^*) (Y^*/Y) \quad \ldots\ldots 2.17$$

From equation 2.17 what determines the exchange rate is the relative supply of money, real incomes and velocities in the countries in question. Exchange rate will depreciate if; ceteris paribus, nominal money stock rises relative to money stock abroad.

This theory is relevant to this study as it provides a theoretical linkage between the financial strength of the central bank and the exchange rate. Weak central bank finances constraints ability of central bank in undertaking open market operations. Mopping up surplus liquidity in the banking system can be an expensive undertaking. If economic agents view is that the monetary authority is relying heavily seignorage revenues to fund its operations, they would seek to exchange their holdings of the monetary base for assets that are likely to maintain their value, leading to depreciation of the currency (Leone 1993).

2.3 Empirical Literature review

The study by Stella (2008) was the first empirical research to explore linkage econometrically between financial strength of the central bank and inflation. The study adopted pooled regressions analysis with inflation as the explained variable, for a cross-section of 97 countries with two control variables. The countries included in the analysis were mainly from Europe, Asia and Caribbean. Secondary annual data for the year 2005 was used for the analysis and was obtained from International Financial Statistics. The aim of the study was to determine if the financial strength of the central bank affects monetary policy performance.

The financial strength of the central bank was measured as follows;

Central bank financial strength= (Central bank capital + Other Items Net)/ Total Assets

For estimation purposes, regression analysis was adopted and modeled as shown below:

Inflation=f(Financial strength of the central bank, trade openness, degree of economic development)

The study concluded a robust negative relationship exists between the financial strength of the central bank and inflation. Specifically, the study established that inflation was on average 23.8 percent for central banks with weak financial strength and 11.2 percent for central banks with strong financial strength at 99 confidence level. The shortcomings of the study was that it relied purely on cross-section analysis approach, it did not provide estimates with panel econometric methods and

few control variables were used, two control variables were included which are few and can be highly correlated with variables not controlled for in the regression (Benecka *et al.*,2012).

The next empirical research in this area was the study by Adler *et al.,* (2012). The objective of the study compared with the one conducted by Stella (2008) was not to empirically investigate the impact of CBFS on inflation, alternatively, it focused on measures that constraints monetary policy. The monetary policy constraint was defined as the deviation of actual interest rates from an estimated forward-looking Taylor rule. The study therefore focused on the link between central bank capital and monetary policy actions, rather than the previous studies which focused on monetary policy outcomes. The study employed a sample of 41 countries drawn from developed and emerging countries covering the period 2002 to 2010.

Instrumental variable using general methods of moment (IV-GMM) was used in estimating the model. The methodology involved the estimation of interest rate rules for the sample of countries and testing whether deviations from the rule could be explained by a measure of CBFS. This estimation technique approach dealt with possible endogeneity bias problems as forward-looking variables were obtained from a linear combination of lagged variables and so the dependent variable were not correlated with the error term from the interest rate rule. Independent variables lag for all the explanatory variables, the interest rate and the commodity price index logs were used as instruments.

The regression equation employed made use of; inflation as the predictor variable and central bank capital as the explanatory variable. The study by Adler *et al.,* (2012) established that the central bank capital is statistically significant variable in explaining huge negative interest rate deviations from targeted levels. The limitation of the study mainly stems from using capital as a measure of central bank finances, capital will exclude revaluation accounts and off balance sheet transactions (Perera *et al.,* 2013).

The study of Benecka *et al.*, (2012) addressed weakness in the approach employed by Klüh and Stella (2008) and applied an array of econometric approaches with diverse dependent variables to test the robustness of how the variables between financial strength of the central bank and inflation were related. The study addressed panel data issues arising from endogeneity, accounting for inflation inertia and the unobserved country characteristics. The study used 105 countries and used panel data framework. Secondary annual data for the year covering the period from 2002 to 2009 was used in the study. The countries included in the analysis were mainly from Europe and Asia. The study made use of General Method of Moment estimation technique. CBFS was measured as follows;

Central bank financial strength= (Central bank capital + Other Items Net)/ Total Assets.
For estimation purposes, panel data analysis-general method of moment technique was adopted and modeled as shown below.
Inflation = f (CBFS, lag of inflation, price of oil, economic openness and the degree of economic development).

The study concluded weak and not robust relationship exists between CBFS and the inflation. The limit of the study conducted by Benecka *et al*., (2012), arises mainly from the sample they considered, the countries in the sample were heterogeneous and further they was no closer look on groups of countries which were homogeneous Perera *et al.*, 2013).

Perera *et al.*, (2013) examined the financial strength of central bank and the effect it had on inflation, interest rate variability and exchange rate variability in 14 selected countries. The selected countries include countries in Latin America, South Asia and G7 countries. The study placed more emphasis in India and Sri Lanka and covered the period 1996 to 2008. The study partially addressed shortcomings of the previous works by dealing with heterogeneity between various categories of countries and at the same time employing estimation methods which are robust. CBFS similar to the study conducted by Benecka *et al.*, (2012) was measured as follows;
CBFS= (Central bank capital + Other Items Net)/ Total Assets.

Key measures of monetary policy outcomes were modeled with financial strength of the central bank measure. In order to estimate models for the selected group of countries pooled GMM estimation methods was used. For estimation purposes, panel data analysis-general method of moment technique was adopted and modeled as shown below;

Inflation = f (CBFS, lag of inflation, price of oil, economic openness and the degree of economic development). The study concluded that price stability is generally related to central bank financial strength.

Exchange rate variability = f(CBFS, economic openness interest rate differential and oil price).

The study also concluded that exchange rate variability cannot be explained using the changes in central bank finances.

Interest rate variability = f (CBFS, Credit demand, Budget deficit and Money supply). The study also concluded that real interest rate variability can be explained using the changes in central bank finances.

The limitation of this is largely on the econometric approach used, the study adopted the one-step general method of moment estimator as opposed to two-step estimator. One step estimator generally has a bias problem of asymptotic standard errors (Pinter, 2015).

2.4 Overview of Literature

The main theory that anchors this study is the theory of central bank financial strength. It asserts that success or failure of monetary policy can be determined by the financial ability of the central bank. Central bank must possess adequate financial strength proportionate to policy tasks and the attendant risks. The theory further asserts that if the central bank ability, in terms of its finance, and preference are consistent, then the response of central bank will be consistent with the direction of its goals. However, if the central bank financial ability and preference are in contradiction, then the outcomes of the monetary policy will be in opposite direction of the desired policy or targets. The theory of

CBFS is relevant to this study since it provides theoretical linkage between CBFS and monetary policy outcomes of; inflation, exchange and interest rates that this study investigated.

Other theories reviewed include; monetary theory of inflation, Keynesian theory of interest rates and monetary approach of exchange rate theory. The theories provide theoretical linkages between the main dependent variable that is CBFS and various intervening variables in the study. The theories are further useful in bringing structural determinants of the various dependent variables and providing a basis for the econometric approach to be employed.

Some empirical evidence reviewed confirms that an inadequate financial strength of the central bank is not an optimal position for the bank since it affects its credibility and could affect the monetary policy actions. Further some empirical evidence suggests that CBFS should be strong enough not to make sustained losses, even after a large economic shock, the bank should avoid posting losses persistently and maintain the health of its balance sheet. A strong balance sheet is critical pre-conditions for desirable monetary policy outcomes of the central bank. However, there is no consensus in literature on whether financial strength of the central bank empirically matters for inflation, interest rate variability and exchange rate variability. The lack of consensus is predominantly due to sample selected used in terms of the countries in the sample is main reason for the studys conclusions. From the foregoing the relationship between CBFS and monetary policy outcomes mainly depends on the sample of countries studied and further on the specific countrys structural characteristics.

Empirical studies reviewed have either employed cross sectional data or time series data, few studies have used panel data. The main estimation techniques employed by the studies reviewed is the regression estimation technique, some studies making use of panel regression estimation technique where fixed and dynamic regression model were estimated. The empirical studies reviewed employed secondary data sources retrieved from, central bank balance sheets, World Bank and international monetary fund databases.

The gaps that this study sought to fill include the following; Previous studies lack focus on developing country context, developing countries have fundamental and unique problems for instance; fiscal institutions which are weak, weak financial entities , weak record with regard to monetary policy conduct and low credibility of the central bank. This study also went further and investigated how CBFS is related with interest rate variability and exchange rate variability due to their high correlation with price stability for small open economies. When a currency depreciates, it can lead to extreme inflation by raising the domestic price of imports. Purchasing power parity theory asserts that domestic currency will appreciate if the level of domestic inflation is low.

CHAPTER THREE
METHODOLOGY

3.1 Introduction

Chapter three covers the methodology adopted in this study. It comprises the research design, theoretical framework, model specification, definition and the analysis of data.

3.2 Research Design

The study utilized non-experimental design. Non-experimental study involves predictor variables that the researcher cannot control, manipulate or alter and instead are studied as they exist. Non-experimental design can be categorized into cross-sectional, time series or panel designs. 14 COMESA member countries were considered and annual observations on each country were obtained for the period 2001 to 2017.

3.3 Theoretical Framework

This section discusses theoretical framework that this study relied on namely; the asymmetric loss function of the central bank and the asymmetric loss function of the central bank with additive and multiplicative uncertainties.

3.3.1 The central banks Asymmetric loss function model

The theory of central bank financial strength asserts that success or failure of monetary policy can be determined by the financial ability of the central bank. From the theory of CBFS as discussed in section 2.2.1 implies that;

Monetary policy outcomes = f(CBFS), where monetary policy outcomes include inflation amongst others.

Theoretically, the study objective of investigating the effect of CBFS on inflation in COMESA region was anchored on the central bank asymmetric loss function as advanced by Sweidan (2008). One of the parameters in the loss function is the financial ability of the central bank

representing the central bank financial strength. Central bankers widely use asymmetric loss function to comprehend behavior of the central bank and to also develop optimal policy rates. Asymmetric loss function incorporates the central banks target policy values, the constraint and their relative importance.

The central bank asymmetric loss function is given in equation 3.1.

$$L = \frac{\exp\left(A\alpha\left(\pi_t - \pi^*\right)\right) - A\alpha(\pi_t - \pi^*) - 1}{A^2\alpha^2} + A\phi(Y_t - Y^*)^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.1$$

$A \neq 0,\ \alpha \neq 0,\ \phi \neq 0$

Where A represents the central banks ability (CBFS) to attain the set out policy preferences. The value α represents the degree of asymmetric preferences. If $\alpha > 0$ the monetary authority has a strong aversion to the positive side of the deviation than the negative side of the deviation. The value ϕ represents the weight that the central bank places on the deviation of actual output level from the target level. π_t represent inflation, π^* is the value of expected inflation rate, Y_t is the aggregate supply and Y^* is the expected output. Equation (3.1) shows that the central bank targets inflation rate and output gap.

The mathematical derivation of asymmetric central bank loss function as advanced by Sweidan (2008) is as follows: considering a case where the conduct of the private sector is given by Lucas (1973) aggregate supply function as indicated in equation 3.2;

$$Y_t = Y^N + k(\pi_t - \pi_t^e) + S_t, \text{ where } k>0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.2$$

Y_t represents the real aggregate supply; Y^N is the rate of output; π_t represent the inflation rate; π_t^e denotes the expected rate of inflation; k represents the elasticity of output in regards to inflation rate; S_t denotes the aggregate supply shock. The aggregate demand side of the economy is indicated in equation 3.3;

$$Y_{st} = M_t - \pi_t + d_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.3$$

Where Y_{st} denotes real aggregate demand; M_t represents the money supply; d_t represents the aggregate demand shocks. Equation (3.3) indicates output and inflation are inversely related which is the main characteristic of the aggregate demand. The central bank aim to estimate the optimal rate of inflation by minimizing the central bank loss function subject to the diverse information available in the economy as shown in equation 3.4;

$$L = E\left\{\left(\frac{\exp\left(A\alpha\left(\pi_t - \pi^*\right)\right) - A\alpha\left(\pi_t - \pi^*\right) - 1}{A^2\alpha^2}\right) + A\phi\left(Y_t - Y^*\right)^2\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.4$$

Before performing the minimization problem, Sweidan (2008) estimates the value of the exponential term by employing moment generating functions. Moment generating function provide an approach of expressing a probability distribution by using a function with a single variable. The function uniquely determines the distribution and its strength lies in computation of deviations. It also provides an easier method of characterizing the distribution of the summation of the explained variables. The result is as follows:

$$L = E\left\{\left(\frac{\exp\left(A\alpha\left(\pi_t - \pi^*\right)\right) + \left(A^2\alpha^2\sigma_{\pi}^{2}/2\right)\left(\pi_t - \pi^*\right) - A\alpha\left(\pi_t - \pi^*\right) - 1}{A^2\alpha^2}\right) + A\phi\left(Y_t - Y^*\right)^2\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.5$$

Substituting information in equation (3.2) into equation (3.5) yields:

$$L = E\left\{\left(\frac{\exp\left(A\alpha\left(\pi_t - \pi^*\right)\right) - \left(A^2\alpha^2\sigma^{2}/2\right)\left(\pi_t - \pi^*\right) - A\alpha\left(\pi_t - \pi^*\right) - 1}{A^2\alpha^2}\right) + A\phi\left(Y^N + k\left(\pi_t - \pi_t^e\right) + S_t - Y^*\right)^2\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.6$$

Differentiation of equation (3.6) with respect to π_t and then making use of the approximation and obtaining the derivative of Ln(1-X)) and expressing it as a power series using binomial expansion for value X in the neighborhood of zero yields;

$$\pi_t = \left[\pi^* - \left(A\alpha\sigma_{\pi}^{2}/2\right) - \left(2kA\phi\left(Y^N - Y^*\right)\right)\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.7$$

π_t indicate the rate of inflation , π^* denotes the expected rate inflation, A denotes the financial strength of the central bank, which is the financial ability of the central bank to attain the desired policy preferences, α represents the degree of asymmetric preferences, σ_π^2 denotes the inflation rate variance, k is the output elasticity with respect to rate of inflation, ϕ represents the central banks preference in regard to the output deviation level from the targeted level , Y^N represents the natural output rate t, Y^* is the targeted output level.

The optimal inflation rate is influenced by; the targeted rate of inflation by central bank, CBFS the variance of inflation rate and the difference between the targeted and the natural levels of output. If a central bank is averse to high rate of inflation that is $\alpha>0$ and the central bank is not able to intervene due to weak financial strength that is $A<0$, therefore the rate of inflation variability will have a positive effect on the optimal rate of inflation. If the financial ability is eroded, the actual rate of inflation movement will therefore be in the opposite to the central bank desired preferences.

The theoretical framework as developed by Sweidan (2008) shows that that inflation rate is a function of CBFS that is; Inflation = f(CBFS) as indicated in Equation 3.7.

3.3.2 Asymmetric Loss Function with Additive and Multiplicative Uncertainties model

The theory of the central bank financial strength as discussed in section 2.2.1 implies that; Monetary policy outcomes = f(CBFS), where monetary policy outcomes include interest rate, exchange rate, money supply amongst others.

Though Sweidan (2008) specifically wanted to establish the linkage between financial strength of the central bank (A) and the inflation, the same analogy may be fronted to determine the effect of CBFS on exchange rate and interest rate by incorporating the multiplicative and additive uncertainities to the asymmetric loss function. Using the asymmetric loss function given by;

$$\left\{\left(\right)^{34}\right\}$$

$$L = E \quad \frac{\exp\left(A\alpha\left(\pi_t - \pi^*\right)\right) - A\alpha\left(\pi_t - \pi^*\right) - 1 + A\phi\left(Y_t - Y^*\right)^2}{A^2\alpha^2} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.8$$

Intermediate objectives are viewed as channels via which monetary policy is transmitted to the economy with the aim of affecting the ultimate objectives. The monetary authority will not target the final objective but rather the intermediate objectives as shown in figure 3.1.

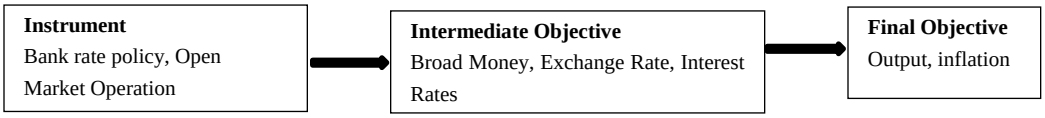

Figure 3.1 Monetary policy frameworks

Replacing the aggregate demand and aggregate supply functions with Equation (3.8). Equation (3.20) shows how inflation rate is determined in the economy. The purpose of this alteration is to open up room for both additive and multiplicative uncertainties. Equation (3.9) shows how inflation behaves in the economy:

$$\pi_t = \mu\left(\pi_t - \pi^*\right) + \theta M_t + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.9$$

Further, the new information will be taken in the central bank objective function which is similar to Equation (3.9) but without the output gap term as follows:

$$L = E\left\{\frac{\exp\left(A\alpha\left(\pi_t - \pi^*\right)\right) + \left(\theta_t M_t + u_t - \pi^*\right)}{A^2\alpha^2}\right\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.10$$

$A \neq 0,\ \alpha \neq 0,\ \phi \neq 0$

Deriving Equation (3.10) subject to M_t gives:

$$M_t = (1/\theta)\,\pi^* - (\mu/\theta)\left(\pi_t - \pi^*\right) - \left(A\alpha\delta^2{}_\theta M^2 t/2\theta\right) - \left(A\alpha\delta^2\mu/2\theta\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.11$$

Finally, the actual inflation rate is computed by substitution of equations

(3.9) and (3.10) into Equation (3.11) and solving for M_t, the results is as follows:

$$M_t = \delta^2{}_\theta \pi^* + \left(1 - \delta^2{}_\theta\right)\left(\pi_t - \pi *\right) - \left(A\alpha\delta^2{}_\theta\delta^2{}_u/2\right) + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.12$$

Equation (3.12) shows that intermediate monetary policy objective that is money supply and by extension exchange rate and interest rate is influenced by central bank financial ability (A). The theoretical framework as developed by Sweidan (2008) shows that that the intermediate monetary policy variable such as exchange rate and interest rate is a function of CBFS that is; interest rate and exchange rate = f(CBFS) as indicated in Equation 3.12.

3.4 Model Specification

The key explanatory variable in this study is the CBFS, the predicted variable in the study objective one of investigating the effect of CBFS on inflation in COMESA region is inflation. From the monetary theory of inflation reviewed in chapter 2, the theory asserts that the current period inflation rate is influenced by inflationary expectations of the past periods. This imply that period t inflation is expected to be correlated with period t-1 inflation because of the so called inflation inertia. This means that that lag of inflation is expected to be correlated with current measure of inflation in the model. Omitting the lag of the dependent variable can result in an omitted variable bias. The study will therefore make use of dynamic estimation method which is suitable in dealing with cases where lag of the dependent variable is included as one of the independent variable.

Model specification in equations (3.7) and (3.12) establishes the linkage between financial strength of a central bank and outcomes of monetary policy. The structural form of equation 3.14, dynamic estimation technique as justified above, was used to address the study objectives.

$$y_{it}=y_{i,t-1}\alpha + x_{it}\beta + v_i + u_{it} \quad \text{………………………………..…………………………….. 3.14}$$

Where $\boldsymbol{y}$ represents a vector of dependent variables (inflation rate, exchange rate variability and interest rate variability) of dimension NT*1. $\boldsymbol{X}$ represents a vector of explanatory variables and control variables of dimension NT*K. $\boldsymbol{v}$ represents a vector of unobserved country specific effect of dimension NT*1, $\boldsymbol{\beta}$ represes a vector of unknown parameter that was estimated, $\mathbf{u}$ denotes a vector

of disturbance term of the dimension NT*1, i=1,…,N represents individual countries and t=1,…,T represents time periods.

The relationship between inflation and CBFS could either be linear as indicated in equation 3.14 or non-linear. Non-linearities in the relationship between CBFS and inflation could exist. In particular, a central bank with weaker CBFS could lead to a higher inflation, this study is interested in establishing whether inflation is high when the CBFS is already low. To achieve this, the study used the approach proposed by Pinter (2015) of squaring the variable of interest that is the CBFS. This approach assumes that the effect is continuously increasing or decreasing with the value of our variable of interest.

To address study objective one on investigating the effect of CBFS on inflation in COMESA region, equation 3.15 was estimated;

$$Inflation_{it}=\alpha inflation_{i,t-1}+\beta_1 CBFS_{it}+\text{Broad money growth}+\beta_2 \text{Per Capita income}_{it}+\beta_3 \text{Economic openness}_{it}+\beta_4 \text{Credit Demand}_{it}+\beta_5 \text{Foreign inflation}_{it}+\beta_6 \text{Commodity Price}_{it}+\beta_7 \text{Exchange rate}_{it}+u_i \quad (3.15)$$

From the monetary theory of inflation and the theory of CBFS as outlined in chapter 2, $inflation_{(t)}$ is explained as follows; $Inflation_{(t)} = f(CBFS, inflation_{(t-1)}, \text{growth in money supply}_t)$. Further from literature review, the other determinants of inflation were included. The explained variable is the rate of inflation, the explanatory variable is the financial strength of the central bank while the control variables are; broad money growth, per capita income, foreign inflation, economic openness, credit demand, commodity prices and exchange rate.

To address study objective two on the effect of CBFS on exchange rate variability in COMESA region, equation 3.16 was estimated;

$$\text{Exchange rate variability}_{it}=\alpha \text{Exchange rate variability}_{i,t-1}+\beta_1 CBFS_{it}+\beta_2 \text{Interest rate differential}_{it}+\beta_3 \text{Economic openness}_{it}+\beta_4 \text{Oil price}_{it}+\beta_5 \text{Foreign inflation}_{it}+u_{it} \quad (3.16)$$

To address study objective three on the effect of CBFS on interest rate variability in COMESA region, equation 3.17 was estimated;

$$\text{Interest rate variability}_{it} = \alpha\text{interest rate variability}_{i,t-1} + \beta_1 CBFS_{it} + \beta_2 \text{Interest rate differential}_{it} + \beta_3 \text{Credit Demand}_{it} + \beta_4 \text{Broad money growth}_{it} + \beta_5 \text{Exchange rate}_{it} + u_{it} \quad \ldots\ldots(3.17)$$

3.5. Definition and Measurement of Variables

Table 2: Definition and Measurement of Variables

Variable	Definition	Measurement
Inflation (CPI)	Persistent rise in the level of prices for goods and services in an economy over a period.	Annual percentage changes in consumer price index.
Exchange rate variability(EXT)	Tendency for foreign currencies to appreciate or depreciate in value.	Change in standard deviation of the nominal exchange rate on an annual basis.
Interest rate variability(INT)	Interest rate volatility on loans and savings over time. Movements in interest rate are affected by prevailing economic conditions.	Change in standard deviation of commercial banks annual lending rate.
Central bank financial strength	Financial ability of the central bank to meet its objectives with its own resources.	Summation of central bank capital and other items net scaled by central bank total assets which expressed in percentage.
Broad money growth	Growth in supply of money made up by currency held by non-bank public, demand deposit held with commercial banks plus time savings deposit held with commercial banks.	Annual change in broad money.
Per capita income	Average income of a country in a year. It is considered as an indicator of standard of living in a country.	Measured as ratio of countries total output in a year in US dollars to the countrys total population.
Foreign inflation	Persistent rise in general price level of goods and services in an economy over a period of time.	Average CPI for advanced (G7) countries.
Economic Openness	Economys trade intensity with other countries. It is the volume of trade between a country and the	Summation of exports and imports as a percentage of

Variable	Definition	Measurement
	rest of the world.	gross domestic product of a country i.e. (Exports + Imports)/ (Gross Domestic Product).
Interest rate differential	Variance between two currencies interest rates.	Difference between 3-months US dollar LIBOR rate and domestic lending rate.
Credit demand	Private sector need for loans from financial institutions	Domestic credit to private sector as a percentage of GDP.
Commodity price	Commodity prices especially the food prices affect inflation. Moreover, food is an essential commodity and changes in the prices has a direct effect on inflation.	Commodity price is computed based on weighted average of select commodity price indices; the prices are based on identified benchmark which are representative of the global market. It represents three broad commodity asset classes: agriculture, energy and metal. Data obtained from IMF database.
Oil price	Refers to the spot price of one barrel of the benchmark crude oil. The price depends upon its grade, location and the content of sulfur present in it.	Crude price per barrel in US dollars.

3.6 Study Area and Target Population

The study focused on countries in Common Market for Eastern and Southern Africa (COMESA) region that signed monetary union co-operation programme in 2005. The co-operation programme was aimed at establishing a regional Monetary Union by the year 2018. COMESA member countries are 19 in number and include: Burundi, Comoros, DR Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Sudan, Swaziland,

Uganda, Zambia, and Zimbabwe. The study however focused on 14 countries. Data for the following countries were either not available or were incomplete: Zimbabwe, Libya, Eritrea, Malawi and Ethiopia.

3.7 Data Type and Source

The study employed secondary data retrieved from World Bank and International Monetary Fund (IMF) databases for the period 2001-2017 for COMESA member countries. Specifically, data on inflation, broad money growth, per capita income, commodity price and credit demand were obtained from International Financial Statistics IMF database. Data on broad money growth, exchange rate, per capita income and interest rate were obtained from World Development Indicators (WDI) database. Data on oil price was obtained from United States Energy Information database World while the various data components used to compute CBFS and foreign inflation were obtained from International Financial Statistics (IFS) database. The raw data is presented in Table A1 in Appendix 1.

Data was presented in a panel format so as to cater for the cross-sectional and time series dimensions. Data is said to be panel when an economic variable includes both multiple economic units and multiple time periods, thus displaying both cross sectional variation and time series variation. Panel data sets are richer in data with greater variability and less collinearity among the variables than is typical of cross-section or time-series data and able to control for individual heterogeneity and effects of missing variables among other benefits (Hsiao, 2006).

3.8 Data Entry and Cleaning

All the data collected was entered in the data sheet and cleaning carried out appropriately. Data on all variables were collected and entered on an annual basis, descriptive statistics analysis was carried out to preview the data characteristics such as stationary.

3.9 Data Analysis

The first objective of the study was to investigate the effect of CBFS on inflation in COMESA region. To achieve this objective equation 3.15 was estimated. To determine the effect of CBFS on monetary policy outcomes in the short run, General Method of Moments (GMM) estimation technique was used. The GMM estimation technique was chosen so as to control for the possible problem of endogeneity that may arise from including lag of explained variables (Baltagi, 2008). It also provides a consistent and defined way to develop valid instruments (Baltagi, 2008). Conversely, to determine the long run effect the static random effect model was employed. According to Van Kiviet (1995) the static panel estimators are consistent and efficient for the long run effect while the GMM estimators are better for estimating short run responses.

The second objective was to determine the effect of CBFS on exchange rate variability in COMESA region. To achieve this objective, equation 3.16 was estimated where short run and long run effect were estimated using General Method of Moments and random effect estimation techniques respectively. The third objective was to investigate the effect of CBFS on interest rate variability in COMESA region. The objective was achieved by estimating equation 3.17.

3.10 Diagnostics Tests

Diagnostic tests performed on GMM estimation model include test of over-identifying restrictions and test of zero autocorrelation: The Sargan test of over-identifying restrictions tests estimation process. In a well specified model with valid moment conditions, the Sargan statistic should be asymptotically distributed with a chi-square random variable with degrees of freedom equal to the number of over-identifying restrictions. Sargan test null hypothesis states that the instruments are exogenous. The P-value for the three test conducted indicated that they were all greater than 0.05 indicating that the null hypothesis could not be rejected and implying that the models were well specified.

The second diagnostic test that was conducted is the Arellano-Bond test for zero autocorrelation which tests the absence of higher-order serial correlation in the idiosyncratic component of the error term with the null hypothesis of no sequential correlation. The test of first order serial correlation of the differenced residuals should be significantly negative while the second order test should be insignificant. The results in table 4.5, table 4.13 and table 4.19 indicated absence of higher-order serial correlation in the error term.

In determining which estimation technique between the fixed or the random effects estimates of the static model to be applied, Hausman test was carried out. The null hypothesis states that there are no systematic differences between the Fixed Effect and Random Effect estimates in which case Random Effect model is the preferred over the Fixed Effect model. However, it the null hypothesis was rejected then it implies that the fixed effect model is the preferred model. The tests conducted returned P-values of less than 0.05 therefore concluding null hypothesis could not be rejected and that the Random Effects model was the preferred model.

The study employed the static and dynamic panel estimation approach. This approach requires that the variables employed in the model are stationary. Considering the possibility of having non-stationary properties, some of the variables were adjusted to avoid spurious estimates bias. Im, Pesaran and shin, ADF Fisher chi-square and PP-Fisher chi square tests were used to test the null hypothesis to ensure that the conclusions arrived at were robust. The panel unit root tests conducted include; Levin, Lin &Chu and Im, Pesaran and Shin Test. The panel unit root test results are indicated in table 4.11.

CHAPTER FOUR
EMPIRICAL FINDINGS

4.1 Introduction

This chapter presents the findings per the study objectives. Section 4.2 presents diagnostic tests and the results relating to the first objective of investigating the effect of CBFS on inflation in COMESA region. The diagnostics tests and results relating to the second objective of determining the effect of CBFS on exchange rate variability in COMESA region is presented in section 4.3. Finally, section 4.4 presents diagnostic tests and results relating to third study objective of investigating the effect of CBFS on interest rate variability in COMESA region.

4.2 Objective one: Investigate the effect of central bank financial strength on inflation in COMESA region.

4.2.1 Descriptive statistics

This section presents and discusses measures of central tendency that is the mean and standard deviation of each study variable including the observed minimum and maximum values of variables in the first objective and results indicated in Table 4.1. Further in Table 4.2, correlation matrix in line with the study objective one was presented.

4.2.2 Measures of central tendency

This section discusses summary statistics for the following variables: inflation rate, CBFS, broad money growth, economic openness, credit demand, foreign inflation, commodity price and per capita income for the period 2001 to 2017. The measures of central tendency and dispersion of these variables were presented and discussed.

Table 4.1: Overall Summary Statistics of key study variables 2001 to 2017

Variable	Unit of Measurement	Mean	SD	Min	Max
Inflation	Percentage	8.28	6.95	(2.40)	36.96
Central Bank	Ratio	0.03	0.20	(1.40)	0.50

Variable	Unit of Measurement	Mean	SD	Min	Max
Financial Strength					
Broad Money growth	Ratio	16.77	11.44	(7.97)	81.85
Economic Openness	Ratio	0.7451	0.4469	0.1900	2.2500
Credit Demand	Ratio	34.38	32.04	0.21	135.71
Foreign Inflation	Ratio	1.54	0.65	0.28	2.85
Commodity Price	Ratio	97.41	3.41	81.01	102.58
Exchange Rate	Ratio	538.66	796.6	2.00	3611.2
Per Capita Income	US Dollars	2263.42	3348.29	112.849	15504.4

Source: International Financial Statistics, World Development Indicators Databases, 2018 and authors computations.

The results in Table 4.1 indicate that observations for each study variable were 238. This corresponds with the panel specification adopted by the study. The 14 cross sectional observations for 17 years yielded a total of 238 observations per variable. Therefore all the variables had 238 observations and none had missing observations over the study period of 17 years. This ensured the technical validity of the study findings.

The mean CBFS for the pooled data was 0.03 with the weakest and strongest central banks having CBFS measure standing at negative 1.4 and positive 0.5 respectively with a standard deviation of 0.20. Sudan, Seychelles, DR Congo and Madagascar were some of COMESA member countries recording negative CBFS while Mauritius and Comoros were some counties in COMESA region with strong CBFS. If the CBFS is negative, it implies that the respective central bank is financially weak (Stella, 2008). The CBFS statistics showed that the level of financial strength varied from one central bank to another in COMESA region. The mean of CBFS of 0.03 recorded in the study period is way below the mean of 0.21 posted by European Monetary Union over the same period indicating weak CBFS by central bank in COMESA members states.

With regards to inflation rate, the pooled data showed a mean of 8.28 per cent and a standard deviation of 6.95. The highest and lowest rate posted over the study period stood at 37 percent and

negative 2.40 percent respectively. Countries with high inflation include Sudan, Seychelles and DR Congo while those that posted low inflation rate over the study period include; Djibouti, Burundi and Comoros. The summary statistics on the rate of inflation indicate that the inflation rate recorded in COMESA region was way above the convergence criteria of 3 percent. COMESA Monetary Union Protocol primary convergence criteria for the period 2005 to 2018 set the inflation target at 3 percent (Central bank of Kenya annual report, 2018). The highest and lowest foreign inflation rates were as a result of 2007-2008 financial crisis impact. Increase in the price of imports is expected to lead to increase in domestic inflation and loss of value of the domestic currency. An inverse relationship is expected as per the CBFS theory between weak central bank finances and inflation, seigniorage revenue is an increasing function of inflation.

The mean growth for broad money in the COMESA region stood at 16.8 percent with the lowest and highest growth standing at negative 7.9 percent and 82 percent respectively. The highest broad money growth was posted in DR Congo where it was noted that CBFS was negative, implying that the countrys central bank was financially weak. The countries that posted low broad money growth include Zambia, Mauritius and Swaziland. It is expected in theory that if money supply growth is higher than real output growth it will result in inflation. Further, increase in money supply may cause depreciation of the currency.

The mean of economic openness in COMESA region stood at 0.75 with the lowest and highest ratio standing at 0.19 zero and 2.25 respectively. The country with the highest mean in economic openness was Seychelles while the one with the lowest was Sudan. Economic openness would have an effect on inflation via its positive influence on the output, which would lead to easing pressure on prices. The price of imports of goods and services affects domestic inflation, import prices transmission has been recognized in monetary policy as key factor in stabilizing prices. thus changes in rate of exchange is identified as a key determinant of the degree of pass-through.

The mean credit demand in the COMESA region stood at 34.4 with the lowest and highest growth standing at negative 0.21 and 135.71 respectively. The highest credit demand was posted in Seychelles and Djibouti. The countries that posted low credit demand include DR Congo and Swaziland. A direct relationship is expected between credit demand and inflation. Excess lending especially to private sectors may lead to rise in money supply and thus inflation. The mean foreign inflation stood at 1.54 with the lowest and highest foreign inflation standing at 2.85. The highest and lowest foreign inflation was posted in the years 2008 and 2009 respectively.

4.2.3 Correlation analysis

Correlation coefficient measures the strength and direction of linear relationship between two study variables. The larger the coefficient, the stronger the linear relationship between the variables. A correlation coefficient of one shows the variables are perfectly linearly related. On the other hand, a correlation coefficient of zero indicate that the variables are not linearly related. When the correlation coefficient between variables exceeds 0.85, then it would lead to multicollinearity problem (Gujarati, 2004). High correlation amongst variable would imply that one variable is a linear combination of the other, which could lead to difficulty in estimating the regression equation. With multicollinearity, the estimators have large variances and covariances, thus the regression coefficients would have big standard errors, implying that it would be difficult estimating coefficients accurately. Correlation between study variables in objective one of investigating the effect of CBFS on inflation in COMESA region is indicated in Table 4.2.

Table 4.2: Correlation between study variables in investigating the effect of CBFS on inflation

Variable	Inflation	CBFS	Broad Money growth	Per Capita income	Economic openness	Credit Demand	Foreign Inflation	Commodity price	Exchange rate
Inflation	1.00								
CBFS	-0.243*** (0.0001)	1.00							
Broad Money	0.2515*** (0.0006)	-0.231*** (0.0001)	1.00						

growth									
Per Capita income	-0.145 ** (0.0247)	0.1751*** (0.0068)	-0.236** * (0.0002)	1.00					
Economic openness	-0.124* (0.0549)	0.2413*** (0.0002)	-0.179*** (0.0055)	0.7780*** (0.000)	1.00				
Credit Demand	-0.116 * (0.072)	0.222*** (0.0006)	-0.267** * (0.000)	0.5831*** (0.000)	0.3333*** (0.000)	1.00			
Foreign Inflation	0.1845*** (0.0043)	0.0281 (0.6663)	0.0854 (0.1892)	-0.0462 (0.4786)	0.0148 (0.8205)	-0.031 (0.6255)	1.00		
Commodity price	0.2283*** (0.0004)	-0.0313 (0.6307)	0.1366** (0.0352)	-0.143** (0.0266)	-0.0734 (0.2596)	-0.2812 *** (0.0000)	0.1636** (0.0115)	1.00	
Exchange rate	-0.0271 (0.6772)	-0.0421 (0.5178)	0.0034 (0.9583)	-0.358*** (0.000)	-0.253*** (0.0001)	-0.35*** (0.000)	-0.065 (0.1451)	0.1451** (0.0252)	1.00

The first number in the cells are the correlation coefficients, while the second number in parenthesis are the p-values with ***, **, * denoting significance at 1 percent, 5 percent and 10 percent correspondingly.
Source: Authors computations.

Table 4.2 shows that inflation is significantly correlated with CBFS, growth in money supply, per capita income, economic openness, credit demand, foreign inflation and commodity price since the p-values are all less than 0.1. However, data for COMESA region showed that inflation and exchange rate are not correlated as demonstrated by high p-value of 0.68. Variables with high correlation include economic openness and per capita income with a correlation coefficient of 0.77 and per capita income and credit demand coming second with a correlation coefficient of 0.58. All the other variables were weakly correlated.

From Table 4.2, inflation is negatively correlated with CBFS with a negative coefficient of 0.24 which is consistent with economic theory where the variables, CBFS and inflation, are expected to be inversely related. High inflation is a tool used by monetary authorities to increase their revenues by collecting more seigniorage income. Further, a positive correlation was noted between inflation and broad money growth with a correlation coefficient of 0.25, as expected theoretically quick increase in supply of money in the economy is expected to lead to a rise in inflation. According to Milton (1963), Inflation has always been a monetary occurrence arising from quick expansion of money in a country than its output. Inflation is also positively correlated with foreign inflation with a

correlation coefficient of 0.18. Theoretically, a positive relationship is expected between domestic and foreign inflation depending on the level of economic openness of a country to the rest of the world. It was also observed that economic openness is negatively correlated with inflation.

4.2.4 Stationarity Tests

The study employed the static and dynamic panel estimation approach. This approach requires that the variables employed in the model are stationary. Considering the possibility of having non-stationary properties, some of the variables were adjusted to avoid spurious estimates bias. To ensure robust conclusions were drawn from the study the following stationary tests were conducted: Im, Pesaran and shin, Levin, Lin &Chu, PP-Fisher chi square and ADF Fisher chi-square. The two most commonly used panel unit root tests are; Levin, Lin &Chu and Im, Pesaran and Shin Test. Im, Pesaran and Shin Test is considered superior since the panel coefficient is considered heterogeneous and converges to standard normal distribution as the sample size increases. The stationarity test equation included individual intercept and trend which is the most robust option for panel data. Summary of the stationary tests are indicated Table 4.3.

Table 4.3: Stationary test results

Variable	**Levin, Lin &Chu**	**Im, Pesaran and Shin Test**	**ADF Fisher Chi-Square**	**PP Fisher Chi Square**
Inflation	(7.319) *** 0.0000	(4.050)*** 0.0001	62.546*** 0.0002	85.143*** 0.0000
Central Bank Financial Strength	(5.086) *** 0.000	(2.755)*** 0.002	51.183*** 0.004	80.934*** 0.000
Broad money growth	(10.73) *** 0.000	(8.21)*** 0.000	106.68*** 0.0000	136.85*** 0.000
Per capita income	(0.141) 0.444	1.4737 0.929	19.606 0.878	25.0592 0.6246
Per capita income (First Difference)	(7.566) *** 0.0000	(5.150)*** 0.0000	78.432*** 0.0000	122.49*** 0.0000
Economic openness	(3.289) *** 0.0001	(0.1767) 0.570	24.138 0.6742	28.670 0.4294
Economic openness (First Difference)	(12.27) *** 0.000	(8.470)*** 0.000	104.42*** 0.000	189.25*** 0.0000

Variable	Levin, Lin &Chu	Im, Pesaran and Shin Test	ADF Fisher Chi-Square	PP Fisher Chi Square
Credit demand	(1.199) 0.115	(0.761) 0.776	24.341 0.663	35.654 0.1516
Credit demand (First Difference)	(8.971) *** 0.000	(4.333)*** 0.000	6.8134*** 00000	116.73*** 0.000
Foreign Inflation	(11.19) *** 0.0000	(6.522)*** 0.000	85.70*** 0.000	94.90*** 0.0000
Commodity price	(2.591) ** 0.005	(4.085) 1.000	3.538 1.000	2.274 1.000
Commodity price (First Difference)	(12.17) *** 0.000	(7.725)*** 0.000	99.23*** 0.000	229.73*** 0.000
Inflation lag	(7.912) *** 0.000	(3.411)*** 0.000	3.636*** 0.000	4.629*** 0.0001

Key: *** significant at 1% and ** significant at 5%, numbers in parenthesis are negatives. The second number in the cells are the p-values.

Source: Authors computations

Stationary tests have a null hypothesis of presence of a unit root, thus rejecting null hypothesis implies that the series is stationary. Table 4.3 indicates that the test statistics for testing the null (presence of the unit root) against the alternative (stationary) for the various series. The test statistics with P less than 0.01 at level include: CBFS, inflation, exchange rate variability, interest rate variability, inflation lag, lag of exchange rate variability, lag of interest rate variability, broad money growth and foreign inflation at one per cent level of significance, implying rejecting the null hypothesis.

However, the test statistics with P- values exceeding 0.1 were; per capita income, interest rate differential and credit demand. This lead to accepting of the null hypothesis that the variables were not stationary at levels. The three series became stationary on differencing (first difference) as evidenced by low p-values as indicated in the table 4.5. The study therefore could safely apply the generalized method of moments (GMM) in the estimation of models without fear of spurious results.

Jarque Bera test of normality was also conducted to ascertain whether parametric or non-parametric t methods were appropriate. The test returned a P-value of 0.065 indicating non-rejection of null hypothesis showing residuals were normally distributed and therefore arriving at the conclusion that parametric tests were appropriate.

4.2.5 Hausman Test

In determining which estimation technique between the fixed or the random effects estimates of the static model was to be applied, Hausman test was conducted and results indicated the Hausman chi-statistic was 106.19 with a p-value of 0.000. Thus the chi statistic exceeded the tabulated value at five per cent level of significance. The null hypothesis of no difference between the estimates of the Random Effects model and Fixed Effects model was therefore not rejected at five per cent level of significance. The Random Effects model was thus interpreted as the long run static model.

4.2.6 Empirical Results

This section presents the regression results, their interpretation and discussions as per the studys objectives. To determine the effect of CBFS on monetary policy outcomes in the short run, General Method of Moments estimation technique was used. Conversely, to determine the long run effect the static random effect model was employed. According to Van Kiviet (1995) the static panel estimators are consistent and efficient for the long run effect while the GMM estimators are better for estimating short run responses.

The first objective of the study was to determine the effect of CBFS on inflation in COMESA member countries. To achieve this objective, an autoregressive ($AR(2)$) framework was used to estimate the effect of CBFS on inflation as indicated in model 3.15. The General Method of Moment (GMM) estimation technique suggested by Arellano and Bond (1991) was used in estimating the dynamic panel data model specification. The method was chosen so as to control for the possible problem of endogeneity that may arise from including lag of explained variables. It also provides a

consistent and defined way to develop valid instruments and solve the problem of short panel bias (Baltagi, 2008). The results are reported in Table 4.6:

Table 4.6: Effect of central bank financial strength on inflation in COMESA region

Dependent Variable: Inflation				
Independent/Control variables	**Static Random Model**		**Dynamic GMM Model**	
	Coefficient (P-value)	**T- statistic (Standard Error)**	**Coefficient (P-value)**	**T- statistic (Standard Error)**
Central bank financial strength	-6.9414** (0.019)	-2.364 (2.9363)	-5.4102** (0.034)	-2.138 (2.5305)
Broad money growth	0.1058*** (0.008)	2.677 (0.0395)	0.0446*** (0.004)	2.919 (0.0153)
Per Capita income (First difference)	-0.2263 (0.4800)	-0.708 (0.3196)	-0.0045*** (0.0002)	-3.804 (0.0012)
Economic Openness (First difference)	-0.2476 (0.949)	-0.064 (3.8688)	-0.2073 (0.426)	-0.798 (0.2598)
Credit Demand (First difference)	-0.3432*** (0.001)	-3.337 (0.1028)	-0.2073*** (0.006)	-2.784 (0.0745)
Foreign inflation	-0.2608*** (0.001)	-3.337 (0.0782)	-0.2304*** (0.003)	-3.012 (0.0765)
Commodity price (First difference)	-0.2219** (0.048)	-1.989 (0.1116)	-0.1465* (0.061)	-1.886 (0.0778)
Constant term	3.0610** (0.0266)	2.233 (1.3708)	3.5605*** (0.005)	2.845 (1.2515)
Inflation First lag			0.2905* (0.0844)	1.736 (0.1673)
Inflation Second lag			0.3112*** (0.0001)	3.988 (0.0780)
Sargan over-identifying test				$Chi^2(43)=55.33$ $P> Chi^2=0.874$
Arellano and Bond 1st order				-4.1503 (0.0034)***
Arellano and Bond 2nd 0rder				0.73689 (0.6031)

Key: P-values and standard errors are reported in parentheses with ***, **, * denoting significance at 1 percent, 5 percent and 10 percent correspondingly.

Source: Authors computations

Before interpreting the results two diagnostic tests were conducted: Test of over-identifying restrictions and test of for zero autocorrelation. The P-value of Sargan over-identifying test was greater than 0.05 indicating that the null hypothesis could not be rejected and thus arriving at a conclusion that over identifying restrictions were valid. The Sargan test provided no evidence of misspecification.

The second diagnostic test that was conducted is the Arellano-Bond test for zero autocorrelation which tests the absence of higher-order serial correlation in the idiosyncratic component of the error term with the null hypothesis of no sequential correlation. The first order serial correlation for the model was negative and significant at one per cent level of significance. The second order serial correlation for the model was insignificant indicating that they were no serial correlation.

Table 4.6 shows the static random effects and the dynamic system GMM estimates of autoregressive $AR(2)$ framework. The results on table 4.6 show that CBFS enters significantly in the two regressions. The coefficient of CBFS under the system GMM model was negative 5.4 implying an inverse relationship between CBFS and inflation. The results indicate that a one-percentage point increase in CBFS, all things constant will lead to a fall in the inflation rate by 0.054 percentage in the short run and 0.069 percentage in the long run. It is expected that greater financial strength of central banks would lead to lower level of inflation. As per expectations, empirical results point to a significant inverse relationship between CBFS and inflation.

The results are in line with those of (Adler *et al*., 2012; Berriel and Bhattarai, 2009 and Klüh and Stella 2008) arguing for an inverse relationship between CBFS and inflation outcomes. The CBFS theory asserts an inverse relationship between weak central bank finances and inflation, high inflation is a tool to generate more income to the central bank through increase in seigniorage revenues. The results also agrees with the findings of Perera *et al*. (2013) regarding the linkage between CBFS and inflation in emerging economies. From the empirical findings, COMESA member countries have every reason to be concerned about their CBFS since it has a negative effect on inflation outcomes.

The system GMM coefficients of first and second lag of inflation were 0.29 and negative 0.311 with P values of 0.084 and 0.001 correspondingly. Therefore, the coefficient of first and second lag of

inflation are important variables affecting inflation at ten per cent level of significance. The results imply that the previous two years inflation affects inflation in the current year and that first and second lags of inflation are important variables in explaining inflation at period t. The first lag and second lag of inflation contributes to 29 percent and 31 percent of period t inflation. The results agree with the monetary theory of inflation which asserts that the current inflation rate is influenced by inflationary expectations of the past period. The lag occurs because people cannot predict the future with certainty.

Regarding the effects of the other control variables, the P-values of; broad money growth, changes in credit demand, foreign inflation and changes in commodity price are all less than 0.1 indicating that they were all important variables in explaining inflation. However, the empirical results show changes in economic openness and changes in per capita income (static model) were not important in explaining inflation since their P-values exceeded 0.1.

Specifically, the results indicate positive and statistically significant relationship between inflation and broad money growth in both the static and the dynamic GMM models. Broad money coefficients in the static random effect model and the dynamic GMM model were 0.11 and 0.045 with P-values of 0.008 and 0.004 in that order. The results agree with the monetary theory of inflation which asserts that inflation has always been a monetary occurrence arising from quick expansion of money in a country than its output (Milton, 1963).

The results also indicated an insignificant relationship between change in economic openness with inflation. Change in economic openness coefficients in the static random effect model and the dynamic GMM model were both negative 0.25 and 0.21 with P values of 0.949 and 0.426 in that order. Economic openness in theory is expected to affect inflation via its positive influence on the

output, which may lessen pressure on the prices. The result does not agree with the results of (Adler *et al*., 2012 and Pinter, 2015) where economic openness was noted to significantly affect inflation, this could be attributed to the reason that countries in COMESA region are developing and thus less open to the rest of the world compared to developed countries.

The results also indicate that change in per capita income negatively affects inflation in the short run. Change in per capita income coefficients in the static random effect model and the dynamic GMM model were both negative 0.226 and 0.0045 with P-values of 0.48 and 0.0002 correspondingly. The coefficient of 0.0045 under the dynamic GMM model is significant, going by its magnitude changes in per capita income is not an important variable affecting inflation in COMESA region in the short run. Further, the results indicated that foreign inflation and inflation are inversely related. Foreign inflation coefficients in the static random effect model and the dynamic GMM model were both negative 0.26 and 0.23 with P-values of 0.001 and 0.003 in that order. Theoretically, domestic and foreign inflation is expected to be inversely related depending on the level of economic openness of a country to the rest of the world.

Changes in commodity prices coefficients in the static random effect model and the dynamic GMM model were both negative 0.222 and 0.147 with P-values of 0.048 and 0.061 in that order. Changes in prices of commodities especially the food prices affect inflation, food is an essential commodity and changes is expected to impact on inflation. Credit demand coefficients in the static random effect model and the dynamic GMM model were both negative 0.343 and 0.207 with P values of 0.001 and 0.006 in that order. The coefficient implies change in credit demand significantly affect inflation. Excess lending especially to private sector leads to increase in money supply and thus inflation.

Alternative measures for CBFS were also considered to account for reverse causality. Inflationary pressures themselves may cause financial weaknesses by leaving the central bank without any other option other than undertaking expensive stabilization operations, it is imperative therefore to account for potential reverse causality (Klüh and Stella 2008). Therefore, in order to deal with the reverse causality, lagged measure (t-1) of CBFS was considered. The use of lagged measure of CBFS recognize the fact that CBFS may not impact the economy during the same period, but also subsequent periods. The results using the alternative measure of the explanatory variable (CBFS) is as shown on table 4.7.

Table 4.7: Effect of lag of central bank financial strength on inflation.

Dependent Variable: Inflation				
Independent/Control Variables	**Static Random Effects Model**		**Dynamic GMM Model**	
	Coefficient (P-Value)	**T- statistic (Standard Error)**	**Coefficient (P-Value)**	**T- statistic (Standard Error)**
Central Bank Financial Strength (t-1)	-3.7421** (0.0151)	-2.450 (1.5274)	-8.0671* (0.0686)	-1.833 (4.4010)
Broad money growth	0.0411** (0.0251)	2.256 (0.018)	0.0366* (0.078)	1.773 (0.0206)
Per Capita income (First difference)	-0.0017** (0.2802)	-1.083 (0.0016)	-0.0043 (0.2455)	-1.165 (0.0037)
Economic Openness (First difference)	-0.4751 (0.6380)	-0.471 (1.0087)	-9.0181 (0.1466)	-1.458 (6.1853)
Credit Demand (First difference)	-0.0032* (0.0604)	-1.888 (0.0017)	-0.0124* (0.0952)	-1.678 (0.0074)
Foreign inflation	-0.8778* (0.1008)	-1.648 (0.5326)	-0.2104 (0.8206)	-0.227 (0.9269)
Commodity price (First difference)	-0.7209* (0.0514)	-1.959 (0.3680)	-0.1121** (0.048)	-1.992 (0.0563)
Inflation (t-1)			0.2538 (0.1162)	1.579 (0.1607)
Inflation (t-2)			0.1781*** (0.0079)	2.689 (0.0662)

Key: P-values and standard errors are reported in parentheses with ***, **,*, denoting significance at 1 percent, 5 percent and 10 percent in that order.

Source: Authors computations

The empirical results indicate that the variable of interest, that is, lag of CBFS is negative and significant in the two regressions. The other results are not so different from the one reported in table 4.6 in terms of direction and significance of various control variables.

The coefficient of lag of CBFS under the system GMM model was negative 8.1, which implies an inverse relationship between CBFS and inflation. A one percentage point increase in the measure of lag of CBFS, all things constant will lead to a fall in the inflation rate by 0.081 percentage in the short run and 0.0374 percentage in the long run. As per expectations, empirical results show that inflation and lag of CBFS are significantly and inversely related.

The results are in line with those of Klüh and Stella (2008) arguing for a negative relationship between CBFS and outcomes of inflation. The CBFS theory asserts a negative relationship between weak central bank finances and inflation, high inflation is a tool used by monetary authorities to increase their revenues by collecting more seigniorage income. It also agrees with the results of Perera *et al*. (2013) regarding the linkage between CBFS and inflation in emerging economies. Arising from the empirical findings, COMESA member countries should be concerned about their CBFS as it affects inflation outcomes.

The system GMM coefficients of the first and second lag of inflation were 0.25 and negative 0.178 with P-values of 0.116 and 0.008 in that order. The results show that the coefficient of the second lag of inflation was significantly different from zero at ten per cent level of significance. The results imply that the previous two years inflation affects inflation in period t. The results agree with the monetary theory of inflation, which asserts that the current period inflation rate is influenced by inflationary expectations of the past periods. The lag occurs because people cannot predict the future with certainty.

Regarding the effects of the other control variables, the P-values of broad money growth, change in per capita income, change in credit demand and change in commodity prices were less than 0.1 indicating that they were all significant in explaining the inflation. However, P-values of changes in economic openness and foreign inflation were greater than 0.1 indicating that were not important in explaining inflation rate. Specifically, the results indicate positive and statistically significant relationship between inflation and broad money growth in the two models. Broad money coefficients in the static random effect model and the dynamic GMM model were 0.0411 and 0.0366 with P-values of 0.025 and 0.078 correspondingly. The results agree with the monetary theory of inflation which asserts that inflation has always been a monetary occurrence arising from quick expansion of money in a country than its output (Milton, 1963).

The results also showed an insignificant relationship between change in economic openness with inflation. Economic openness coefficients in the static random effect model and the dynamic GMM model were negative 0.475 and 9.018 with P-values of 0.638 and 0.1466 in that order. Economic openness in theory is expected to affect inflation via its influence on the countrys output, which is likely to ease the pressure on the prices. The results also indicate that change in per capita income negatively affects inflation in the short run. Change in per capita income coefficients in the static random effect model and the dynamic GMM model were negative 0.0017 and 0.0043 with P-values of 0.28 and 0.245 correspondingly, implying the variable was not significant in explaining inflation.

Further, the results indicated that foreign inflation and inflation were inversely related under the static random effect model. Foreign inflation coefficients in the static random effect model and the dynamic GMM model were negative 0.878 and 0.21 with P values of 0.101 and 0.821 in that order. Theoretically, an inverse relationship is expected between domestic and foreign inflation depending on the level of economic openness a country to the world. Changes in commodity prices coefficients in the static random effect model and the dynamic GMM model were negative 0.721 and 0.112 with

P-values of 0.0514 and 0.048 in that order. The coefficient implies that change in commodity price are important determinants of inflation in COMESA region. Price of commodities especially the food prices affect inflation, food is an essential commodity and changes in the prices has an impact on inflation.

As a further robustness check, the study considered an alternative measure of inflation that is, inflation=(inflation/(1+inflation). The use of actual inflation rates may lead to heteroscedastic error terms due to the existence of hyperinflationary outliers. Hence, previous empirical research introduced a rescaled measure of inflation ranging from 0 to 1. It is interpreted as the rate of decline in consumer purchasing power (Cukierman et al 1992; Klüh and Stella 2008; Chrigui et al 2011). Models 3.15 was re-estimated for transformed new measure of inflation rate. However, no significant difference was observed between results for actual inflation rate and the transformed inflation rate hence, further analysis was based on actual inflation rates.

Table 4.8: Effect of central bank financial strength on rate of change of inflation.

Dependent Variable: Change of inflation			
Independent/ Control Variables	**Coefficient**	**Probability**	**t- statistic (Standard Error)**
Central Bank Financial Strength	-5.014**	0.04074	-2.060 (0.0243)
Broad money growth	0.079**	0.0164	2.421 (0.0326)
Credit demand First Difference	-0.0262**	0.0138	-2.485 (0.0105)
Economic openness First Difference	-1.5147	0.5821	-0.551 (2.7490)
Commodity price First Difference	-0.1562*	0.073	-0.0365 (4.2795)
Foreign Inflation	0.0278***	0.0103	2.594 (0.0107)
Per Capita income First Difference	-0.0007	0.1502	-1.445 (0.0005)

Key: Standard errors are reported in parentheses with ***, **,*, denoting significance at 1 percent, 5 percent and 10 percent in that order.

Source: Authors computations

Although it is possible for the relationship between CBFS and inflation to be examined using a set of other explanatory variables, an array of variables were not utilized in empirical models in order to minimize potential endogeniety problem and also to keep models less complex.

The empirical results in table 4.8 indicates that the variable of interest, that is, the CBFS is negative and significant in the regression equation. The coefficient of CBFS was negative 5.0 implying an inverse relationship between CBFS and adjusted rate of inflation. As per expectations, empirical results point to a significant inverse relationship between CBFS and adjusted rate of inflation.

Regarding the effects of the other control variables, the P-values of broad money growth, change in credit demand and foreign inflation were less than 0.1 indicating that they were all significant in explaining adjusted inflation rate. However, P-values of changes in economic openness and change in per capita income were greater than 0.1 indicating that they were not important in explaining adjusted inflation rate. Specifically, the results indicate positive and statistically significant relationship between adjusted inflation rate and broad money growth. Broad money coefficient was 0.079 with P-value of 0.0164.

The results further indicated an insignificant relationship between change in economic openness with adjusted inflation rate. Economic openness coefficient in the model was negative 1.5 with P-value of 0.58. The results also indicate that per capita income does not affect adjusted rate of inflation. Change in per capita income coefficients in the model was negative 0.0007 with P-values of 0.15, implying the variable was not significant in explaining adjusted inflation. Further, the results indicated that foreign inflation and adjusted inflation were positively related with Foreign inflation coefficient of 0.028 and P value of 0.01. Theoretically, a direct relationship is expected between domestic and foreign inflation depending on the level of economic openness a country to the world.

Changes in commodity prices coefficients in the regression model was negative 0.1562 with a P-value of 0.073. The coefficient implies that change in commodity price is important determinant of adjusted inflation in COMESA region. Price of commodities especially the food prices affect inflation, food is an essential commodity and changes in the prices has an impact on inflation.

The empirical results indicate that the variable of interest, that is, the square of CBFS was negative and not significant signifying that a decline in the CBFS has no additional effect on inflation when CBFS is already low.

4.3 Objective two: Determine the effect of central bank financial strength on exchange rate variability in COMESA region.

4.3.1 Descriptive statistics

This section presents and discusses the measures of central tendency that is the mean and standard deviation of each study variable including the observed minimum and maximum values of those variables and results indicated in Table 4.9. Further in Table 4.10, correlation matrix for each of the three equations in line with the study objectives is presented.

4.3.2 Measures of central tendency

This section discusses summary statistics for CBFS, inflation rate, exchange rate variability, broad money growth, economic openness and finally the interest rate variability for the period 2001 to 2017. The measures of central tendency and dispersion of these variables were presented and discussed.

Table 4.9: Overall Summary Statistics of key study variables 2001 to 2017

Variable	Unit of Measurement	Mean	SD	Min	Max
Exchange rate Variability	Ratio	27.59	62.48	0.00	453.15

Variable	Unit of Measurement	Mean	SD	Min	Max
Central Bank Financial Strength	Ratio	0.03	0.20	(1.40)	0.50
Economic openness	Ratio	0.7451	0.4469	0.1900	2.2500
Foreign Inflation	Ratio	1.54	0.65	0.28	2.85
Oil price	Us Dollars	59.68	25.89	21.84	95.99
Interest rate differential	Ratio	14.485	11.46	0.00	63.84

The results in Table 4.9 indicate that observations for each study variable were 238. This corresponds with the panel specification adopted by the study. The 14 cross sectional observations for 17 years yielded a total of 238 observations per variable. The fact that all variables had 238 observations means that none of the variables had missing observations over the study period of 17 years. This ensured the technical validity of the study findings.

Exchange rate variability as measured by standard deviation stood at 27.59 with the highest and lowest variability of 453.15 and zero respectively. The lowest exchange rate variability was posted in Djibouti, the country has adopted a fixed exchange rate to the US dollar. The countries with high exchange rate variability include Madagascar, Uganda and DR Congo. In general, the mean exchange rate variability in COMESA region of 27.59 over the study period was way above mean of 1.3 posted by European Monetary union over the same period. This is per the data posted in the International Financial Statistics database. An inverse relationship is expected between exchange rate variability and central bank financial position. Central banks engage in foreign exchange operations with a view to stabilise the exchange rate.

The mean CBFS for the pooled data was 0.03 with the weakest and strongest central banks having CBFS measure standing at negative 1.4 and positive 0.5 respectively with a standard deviation of 0.20. Sudan, Seychelles, DR Congo and Madagascar were some of COMESA member countries with negative CBFS while Mauritius and Comoros were some counties in COMESA region with

strong CBFS. If the CBFS is negative, it implies that the respective central bank is financially weak (Stella, 2008). The CBFS statistics showed that the level of financial strength varied from one central bank to another in the COMESA region.

Regarding the mean of economic openness in COMESA region stood at 0.75 with the lowest and highest ratio standing at 0.19 zero and 2.25 respectively. The country with the highest mean in economic openness was Seychelles while the one with the lowest was Sudan. Economic openness is expected to affect inflation via its influence on the output, which is likely to lessen the pressure on the prices.

The mean foreign inflation stood at 1.54 with the lowest and highest foreign inflation standing at 2.85. The highest and lowest foreign inflation was posted in the years 2008 and 2009 in that order. The highest and lowest foreign inflation rates were due to the effects of the 2007-2008 financial crisis. Rise of the import price of imports is expected to result to rise in domestic inflation and depreciation of the domestic currency.

4.3.3 Correlation of analysis

High correlation amongst variable could imply that one variable is a linear combination of the other, which could lead to difficulty in estimating the regression equation. Table 4.10 shows correlation between study variables on exchange rate variability.

Table 4.10: Correlation matrix for variables in determining the effect of CBFS on exchange rate variability

Variable	Exchange rate variability	CBFS	Interest Rate Differential	Lag of exchange rate variability	Economic openness	Foreign Inflation	Oil price
Exchange rate variability	1.00						
Central bank financial strength	-0.0135* (0.0541)	1.00					
Interest Rate Differential	0.4288*** (0.0000)	0.078 (0.2307)	1.00				

Lag of exchange rate variability	0.4489*** (0.0000)	0.4488*** (0.0000)	0.4498*** (0.0000)	1.00			
Economic openness	0.1272** (0.0499)	0.2413*** (0.0002)	-0.03* (0.0643)	-0.1396** (0.0313)	1.00		
Foreign Inflation	0.1179* (0.0695)	0.0281 (0.6663)	-0.0801 (0.2185)	-0.0384 (0.556)	0.0148 (0.8205)	1.00	
Oil price	0.0758** (0.0442)	0.0495 (0.447)	0.0103 (0.8741)	-0.0595 (0.3608)	0.0863 (0.1843)	0.3675*** (0.0000)	1.00

The first number in the cells are the correlation coefficients, while the second number in parenthesis are the p-values with ***, **, * denoting significance at 1 percent, 5 percent and 10 percent correspondingly.
Source: Authors computations.

Table 4.10 indicates that exchange rate variability is significantly correlated with CBFS, lag of exchange rate variability, interest rate differential, economic openness and foreign inflation since the p-values are all less than 0.1. The data for COMESA region indicate that exchange rate variability and oil price are correlated as demonstrated by p-value of 0.04. A direct relationship is expected between oil price and exchange rate especially for developing countries where oil is one of the key imports, movement in oil price is expected to have an impact on exchange rate. All the variables were weakly correlated with none having a correlation coefficient of less than 0.5. High correlation amongst variable could imply that one variable is a linear combination of the other, which could pose challenge in estimating the regression equation.

Table 4.10 above shows that exchange rate variability was negatively correlated with CBFS with a negative coefficient of 0.13 as well as priori signs were observed as per theory. The correlation results were consistent with the fact that central banks in emerging and third world countries engage in foreign exchange operations with a view to stabilise exchange rate. Further, when the central banks financial position is strong, central banks can effectively offer intervention in foreign exchange markets to stabilize exchange rates and absorb resultant losses.

Further, a positive relationship is observed between exchange rate variability and its lag, reinforcing the choice of the econometric methodology adopted. General Method of Moment was used to avoid

endogeniety problem as a result of having lag of dependent variable as one of the predictor variables. A positive correlation was also noted between exchange rate variability and interest rate differential with a coefficient of 0.43. Theoretically differentials in changes of real interest rate tend to move the exchange rate, especially if unanticipated. A positive correlation was also noted between exchange rate variability and economic openness with a correlation coefficient of 0.13. Increase in the price of imports is expected to lead to depreciation of the domestic currency.

4.3.4 Stationarity Tests

The study employed the static and dynamic panel estimation approach. This approach requires stationarity of the variables employed in the model. Considering the possibility of having non-stationary properties, some of the variables were adjusted to avoid spurious estimates bias. Im, Pesaran and shin, ADF Fisher chi-square and PP-Fisher chi square tests were used to test the null hypothesis. This was to make sure conclusions reached were robust. The two most commonly used panel unit root tests are; Levin, Lin &Chu and Im, Pesaran and Shin Test. Im, Pesaran and Shin Test is considered superior since the panel coefficient is considered heterogeneous and converges to standard normal distribution as the sample size increases. The stationarity test equation included individual intercept and trend which is the most robust option for panel data. Summary of the stationary tests are as indicated Table 4.11.

Table 4.11: Stationarity Test Results

Variable	**Levin, Lin &Chu**	**Im, Pesaran and Shin Test**	**ADF Fisher Chi-Square**	**PP Fisher Chi Square**
Exchange rate variability	(6.176) *** 0.000	(4.966) *** 0.0000	4.6413 *** 0.000	4.726*** 0000
Central Bank Financial Strength	(5.086) *** 0.000	(2.755) *** 0.002	51.183*** 0.004	80.934*** 0.000
Foreign Inflation	(11.19) *** 0.0000	(6.522) *** 0.000	85.70*** 0.000	94.90*** 0.0000
Economic openness	(3.289) **	(0.1767)	24.138	28.670

Variable	Levin, Lin &Chu	Im, Pesaran and Shin Test	ADF Fisher Chi-Square	PP Fisher Chi Square
	0.0001	0.570	0.6742	0.4294
Economic openness	(12.27) ***	(8.470) ***	104.42***	189.25***
(First Difference)	0.000	0.000	0.000	0.0000
Interest rate differential	1.855	2.311	9.4234	12.306
	0.9682	0.9896	0.998	0.9893
Interest rate differential	(4.715) ***	(2.732) ***	44.075***	53.118***
(First Difference)	0.000	0.003	0.0031	0.0001
Oil price	(2.601) **	(3.647)	4.297	3.490
	0.005	1.000	1.000	1.000
Oil price	(13.35) ***	(8.349) ***	106.45***	257.89***
(First Difference)	0.000	0.000	0.000	0.000
Exchange rate variability lag	(6.211) ***	(4.258) ***	68.576 ***	99.282 ***
	0000	0.000	0.000	0.000

Key: *** significant at 1 percent and ** significant at 5 percent, numbers in parenthesis are negatives .The second number in the cells are the p-values.

Source: Authors computations

Table 4.11 indicates that the test statistics for testing the null against the alternative for the various series. The test statistics with P less than 0.01 at level include: CBFS, exchange rate variability, lag of exchange rate variability and foreign inflation at one per cent level of significance, implying rejecting the null hypothesis.

However, the test statistics with P-values greater than 0.1 was the interest rate differential accepting the null hypothesis that the variables were not stationary at levels. The three series became stationary on differencing (first difference) as evidenced by low p values as indicated in the table 4.11. Therefore, the study could safely apply the generalized method of moments (GMM) in the estimation of models without fear of spurious results. Jarque Bera test of normality was also conducted to ascertain whether parametric or non-parametric t methods were appropriate. The test returned a p-Value of 0.072 indicating non-rejection of null hypothesis showing residuals were normally distributed and therefore arriving at the conclusion that parametric tests were appropriate.

4.3.5 Hausman Test

In determining which estimation technique between the fixed or the random effects estimates of the static model was to be applied, Hausman test was carried out and results presented indicated that the Hausman chi-statistic was 83.39 with a p-value of 0.000. The null hypothesis was therefore not rejected at five per cent level of significance. The Random Effects model was thus interpreted as the long run static model.

4.3.7 Empirical Results

This section presents the regression results, their interpretation and discussions as per the studys objectives. To determine the effect of CBFS on monetary policy outcomes in the short run, General Method of Moments estimation technique was used. Conversely, to determine the long run effect the static random effect model was employed. According to Van Kiviet (1995) the static panel estimators are consistent and efficient for estimating long run effects while the GMM estimators are better for estimating short run responses.

The second objective of the study of determining the effect of CBFS on exchange rate variability in COMESA member countries. To achieve the stated objective, an autoregressive $AR(1)$ framework which was determined empirically was estimated as indicated in model 3.16. The results are indicated in Table 4.14.

Table 4.14: Effect of Central Bank Financial Strength on exchange rate variability.

Dependent Variable: Exchange rate variability				
Independent/ Control Variables	**Random Effects Model**		**Dynamic GMM Model**	
	Coefficient (P-Value)	**T- statistic (Standard Error)**	**Coefficient (P-Value)**	**T- statistic (Standard Error)**
Central Bank Financial Strength	-0.06829 (0.222)	-1.225 (0.0557)	-0.0764 (0.601)	-0.524 (0.1458)
Interest Rate Differential (First Difference)	0.5433** (0.0249)	2.259 (0.2405)	0.4263* (0.0519)	1.958 (0.2177)

Dependent Variable: Exchange rate variability				
Independent/ Control Variables	**Random Effects Model**		**Dynamic GMM Model**	
	Coefficient (P-Value)	**T- statistic (Standard Error)**	**Coefficient (P-Value)**	**T- statistic (Standard Error)**
Foreign Inflation	0.8443** (0.0191)	2.362 (0.3575)	0.6694*** (0.001)	3.350 (0.1998)
Economic Openness First Difference	0.9606** (0.0134)	2.494 (0.3852)	0.0411 (0.157)	1.422 (0.0289)
Oil Price First Difference	0.7943** (0.022)	2.307 (0.3443)	0.0492* (0.096)	1.674 (0.0294)
Constant	3.5482 (0.2502)	1.153 (17.8215)	10.03** (0.047)	2.001 (5.0125)
Exchange rate variability (t-1)			0.1740** (0.014)	2.484 (0.0700)
Sargan over-identifying test				$Chi^2(43)=37.356$ P> 0.7321
Arellano and Bond 1st order				-3.2543 (0.0067)***
Arellano and Bond 2nd 0rder				0.8342(0.4587)

Key: P-values and standard errors are reported in parentheses with ***, **,* denoting significance at 1 percent, 5 percent and 10 percent correspondingly.
Source: Authors computations

Before interpreting the results two diagnostic tests were conducted: Test of over-identifying restrictions and test of for zero autocorrelation. The P-value of Sargan over-identifying test was greater than 0.05 indicating that the null hypothesis could not be rejected and thus arriving at a conclusion that over identifying restrictions were valid. The Sargan test provided no evidence of misspecification.

The second diagnostic test conducted is the Arellano-Bond test for zero autocorrelation which tests the absence of higher-order serial correlation in the error term. The first order serial correlation for the model was negative and significant at one per cent level of significance. The second order serial correlation for the model was insignificant indicating that they were no serial correlation.

Table 4.14 shows the static random effects and the dynamic system GMM estimates of $AR(1)$ as determined empirically on exchange rate variability model. Focusing on CBFS the results on Table 4.14 indicates that CBFS is not statistically significant in the two regressions. CBFS coefficients in the static random effect model and the dynamic GMM model were both negative 0.068 and 0.076 with P-values of 0.22 and 0.601 in that order. The results imply that exchange rate variability in COMESA region cannot be explained using the central bank financial position.

The results are in line with those of Perera (2013) where no significant relationship was noted between CBFS and exchange rate variability. The outcomes contradict theory, exchange rate variability and central bank financial position are expected to be inversely related. Central banks engage in foreign exchange operations with a view to stabilise the exchange rate. Greater CBFS is expected to lead to lower exchange rate variability. Further, when the financial position is strong, central bank intervention in foreign exchange markets would stabilize exchange rates and absorb resultant losses.

The reason for the unexpected results could be due to some countries in the COMESA region for instance Djibouti and Burundi were either on fixed exchange rate regime or pegged floating rate making monetary policy ineffective or impotent to affect exchange rate. Further central banks in developing and emerging economies sometimes take actions to either raise or lower the exchange rate leading to the semi-regular regime referred to as managed or dirty float (Mihaljek , 2005). Some Central banks in COMESA region are under dirty float regime, which may have contributed to the un-expected results.

The results also indicate positive and statistically significant relationship between exchange rate variability and its lag. The lag of exchange rate variability coefficients in the dynamic GMM model was 0.17 with a P-value of 0.014. The results imply that the previous one year exchange rate variability affects variability in exchange rate in the current year. The results further indicates that exchange rate variability and the interest rate differential are positively related. Coefficients of

interest rate differential in the static random effect model and the dynamic GMM model were 0.54 and 0.43 with P-values of 0.0249 and 0.052 in that order. A higher interest rate. differential between domestic currency and the foreign currency is expected to attract and increase demand for domestic currency hence leading to exchange rate appreciation. Higher interest rates is expected to attract foreign investment which would lead to a rise in the demand and value of the currency of the home country.

Coefficients of changes in oil prices in the static random effect model and the dynamic GMM model were 0.7943 and 0.049 with P-values of 0.022 and 0.096 respectively implying exchange rate variability and changes in oil price were directly and significantly related. The empirical results agree with those of Perera (2013) where changes in oil prices were noted to affect exchange rate variability. A direct relationship is expected between oil price and exchange rate. Exchange rate variability and foreign inflation were also noted to be directly and positively related. Coefficients of foreign inflation in the static random effect model and the dynamic GMM model were 0.8443 and 0.669 with P-values of 0.02 and 0.001 respectively. Rise in the price of imports is expected to result to a rise in domestic inflation and depreciation of the domestic currency.

Further, positive relationship was noted between the change of economic openness and exchange rate variability. Coefficients of the change in economic openness in the static random effect model and the dynamic GMM model were 0.96 and 0.041 with P-values of 0.0134 and 0.157 in that order. However, the coefficient under the system GMM model was not significant implying lack of relationship between change in economic openness and exchange rate variability in the short run in COMESA region. Volatility in exchange rates is acknowledged as a key determinant of inflation due to the high degree of pass-through of foreign inflation to domestic inflation.

Alternative measure of CBFS was also considered to account for reverse causality. In order to deal with the reverse causality, lagged measure (t-1) of CBFS was considered. The use of lagged measures recognizes the fact that CBFS may not impact the monetary policy outcomes in the same

period, but also in the subsequent periods. The results using the alternative measure of CBFS is as shown in table 4.15.

Table 4.15: Effect of the lag of Central Bank Financial Strength on exchange rate variability.

Dependent Variable: Exchange rate variability				
Independent/ Control Variables	**Random Effects Model**		**Dynamic GMM Model**	
	Coefficient (P-Value)	**T- statistic (Standard Error)**	**Coefficient (P-Value)**	**T- statistic (Standard Error)**
Central Bank Financial Strength (t-1)	-0.19122 (0.6649)	-0.434 (0.4406)	-0.7209 (0.6100)	-0.511 (1.4108)
Interest Rate Differential (First Difference)	0.4152** (0.0184)	2.381 (0.1744)	0.3390** (0.0150)	2.458 (0.3007)
Foreign Inflation	0.6450** (0.0214)	2.323 (0.2778)	0.4140** (0.0459)	2.011 (0.2059)
Economic Openness (First Difference)	0.4232 (0.1588)	1.415 (0.2991)	0.1228** (0.0473)	1.998 (0.0615)
Oil price First Difference	0.8123** (0.035)	2.126 (0.3821)	0.0712** (0.053)	1.949 (0.0365)
Exchange rate variability (t-1)			0.1154*** (0.0001)	3.987 (0.0289)

Key: P-values and standard errors are reported in parentheses with ***, ** denoting significance at 1 percent and 5 percent correspondingly

Source: Authors computations.

Using the alternative measure of CBFS that is the lag of CBFS, the results of both the static random effect model and the dynamic GMM models were not significantly different in terms of the relationship between the lag of CBFS and the explanatory and control variables. Regarding the System GMM model, the variable of interest CBFS, was not significant. The results imply that CBFS does not affect exchange rate variability in COMESA member countries both in the long run and in the short run.

The results further indicate positive and statistically significant relationship between exchange rate variability and its lag. The lag of exchange rate variability coefficients in the dynamic GMM model

was 0.115 with a P-value of 0.00. The results further show that the lag of CBFS and that of interest rate differential are directly related. Coefficients of interest rate differential in the static random effect model, and the dynamic GMM model were 0.415 and 0.739 with P-values of 0.0184 and 0.015 in that order. A higher interest rate differential between domestic currency and the foreign currency is expected to attract and increase demand for domestic currency hence leading to exchange rate appreciation. Higher interest rates is expected to attract foreign investment thus increasing the demand for and value of the currency home country.

4.4 Objective 3: Investigate the effect of central bank financial strength on interest rate variability in COMESA region.

4.4.1 Descriptive statistics

This section presents and discusses the measures of central tendency that is the mean and standard deviation of each variable including the observed minimum and maximum values of those variables and results indicated in Table 4.16. Further in Table 4.17, correlation matrix for each of the three equations in line with the study objectives were also presented.

4.4.2 Measures of central tendency

This section discusses summary statistics for CBFS, inflation rate, exchange rate variability, broad money growth, economic openness and finally the interest rate variability for the period 2001 to 2017. The measures of central tendency and dispersion of these variables were presented and discussed.

Table 4.16: Overall Summary Statistics of key study variables 2001 to 2017

Variable	Unit of Measurement	Mean	SD	Min	Max
Interest rate variability	Ratio	1.26	2.95	0.00	35.65
Central Bank Financial Strength	Ratio	0.03	0.20	(1.40)	0.50
Foreign Inflation	Ratio	1.54	0.65	0.28	2.85
Oil price	Us Dollars	59.68	25.89	21.84	95.99
Exchange Rate	Ratio	538.66	796.6	2.00	3611.2

Table 4.16 shows that the pooled observations for each study variable were 238. This corresponds with the panel specification adopted by the study. The 14 cross sectional observations for 17 years yielded a total of 238 observations per variable. The fact that all variables had 238 observations means that none of the variables had missing observations over the study period of 17 years. This ensured technical validity of the study findings.

The mean interest rate variability posted for COMESA region stood at 1.26, with the lowest and highest variability standing at zero and 35.65 respectively. Zero interest rate variability was posted in Sudan where interest rate is regulated by the central bank. The highest variability was posted in DR Congo where there is less development of the financial sector and has also been facing political instability. An inverse relationship is expected between interest rate volatility and CBFS. A financially weak central bank may opt not to raise bank rate so as to increase money issuance to generate seigniorage revenues to boost its financial position.

The mean CBFS for the pooled data was 0.03 with the weakest and strongest central banks having CBFS measure standing at negative 1.4 and positive 0.5 respectively with a standard deviation of 0.20. Sudan, Seychelles, DR Congo and Madagascar were some of COMESA member countries with negative CBFS while Mauritius and Comoros were some counties in COMESA region with strong CBFS. If the CBFS is negative, it implies that the respective central bank is financially weak

(Stella, 2008). The CBFS statistics showed that the level of financial strength varied from one central bank to another in the COMESA region.

Regarding the mean of economic openness in COMESA region stood at 0.75 with the lowest and highest ratio standing at 0.19 and 2.25 respectively. The country with the highest mean in economic openness was Seychelles while the one with the lowest was Sudan.

4.4.3 Correlation of analysis

Correlation coefficient measures the strength and direction of linear relationship between two variables. The larger the coefficient, the stronger the linear relationship between the variables. Table 4.16 shows correlation between study variables on exchange rate variability.

Table 4.16: Correlation matrix for key variables in investigating the effect of CBFS on interest rate variability

Variable	Interest Rate Variability	CBFS	Interest Rate Differential	Lag of Interest Variability	Credit Demand	Broad Money Growth	Exchange Rate
Interest Rate Variability	1.00						
Central bank financial strength	-0.104* (0.0951)	1.00					
Interest Rate Differential	0.4699*** (0.000)	0.7800 (0.2307)	1.00				
Lag of Interest Rate variability	0.2581*** (0.0001)	-0.110* (0.0910)	0.3869*** (0.0000)	1.00			
Credit Demand	-0.124* (0.0567)	0.221*** (0.0006)	-0.163** (0.0119)	-0.1143** (0.0272)	1.00		
Broad Money Growth	0.2393*** (0.0002)	-0.231*** (0.0003)	0.0505 (0.4380)	0.0655 (0.3147)	-0.268*** (0.000)	1.00	
Exchange rate	0.669 (0.3043)	-0.0421 (0.5178)	0.5808*** (0.0000)	0.703 (0.2800)	-0.357*** (0.000)	0.0034 (0.9583)	1.00

The first number in the cells are the correlation coefficients, while the second number in parenthesis are the p-values with ***, **, * denoting significance at 1 percent, 5 percent and 10 percent correspondingly.

Source: Authors computations

Table 4.16 indicates that interest rate variability is significantly correlated with CBFS, interest rate differential, interest rate variability lag, growth in money supply and credit demand since the p-values are all less than 0.1. However, data for COMESA region indicate that interest rate variability and exchange rate were not correlated as demonstrated by high p-value of 0.3. A rise in the interest paid on the local currency will result to the currency to appreciate against foreign currencies. Variables with high correlation coefficient include interest rate differential and exchange rate with correlation coefficient of 0.58. All the other variables were weakly correlated with a correlation coefficient of less than 0.5. High correlation amongst variable could imply that one variable is a linear combination of the other which could lead to difficulty in estimating the regression equation.

The correlation matrix in Table 4.16 shows that interest rate variability is negatively correlated with CBFS with a negative correlation coefficient of 0.104**.** Theoretically, CBFS and interest rate variability are expected to be negatively related. A financially weak central bank may opt not to raise bank rate so as to increase money issuance to generate seigniorage revenues to boost its financial position. Mopping up surplus liquidity in the banking system through increase in interest rate can be an expensive undertaking and a weak central bank may opt not to intervene thus compromising on the desired monetary policy outcomes.

Table 4.4 further shows a positive correlation between interest rate variability and broad money growth with a correlation coefficient of 0.24, as expected theoretically. The theory of interest rate as advanced by Keynes argues that changes in money supply affect aggregate demand via changes in interest rates. Further, a positive relationship is observed between interest rate variability and its lag, reinforcing the choice of the econometric methodology adopted. General Method of Moment is used to avoid endogeniety problem as a result of having lag of dependent variables as one of the predictor variables.

4.4.4 Stationarity Tests

The study employed the static and dynamic panel estimation approach. This approach requires that the variables employed in the model are stationary. Considering the possibility of having non-stationary properties, some of the variables were adjusted to avoid spurious estimates bias.. The two most commonly used panel unit root tests are; Levin, Lin &Chu and Im, Pesaran and Shin Test. Im, Pesaran and Shin Test is considered superior since the panel coefficient is considered heterogeneous and converges to standard normal distribution as the sample size increases. The stationarity test equation included individual intercept and trend which is the most robust option for panel data. The results of the stationary tests indicated in Table 4.17.

Table 4.17: Stationarity Test Results

Variable	**Levin, Lin &Chu**	**Im, Pesaran and Shin Test**	**ADF Fisher Chi-Square**	**PP Fisher Chi Square**
Interest rate variability	(5.836) *** 0.000	(2.9536) *** 0.000	64.21*** 0.000	109.78*** 0.000
Central Bank Financial Strength	(5.086) *** 0.000	(2.755) *** 0.002	51.183*** 0.004	80.934*** 0.000
Broad money growth	(10.73) *** 0.000	(8.21) *** 0.000	106.68*** 0.0000	136.85*** 0.000
Foreign Inflation	(11.19) *** 0.0000	(6.522) *** 0.000	85.70*** 0.000	94.90*** 0.0000
Economic openness	(3.289) *** 0.0001	(0.1767) 0.570	24.138 0.6742	28.670 0.4294
Economic openness (First Difference)	(12.27) *** 0.000	(8.470) *** 0.000	104.42*** 0.000	189.25*** 0.0000
Interest rate differential	1.855 0.9682	2.311 0.9896	9.4234 0.998	12.306 0.9893
Interest rate differential (First Difference)	(4.715) *** 0.000	(2.732) *** 0.003	44.075*** 0.0031	53.118*** 0.0001
Credit demand	(1.199) 0.115	(0.761) 0.776	24.341 0.663	35.654 0.1516
Credit demand (First Difference)	(8.971) *** 0.000	(4.333) *** 0.000	6.8134*** 00000	116.73*** 0.000
Exchange rate	0.208	4.177	8.998	16.457

Variable	Levin, Lin &Chu	Im, Pesaran and Shin Test	ADF Fisher Chi-Square	PP Fisher Chi Square
	0.5823	1.000	0.999	0.9246
Exchange rate (First Difference)	(4.749) *** 0.0000	(3.199)*** 0.0001	61.709*** 0.0001	92.017*** 0.000
Interest rate variability lag	(8.316) *** 0.000	(6.479) *** 0.000	79.33*** 0.000	94.9*** 0.0000

Key: *** significant at 1 percent and ** significant at 5 percent, numbers in parenthesis are negatives.
The second number in the cells are the p-values.
Source: Authors computations

The test statistics with P less than 0.01 at level include: CBFS, exchange rate variability, interest rate variability, lag of interest rate variability and broad money growth at one per cent level of significance, implying rejecting the null hypothesis.

However, the test statistics with P-values greater than 0.1 were; interest rate differential and credit demand. This lead to accepting of the null hypothesis that the variables were not stationary at levels. The two series became stationary on differencing (first difference) as evidenced by low p-values as indicated in table 4.17.

Jarque Bera test of normality was also conducted to ascertain whether parametric or non-parametric t methods were appropriate. The test returned a P-value of 0.059 indicating non-rejection of null hypothesis showing residuals were normally distributed and therefore arriving at the conclusion that parametric tests were appropriate.

4.4.5 Hausman Test

In determining which estimation technique between the fixed or the random effects estimates of the static model was to be applied, Hausman test was conducted out and results indicated the Hausman chi-statistic was 34.19 with a corresponding p-value of 0.000 implying the Random Effects model should be interpreted as the long run (static) model.

4.4.7 Empirical Results

This section show the regression results, their interpretation and discussions per the objective of the study. To determine the effect of CBFS on monetary policy outcomes in the short run, General Method of Moments estimation technique was used. Conversely, to determine the long run effect the static random effect model was employed. According to Van Kiviet (1995) the static panel estimators are consistent and efficient for the long run effect while the GMM estimators are better for estimating short run responses.

Objective three of determining the effect of CBFS on interest variability in COMESA member countries. To achieve this objective, an autoregressive $AR(2)$ framework which was determined empirically was used to estimate equation 3.17 . The results are reported in Table 4.20.

Table 4.20: Effect of central bank financial strength on interest rate variability.

Dependent Variable: Interest rate variability				
Independent/ Control Variables	**Random Effects Model**		**Dynamic GMM Model**	
	Coefficient (P-Value)	**T- statistic (Standard Error)**	**Coefficient (P-Value)**	**T- statistic (Standard Error)**
Central Bank Financial Strength	-0.0651* (0.0648)	-1.857 (0.0351)	-0.1957* (0.0613)	-1.885 (0.1038)
Credit Demand (First difference)	0.0068* (0.0606)	1.887 (0.0036)	0.0851** (0.0445)	2.025 (0.0420)
Broad money growth	0.0479* (0.0950)	1.678 (0.0285)	0.0174** (0.03418)	2.136 (0.0081)
Exchange rate First Difference	-0.0057 (0.747)	-0.323 (0.0176)	-0.0671 (0.2789)	-1.087 (0.0617)
Interest rate variability (t-1)			0.8997*** (0.004)	2.921 (0.3080)
Interest rate variability (t-2)			0.3930*** (0.0021)	3.127 (0.1257)
Sargan over-identifying test				chi2(43) = 23.163 Prob>chi2= 0.6734
Arellano and Bond 1st order				-2.6472 (0.0309)***
Arellano and Bond 2nd 0rder				0.73689 (0.6031)

Key: P-values are reported in parentheses with ***, **, * denoting significance at 1 percent, 5 percent and 10 percent correspondingly.

Source: Authors computations

Before interpreting the results two diagnostic tests were conducted: Test of over-identifying restrictions and test of for zero autocorrelation. The P-value of Sargan over-identifying test was greater than 0.05 indicating that the null hypothesis could not be rejected and thus arriving at a conclusion that over identifying restrictions were valid. The Sargan test provided no evidence of misspecification.

The second diagnostic test that was conducted was the Arellano-Bond test for zero autocorrelation which tests the absence of higher-order serial correlation in the error term. The first order serial correlation for the model was negative and significant at one per cent level of significance. The second order serial correlation for the model was insignificant indicating that they were no serial correlation.

Table 4.20 shows the static random effects and dynamic system GMM estimates of $AR(2)$ as determined empirically on interest rate variability model. As expected in theory, the CBFS and interest rate variability are significant and negatively related across the two regressions. Coefficients of CBFS in the static random effect model and the dynamic GMM model were negative 0.065 and 0.196 with P-values of 0.0648 and 0.0613 correspondingly implying a significant inverse relationship between interest rate variability and CBFS. A one percent increase in the measure of central bank strength, all things constant reduces interest rate variability by 0.195 percent in the short run and 0.065 percent in the long run.

Theoretically, when the central bank financial position is weak it may opt not to raise bank rate so as to increase money issuance to generate seigniorage revenues to boost its financial position. Mopping up surplus liquidity in the banking system through increase in interest rate can be an expensive undertaking and weak central bank may prefer to avoid that option thus compromising on the desired monetary policy outcomes. Theoretically, interest rate and central bank financial position were negatively related, an expansionary monetary policy influences interest rates downwards. The results are similar to those of Perera (2013) that found that CBFS and interest rate variability are significantly related.

The system GMM coefficients of first and second lag of interest rate variability were 0.899 and negative 0.393 with P values of 0.004 and 0.0021 correspondingly. The results imply that the previous two years interest rate variability affects variability in interest rate in the current year.

Broad money coefficients in the static random effect model and the dynamic GMM model were 0.048 and 0.017 with P-values of 0.095 and 0.034 respectively. The results show a direct relationship exists between broad money growth and interest rate variability in COMESA region. Coefficients of changes in credit demand in the static random effect model and the dynamic GMM model were 0.007 and 0.0851 with P-values of 0.0606 and 0.045 in that order. The results imply that credit demand and interest rate variability are directly related in COMESA region. Excess lending especially to private sectors leads to rise in the supply of money supply and thus to changes in the rates of interest.

Coefficients of changes in exchange rate in the static random effect model and the dynamic GMM model were both negative 0.0057 and 0.067 with P-values of 0.747 and 0.279 in that order. The results imply changes in exchange rate and interest rate variability are not related in COMESA region. Higher interest rates is expected to lead to appreciation of a countrys currencies, higher rates of interest is expected to attract foreign investment thus increasing the demand for and value of currency of the home country.

Alternative measure of CBFS was also considered to account for reverse causality. In order to address the reverse causality, lagged measure (t-1) of CBFS was used as an alternative measure. The use of lagged measure recognizes the fact that CBFS may not have an impact on the outcomes of monetary policy in the same period but in subsequent periods. The results using the alternative measure of lag of CBFS is as shown on table 4.21.

Table 4.21: Effect of the lag of central bank financial strength on interest rate variability.

Dependent Variable: Interest rate variability				
Independent/ Control Variables	**Random Effects Model**		**Dynamic GMM Model**	
	Coefficient (P-Value)	**T- statistic (Standard Error)**	**Coefficient (P-Value)**	**T- statistic (Standard Error)**
Central Bank Financial Strength (t-1)	-0.05886** (0.0203)	-2.343 (0.0251)	-0.1689* (0.0603)	-1.892 (0.0893)
Credit Demand (First difference)	0.06864** (0.01629)	2.427 (0.0283)	0.06187* (0.05159)	1.961 (0.0316)
Broad money growth	0.04716** (0.03263)	2.155 (0.0219)	0.03269*** (0.01019)	2.601 (0.0126)
Exchange rate (First Difference)	-0.0455 (0.3472)	-0.943 (0.0483)	-0.0672 (0.2540)	-1.145 (0.0587)
Interest rate variability (t-1)			0.92408*** (0.0000)	5.439 (0.1699)
Interest rate variability (t-2)			0.29490* (0.1003)	1.653 (0.1784)

Key: P-values and standard errors are reported in parentheses with ***, **,*, denoting significance at 1 percent, 5 percent and 10 percent in that order.

Source: Authors computations

Using the alternative measure of CBFS, lag of CBFS the results of the static random effect and the dynamic system GMM are a not significantly different from the ones obtained using CBFS in respect to the magnitude of the coefficient and direction of relationships. Coefficients of CBFS in the static random effect model and the dynamic GMM model were both negative 0.059 and 0.169 with P-values of 0.02 and 0.06 in that order implying interest rate variability and the lag of CBFS are significant and inversely related. Further, no major variation in the results were obtained for the control variables in terms of the direction of relationships. The results imply that the lag of CBFS affects interest rate variability in COMESA member countries.

The system GMM coefficients of first and second lag of interest rate variability were 0.924 and negative 0.295 with P-values of 0.000 and 0.1003 correspondingly. The results therefore imply that the previous two years interest rate variability affects interest rate variability in the current year.

Broad money coefficients in the static random effect model and the dynamic GMM model were 0.047 and 0.033 with P-values of 0.033 and 0.01 in that order. The results show a direct relationship exists between broad money growth and interest rate variability in COMESA region. Coefficients of changes in credit demand in the static random effect model and the dynamic GMM model were 0.068 and 0.062 with P-values of 0.016 and 0.052 respectively. The results imply credit demand and interest rate variability are directly related in COMESA region. Excess lending especially to private sectors leads to rise in the supply money and thus to variation in the rates of interest.

Coefficients of exchange rate in the static random effect model and the dynamic GMM model were both negative 0.046 and 0.0672 with P-values of 0.347 and 0.25 in that order. The results imply exchange rate and interest rate variability are not related in COMESA region. Higher interest rates is expected to lead to appreciation of currency of a country, higher rates of interest is further expected to attract foreign investment thus boost the demand for and value of currency of a home country.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Introduction

Chapter five covers the summary of the study, conclusions, policy implications and areas proposed for further research.

5.2 Summary

Price stability is a key objective for central banks in COMESA member countries. The member countries adopted the COMESA monetary co-operation programme which was aimed at establishing a Monetary Union by the year 2018. To this end, member countries agreed on a number of convergence criteria which among others include; achieve annual average inflation rate not exceeding three percent, achieve and maintain stable exchange rates, achieve and maintain stable interest rates amongst others. The convergence criteria were aimed at removing macroeconomic disharmonies existing amongst COMESA member states as a result of pursuing different economic policies.

However, COMESA region did not achieve its objective of establishing a Monetary Union by the year 2018. Regarding specific convergence criteria, the region posted an average rate of inflation of nine percent for the period 2001 to 2017 which was higher than the set target of three percent. Similarly, interest rate variability in COMESA region measured by the standard deviation over the study period of 2001 to 2017 was 1.05 which was way above 0.04 posted by European Monetary union over the same period.

Further, the convergence criteria of maintaining stable exchange rate was not achieved, many COMESA member countries currencies experienced high volatility to the dollar. Exchange rate variability in COMESA region measured by the standard deviation over the study period of 2001 to

2017 was 25.5, which was way above 1.3 posted by European Monetary union over the same period. COMESA member countries that posted more than 10 percent depreciation to the dollar in one year include: Zambia 66 percent, Malawi 38 percent, Swaziland 30 percent, Madagascar 22 percent, Uganda 18 percent and Kenya 12 percent.

Central banks are modelled more often than not as maximizers of some objectives which include promoting stability of prices, growth promotion, attaining full employment, stabilising interest rates and the exchange rates. However, this viewpoint ignores the reality that central bank roles are deployed on its balance sheet and thus affects the financial strength of the monetary authority.

The theory of CBFS asserts that if a central bank financial capacity, in terms of its finance, and preference are consistent, then the response of central bank will be consistent with the direction of the goals. Conversely, if the central bank financial ability and preference contradict, then the response of the monetary policy will be in the reverse direction of the preferences or goals. No empirical studies have been conducted to establish whether CBFS affect monetary policy outcomes in COMESA region. Previous empirical studies suggest the relationship may be conditional to countrys unique characteristics.

This study sought to analyse the effect of CBFS on monetary policy outcomes in COMESA member countries for the period 2001 to 2017. Three key measures of monetary policy outcomes investigated were; inflation rate, exchange rate variability and interest rate variability. The General Method of Moment estimation technique was used to estimate the dynamic panel data regression model. The econometric approach was chosen so as to control for the possible problem of endogeneity that may arise from including lag of the predicted variable as one of the predictor an explanatory variable. The specific objectives were; investigate the effect of CBFS has on inflation in COMESA region, determine the effect of CBFS on exchange rate variability in COMESA region and finally to investigate the effect of CBFS on interest rate variability in COMESA region.

With regard to investigating the effect of CBFS strength on inflation in COMESA region, the study established that both in the short run and long run the coefficient of the CBFS was significant implying that CBFS and inflation were negatively related. The finding is consistent with CBFS theory which asserts an inverse relationship between weak central bank finances and inflation. If the central bank financial ability and the desired policy outcomes are consistent with each other, then the monetary policy outcome will be consistent with the central bank preference.

The study objective of investigating the effect of CBFS on exchange rate variability in COMESA region the study showed that CBFS has no effect on exchange rate variability both in the short run and in the long run. The results contradict theory, a negative relationship is expected between exchange rate variability and central bank financial position. Central banks engage in foreign exchange operations with a view to stabilise the exchange rate. Finally, with respect to the study objective of determining the effect of CBFS on interest rate variability in COMESA region, the coefficient of CBFS was negative and significant. The results imply that CBFS affects interest rate variability in COMESA member countries. The finding is consistent with CBFS theory, which asserts an inverse relationship between CBFS with interest rate variability.

5.3 Conclusions

The study broadly concludes that central bank financial strength affects monetary policy outcomes in COMESA region. Further, the study specifically concludes that CBFS effects inflation in COMESA region both in the short run and in long run. The study also established that the two variables, CBFS and inflation, were inversely related.

Regarding the study objective of investigating the effect of CBFS on exchange rate variability in COMESA region the study concludes that CBFS has no effect on exchange rate variability in COMESA region.

Finally, premised on the study objective of determining the effect of CBFS on interest rate variability in COMESA region, the study concludes that the CBFS affects interest rate variability in COMESA region. The study also established that the two variables, CBFS and interest rate variability, were inversely related.

5.4 Policy Implications

The first objective of the study was to investigate the effect of central bank financial strength on inflation in COMESA region. The empirical results established CBFS and inflation are inversely related in COMESA region. The study findings regarding objective one imply that financial strength of central banks in COMESA region should be enhanced; a financially strong central bank is a critical requirement for desirable monetary policy outcomes in the region. Further, the Monetary Affairs Committee of COMESA region should consider including CBFS as one of the convergence criteria, which this study established affects monetary policy outcomes in the region. Enhancing the financial strength of the central bank in the region will contribute in ensuring the convergence criteria regarding stability of prices and interest rates are achieved.

Central banks in COMESA region should avoid large deterioration of their balance sheet if they are to succeed in supporting low inflation outcomes in the region and further meet convergence criteria set in regard to inflation. To avoid large deterioration of their balance sheet, central banks should avoid excessive profit transfers to the national treasury which has an impact of eroding its financial resources (Sweidan and Widner, 2008). The Monetary Affairs Committee of COMESA should bring to the attention of their members the importance of financially strong central banks in meeting the convergence criteria and spell out polices that would strengthen central bank financial position in the region.

Regarding the other variables included in the study findings, empirical results in objective one of investigating the effect of CBFS on inflation in COMESA region indicated that broad money growth had a positive influence on inflation. The finding implies that central banks in COMESA region

should ensure that growth in broad money is closely monitored to ensure that it does not grow at higher rate than real output growth as it would lead to high inflation. Foreign inflation on the other hand was found to negatively influence inflation, COMESA member countries should ensure that they set aside budgetary allocations to invest in key sectors of the economy that have potential of reducing imports. Increased production in these sectors would have an impact of reducing imports which would contribute to decline of domestic inflation.

The second objective of the study was to determine the effect of CBFS on exchange rate variability in COMESA member countries. Foreign Inflation was empirically found to positively influence on exchange rate variability. Rise in imports is expected to lead to depreciation of the domestic currency. COMESA member countries should therefore ensure that they set aside budgetary allocations to invest in key sectors of the economy that have potential of reducing imports. Increased production in these sectors would have an impact of reducing imports which would contribute to decline in exchange rate variability.

The third objective of the study on the other hand was to determine the effect of CBFS on interest rate variability in COMESA region. Similarly, an inverse relationship between interest rate variability CBFS was noted. The results imply that Monetary Affairs Committee and the respective national treasuries of the member countries should ensure the CBFS is enhanced since it would contribute in reducing interest rate variability in the region and thereby meeting the convergence criteria with regard to stability of interest rates.

CBFS can be enhanced in various ways including; financial support from the national treasury through recapitalisation, reviewing profit distribution rules to give central bank agility to maneuver and have adequate financial reserves in the event of losses. Recapitalisation can be done by national treasury injecting money or national treasury providing treasury bills or bonds that could be presented to the market through sale or repurchase agreements. Which could act as a base for

developing an active money market. Capital is a key indicator of CBFS and therefore enhancing capital position of a central bank will improve the central bank financial health.

To further enhance CBFS, legal provisions of the central banks should be reviewed to ensure loan and advances to government is eliminated or reduced to minimal levels. Loan facilities extended to government by central banks is either not serviced, rescheduled, deferred or are offered at below market interest rates.

Countries in the COMESA region where their central banks have been recapitalized, albeit with resistance from their national treasuries, include: Uganda, Burundi and Kenya. In the case of Kenya, Public Finance Management (PFM) Act requires all regulators which include the Central Bank of Kenya (CBK) to submit 90 per cent of their surpluses to the exchequer. CBK was recapitalized in 2009 and in 2019 by changing profit distribution rule to strengthen its financial position. This study can be used by CBK to push for exemptions from the provisions of PFM Act which will enhance its financial strength and enable the bank achieve the desired/ set monetary policy outcomes.

Regarding the other variables included in the study findings, empirical results in objective three of determining the effect of CBFS on interest variability in COMESA member countries. Foreign Inflation was empirically found to positively influence on interest rate variability. Increased production in these sectors would have an impact of reducing imports which would contribute to decline in rate variability.

5.5 Contribution to Knowledge

This study makes contribution to body of knowledge on two accounts. Firstly, the study focused on developing country context specifically in COMESA region. Previous empirical studies were not conclusive on the linkage between CBFS and inflation and suggested that the relationship is conditional to countrys unique characteristics. COMESA region is unique on many ways including; the region has weak fiscal institutions, financial institutions which are weak, bad record in relation to

conducting monetary policy and the low credibility of the monetary authority. To this end, this study has thus provided empirical evidence that in COMESA region central bank financial position affects the outcomes of monetary policy.

Secondly, previous studies mainly concentrated on the effects of the central bank financial position on price stability. This study is the first one to my knowledge that has extended and examined the effect of CBFS on interest rate stability and exchange rate stability in COMESA region. These variables are highly correlated with price stability in small open economies and are key convergence criteria in the region. Monetary policy plays a critical role in realizing the economic objectives of stability in prices, in pursuing these goals, the central bank sets intermediary objectives. These intermediary objectives relate to using money supply, interest rate, and the exchange rate to accomplish the final objective of monetary management. Intermediate objectives are viewed as channels via which monetary policy is transmitted to the economy with the aim of affecting the final objectives. This study further adds to the literature on significance of the central bank finances in the developing economies context and specifically in COMESA region.

5.6 Areas for further Research

The conclusions of the study relied on COMESA region member countries, most of them being developing countries. The results obtained may not be generalised for different economic and financial contexts. To that end, repeating the same study to include a large sample of countries for instance countries in South African Development Community (SADC) and West Africa Monetary and Economic Union (WAEMU) would help to strengthen the conclusions drawn from this study. A similar study conducted in the two economic regions is important, the African Union propose a creation of economic and monetary union for African Union member countries to be administered by yet to be created African Central Bank through merging of various economic blocks in the continent.

Further robustness tests of results using a different empirical measure of CBFS could be used that incorporates net present value of future central banks income. Future studies could also

focus on potential loss of independence following recapitalization or financial support by treasury which is the shareholder of the central bank.

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Appendix 2: Descriptive Statistics

Table A2: Overall Summary Statistics of study variables for the period 2001 to 2017

Variable	Obs	Mean	Std. Dev.	Min	Max
Central Bank Financial Strength	238	0.031812	0.1967467	-1.398441	0.5038001
Inflation	238	8.277586	6.951329	-2.404639	36.96476
Lag of Inflation	238	8.4018	7.045604	-2.404639	36.96476
Broad Money growth	238	16.766	11.443	-7.973	81.854
Per Capita Income	238	2263.424	3348.292	112.849	15504.460
Foreign Inflation	238	1.537	0.654	0.279	2.854
Economic openness	238	0.708	0.465	0.000	2.250
Exchange rate Variability	238	25.501	60.500	0.000	453.155
Lag of Exchange rate Variability	238	26.313	60.842	0.000	453.155
Interest rate differential	238	14.485	11.463	0.000	63.844
Interest rate variability	238	1.047	2.733	0.000	35.651
Lag of Interest rate variability	238	1.027	2.729	0.000	35.651
Credit demand	238	34.388	32.043	0.210	135.710
Commodity price	238	97.418	3.414	81.014	102.584
Oil price	238	59.684	25.892	21.840	95.990
Exchange rate	238	538.659	796.602	2.016	3611.224

Source: International Financial Statistics and World Development Indicators Databases, 2018 and authors computations.

Appendix 3: Correlation matrix for study the variables.

Table A3: Correlation between key study variables in objective to investigate the effect of CBFS on inflation.

	NF	CBFS	INF1	M3G	PCI	EO	CD	FINF	CP	EXT
INF	1									
CBFS	-0.243*	1								
	0.0001									
INF1	0.5761*	-0.25*	1							
	0.000	0.0001								
M3G	0.2515*	-0.231*	0.2918*	1						
	0.0001	0.0003	0.000							
PCI	-0.145*	0.1751*	-0.153*	-0.236*	1					
	0.0247	0.0068	0.0178	0.0002						
EO	-0.124*	0.2413*	-0.119*	-0.179*	0.7780*	1				
	0.0549	0.0002	0.0651	0.0055	0.000					
CD	-0.116*	0.2221*	-0.175*	-0.267*	0.5831*	0.3333*	1			
	0.072	0.0006	0.0067	0.000	0.000	0.000				
FINF	0.1845*	0.0281	-0.0951	0.0854	-0.0462	0.0148	-0.031	1		
	0.0043	0.6663	0.1436	0.1892	0.4786	0.8205	0.6255			
CP	0.2283*	-0.0313	0.1613*	0.1366*	-0.143*	-0.0734	-0.28*	0.1636*	1	
	0.0004	0.6307	0.0127	0.0352	0.0266	0.2596	0.000	0.0115		
EXT	-0.0271	0.0421	-0.0347	0.0034	-0.358*	-0.253*	-0.35*	0.0658	0.1451*	1
	0.6772	0.5178	0.5944	0.9583	0.000	0.0001	0.000	0.1451*	0.0252	

The first number in the cells are the correlation coefficients, the second number in the cells are the p-values with * denoting significance at 10 percent.

Key: *P-value less than 0.1

Appendix 4: Research Permit.

THIS IS TO CERTIFY THAT:

MR. LABAN KIMANJA MUTHUA

of KENYATTA UNIVERSITY, 60-254

Nairobi,has been permitted to conduct

research in *Nairobi County*

on the topic: *CENTRAL BANK FINANCIAL STRENGTH AND MONETARY OUTCOMES IN COMESA REGION.*

for the period ending:

24th July,2020

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Date Of Issue : 13th August,2019

Fee Recieved :Ksh 2000

Applicant's Signature

Director General

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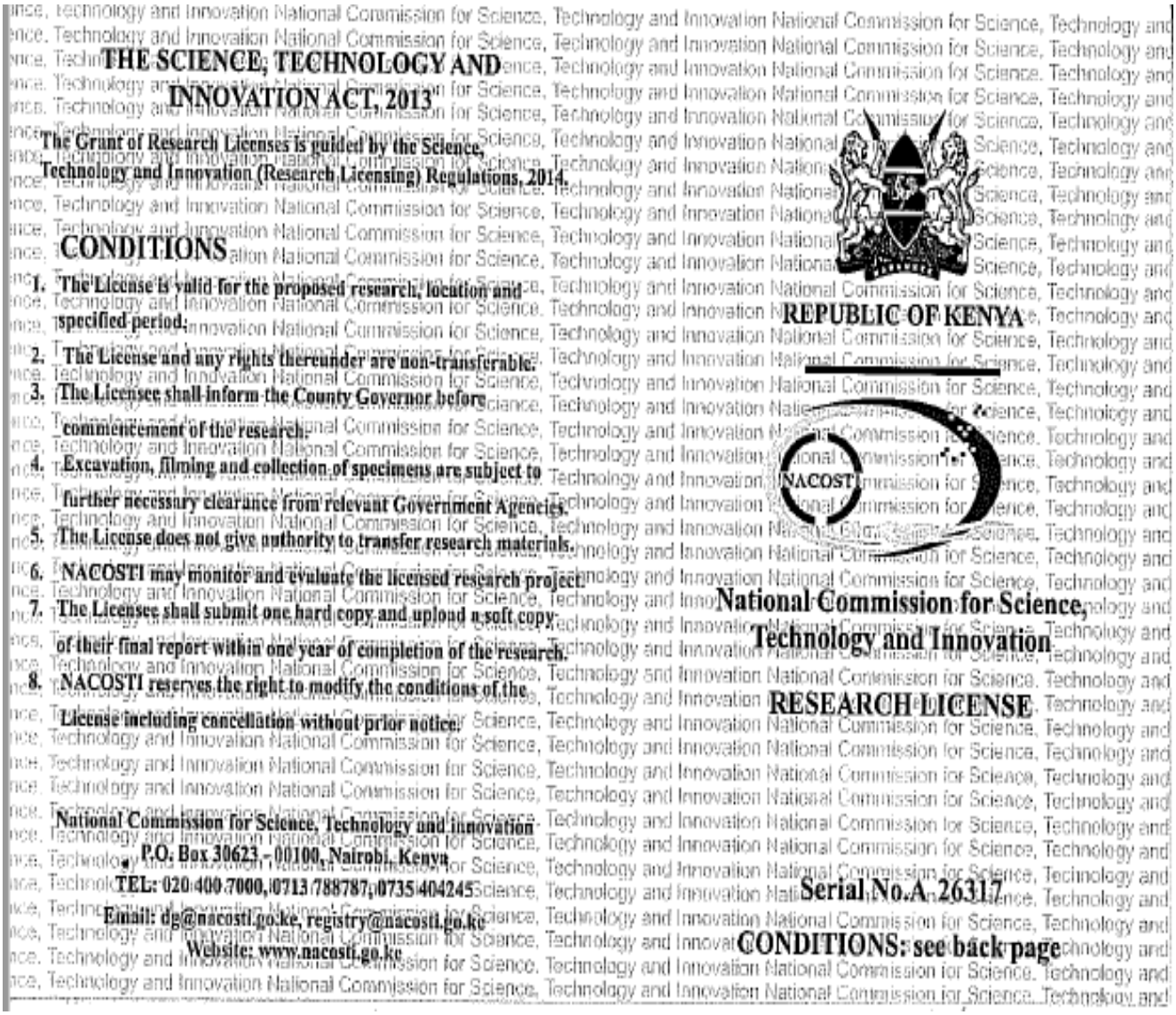

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