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THE DIVISIA MONETARY AGGREGATES, DEMAND FOR MONEY STABILITY, INCOME, AND INFLATION FLUCTUATIONS IN SELECTED SUB-SAHARAN AFRICA

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Universiti Utara Malaysia

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DIVISIA MONETARY AGGREGATES, DEMAND FOR MONEY STABILITY, INCOME AND INFLATION FLUCTUATIONS IN SELECTED SUB-SAHARAN AFRICA

BY

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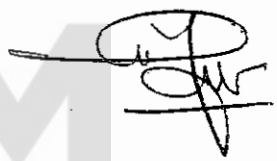

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ABSTRACT

The financial sector reforms adopted in the 4 selected Sub-Saharan Africa (SSA) countries, namely Kenya, Malawi, Nigeria, and South Africa have resulted to a remarkable change in the composition of monetary aggregates making the simple sum measure of money questionable. The reforms affect the stability of money demand function and create uncertainty in the macroeconomic environment leading to a slow growth and high inflation rates. This study constructs a new Divisia monetary aggregates for 4 selected SSA countries and investigate the role of monetary aggregates in the money demand stability, income and price fluctuations. Two variables; monetary uncertainty (MOU) and output uncertainty (OUU) were incorporated into the model. The study employed quarterly time series data covering 2000Q1 to 2015Q3. The ARDL and Toda Yamamoto causality methods were utilized in the analysis. The main objective of the study is to investigate the role of monetary aggregates in monetary policy decisions. The results indicate that Divisia monetary aggregates perform well in explaining the stability of money demand functions. Both MOU and OUU are quite significant in the money demand stability. The study added to the existing literature on money demand by empirically exploring the impact of the MOU and OUU on money demand stability using an alternative monetary aggregate. The results also shows a significant two-way causality between money and income, however, money and prices signifying an endogeneity in money supply. The Divisia monetary aggregates perform relatively well in explaining income and prices fluctuations. The important policy implication of this finding is that monetary targeting could be more appropriate for the 4 selected SSA countries monetary policy decisions and therefore that monetary aggregates can be used to influence the growth in income and to minimize price fluctuations.

Keywords: ARDL, Divisia aggregates, money demand stability, simple sum aggregates, Toda-Yamamoto causality.

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ABSTRAK

Pembaharuan sektor kewangan yang diterima pakai di 4 negara Sub-Sahara Afrika (SSA) yang dipilih, iaitu Kenya, Malawi, Nigeria, dan Afrika Selatan telah menghasilkan perubahan yang luar biasa dalam komposisi agregat monetari masih dipersoalkan penjumlahan mudah wang. Pembaharuan menjejaskan kestabilan fungsi permintaan wang dan mewujudkan ketidakpastian dalam persekitaran makroekonomi yang membawa kepada pertumbuhan perlahan dan kadar inflasi yang tinggi. Kajian ini membina agregat kewangan Divisia baru untuk 4 negara SSA terpilih dan menyiasat peranan agregat monetari dalam kestabilan permintaan wang, turun naik pendapatan dan harga. Dua pembolehubah; ketidakpastian kewangan (MOU) dan ketidakpastian pengeluaran (OUU) dimasukkan ke dalam model. Kajian ini menggunakan data siri masa suku tahunan yang meliputi 2000Q1 hingga 2015Q3. Kaedah kausaliti Toda Yamamoto dan ARDL digunakan dalam analisis. Objektif utama kajian ini adalah untuk mengkaji peranan agregat monetari dalam membuat keputusan dasar monetari. Dapatan kajian menunjukkan bahawa agregat monetari Divisia berfungsi dengan baik dalam menjelaskan kestabilan fungsi permintaan wang. Kedua-dua MOU dan OUU menunjukkan kestabilan permintaan wang yang signifikan. Kajian ini menambah kepada kajian sedia ada mengenai permintaan wang secara empirik dalam meneroka impak MOU dan OUU terhadap kestabilan permintaan wang dengan menggunakan alternatif agregat monetari. Selain itu, keputusan ini juga menunjukkan hubungan dua hala yang signifikan di antara wang dan pendapatan, walaubagaimanapun, wang dan harga menunjukkan ada endogeniti dalam bekalan wang. Agregat kewangan Divisia berfungsi dengan baik dalam menjelaskan turun naik pendapatan dan harga. Implikasi dasar yang penting dalam penemuan ini ialah penyasaran kewangan mungkin lebih sesuai untuk keputusan dasar monetari bagi 4 negara-negara SSA yang dipilih, dan agregat monetari itu boleh digunakan untuk mempengaruhi pertumbuhan pendapatan dan untuk meminimumkan turun naik harga.

Kata Kunci: ARDL, agregat Divisia, kestabilan permintaan wang, agregat penjumlahan mudah, Kaedah Toda-Yamamoto.

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
ARCH	Auto Regressive Conditional Heteroskedasticity
ARDL	Auto Regressive Distributed Lag
CBN	Central Bank of Nigeria
CBK	Central Bank of Kenya
CBM	Central Bank of Malawi
CE	Currency Equivalent
CES	Constant Elasticity of Substitution
CFS	Centre for Financial Stability
DM	Divisia Money
ECM	Error Correction Model
ECT	Error Correction Term
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
GDP	Gross Domestic Product
IFS	International Financial Statistics
IMF	International Monetary Fund
LM	Langrange Multiplier
PP	Philip-Perron Unit Root Test
SARB	South Africa Reserve Bank
SBC	Schwartz Bayesian Criterion
SM	Simple Sum Money
SSA	Sub Saharan Africa
VAR	Vector Autoregression
VES	Variable Elasticity of Substitution
WDIs	World Development Indicators.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

In small open economies such as the Sub -Saharan African (SSA) countries, stability in price signifying a low and stable rate of inflation plays a vital role in maintaining stability for both macroeconomic and financial system (Hossain 2017). Stability in macroeconomic system boast innovations in technology and rises investment output. The productive investment thus remains a key source of a sustainable economic growth (Faria & Carneiro, 2001). The rapid economic advancement realized by the Latin America and Asian coutries shows that stability in macroeconomic is important in developing nations due to the simple reason that the economic, political, and social institutions in the economies are not fully developed to accommodate the severe impact of macroeconomic instability on key factors like; savings, investments, trade and capital flows (Montiel, 2011).

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What role can money play in the conduct of monetary policy for price stability, and sustainable economic growth has remained a major policy issue in the Sub-Saharan Africa (SSA) countries. The central banks have options to apply a monetary aggregates-based framework or a short-term interest rate-based framework of monetary polcy to achieve the goal of price stability and economic growth. Which of these frameworks is the best option for developing countries such as the SSA countries is yet an unresolved issue (Hossain, 2017). This is because it depends on numerous factors which among others includes; whether the predominant shocks to the economies are monetary or real or a combination of both (Poole, 1970). Usng the

monetary aggregates-based framework for monetary policy, the central banks can control and deploy a monetary aggregate to stabilize prices and realize a set target of economic growth.

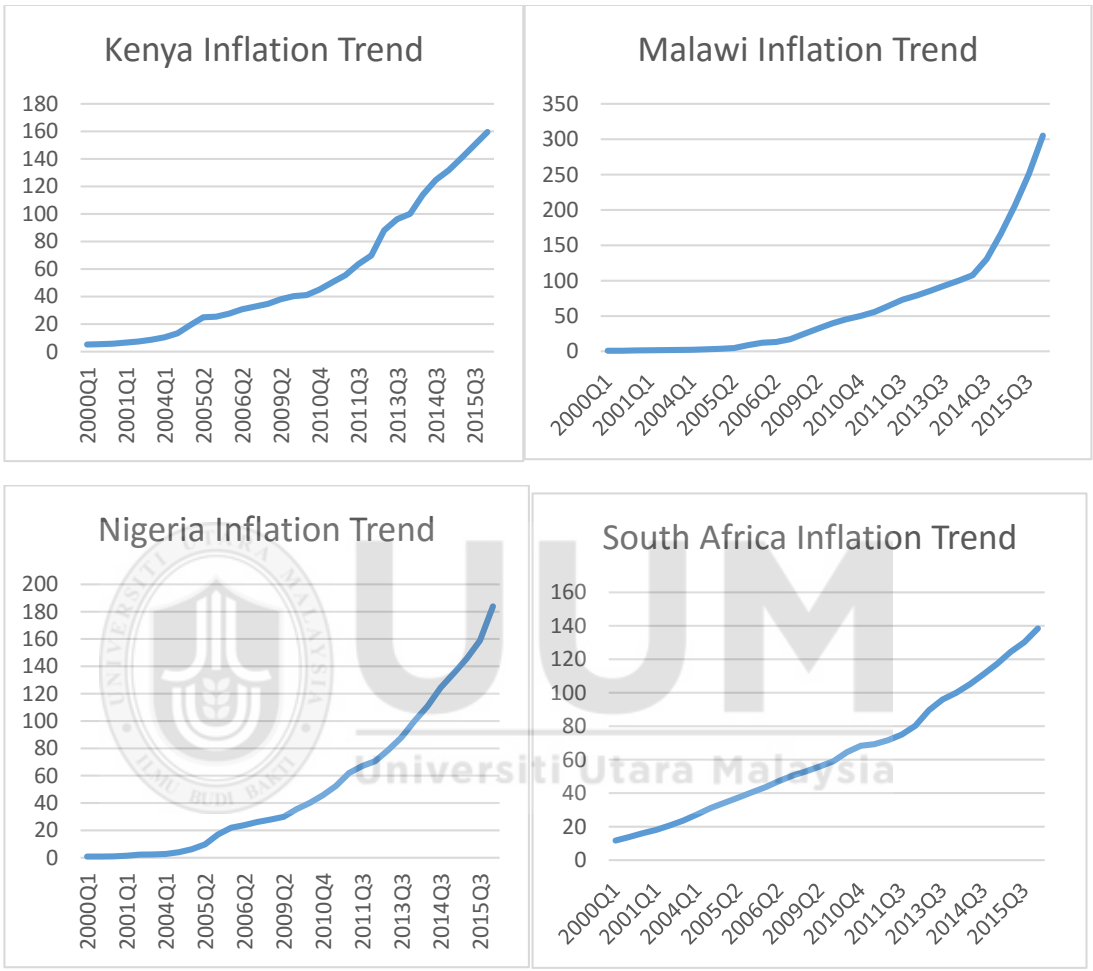

Figure 1.1 *Inflation movements in the selected SSA countries*

Figure 1.1 shows the inflationary trend of the selected SSA countries indicating a similar pattern in the direction of inflation. This indicate that generally inflation in the SSA countries has been on a rising trend over the years. Rising and volatile inflation distorts savings and investment in an economy leading to a low productivity and a declining GDP growth rate (Hossain, 2017).The most recent global financial sector crisis and the current monetary policies influencing the money supply in different economies, has driven interest in fresh theoretical and empirical studies to investigate

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the possible effects for variations in money on price movements and the overall macro-economic activities.

There has been a resurgence in the empirical investigations on the role of money and its influence on the prices and economic activities (Serletis & Rahman, 2013). During the period 1985 to 2000s the Sub-Saharan Africa (SSA) countries including Kenya, Malawi, Nigeria and South Africa have witnessed transformations in their financial systems which among others comprises of interest rate deregulation, adoption of flexible exchange rate arrangement, financial innovation, banking system deregulation, relaxation of exchange control, privatization and commercialization of public financial enterprises and elimination of credit ceilings (Baldini & Poplawski-Ribeiro, 2011). Those reforms resulted to a remarkable change in the monetary aggregates behaviour in terms of their ability to forecast and predict the levels of income and prices (Habibullah, 1999).

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These developments emphasized the need for an accurate re-measurement of money which considers the new financial assets, producing a more meaningful measure of money and restoring its explanatory power. Barnett (1980), Hendrickson (2014), Darvas (2015), have highlighted the weaknesses of the traditional sum aggregates in policy implementation. Barnett (1980) Divisia index which emphasized on monetary aggregation using a weighted approach needs to be examined in relation to developing countries. The key contribution presented by Divisia monetary aggregates measure of money in the monetary aggregation literature is towards a most appropriate and effective indicator for monetary policy implementation. While a number of studies established the empirical advantage of the Divisia monetary aggregates over the simple sum in monetary policy application.

However, studies such as Drake and Mills (2005), Ndjokou (2013), found that their empirical findings show the opposite. That the advantage of Divisia over simple sum aggregates cannot be confirmed based on empirical evidence.

Following the financial system deregulation and reforms adopted by the developed countries in the late 1970s and early 1980s, the money demand relation becomes unstable in manay countries (Sriram, 2000). This led to the monetary aggregates-based framework lost ground because of the conviction that the relationship between money, income and prices had weakened over the period. A number of economists took position that money does not matter in income and inflation analysis (Svensson, 2011). This led other countries to adopt the inflation targeting strategy which further support the weakness of monetary aggregates in monetary policy framework. However, some reknowned economists strongly criticized this view.

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They provided evidence that money, income, and prices maintain a good causal relationship across many countries over a long-time period (Lucas, 1980; Nelson, 2013). A stable money demand is a necessary condition for the monetary aggregates to be used as monetary policy instruments (Goldfeld & Sichel, 1990). Since the stability of money demand dictates the choice of monetary policy instruments, it is therefore important to re-examine the stability of the money demand function for the selected SSA countries using an alternative monetary aggregate.

Studies on money demand indicate that money demand studies hardly focus attention on the economic uncertainty and its effects on the money. The emphasis is rather on the scale and opportunity cost variables. Financial markets problems such as those witnessed in 2007 can amplify a negative impact of uncertainty on income and growth

(Gan, 2014). According to Choi and Oh (2003), increase in either output or monetary uncertainties will translate into a substitution effect by moving from money assets to other non-financial assets that are less volatile thereby indicating a negative estimate of the two variables. On the other angle, similar increase in both output uncertainty and money uncertainty will create caution among the public, thereby induce them to keep their liquidity position allowing the two measures to bear a positive coefficient value.

Although in the interest rate based targeting or inflation targeting frameworks place little emphasis on money demand stability, the last global financial crisis has again renewed the focus on excess liquidity in the discussion of inflation and the business cycle fluctuations (Taylor, 2009). Since evidence has proven the still presence of a connection amongst the growth of money stock and inflation, economies that are focusing on price stability must put into consideration the consequences of any excessive growth in monetary stock on the inflationary pressures. Not withstanding, the importance of money in monetary policy implementation remains debatable in the SSA region (Kumar, 2011). The empirical conclusions of this study added to the discussion.

A considerable evidence exists on the causality between monetary stock and income, and monetary stock and inflation in developed countries as shown by some studies. These studies includes; Hayo (1999), Hafer and Kutan (2002), Mishkin (2009), Leeper and Roussh (2002). However, literature on developing countries is quite limited (Bahmani-Oskooee & Bahmani, 2015). In the case of SSA countries, few studies were conducted on the money-income, and money-inflation causality. These includes; Darrat, (1986); Dwyer and Hafer (1999), Kabundi and Schaling (2013), and Asongu

(2014). These few studies are often characterized by inconclusive inferences and divergent conclusions. For instance, while studies like Darrat (1986) and Asongu (2014) established a two-way causality between money and income, Kabundi and Schaling (2013) draws an opposite conclusion. Added to that, since these studies are affected with a number of theoretical and methodological problems, their conclusions do not provide reliable results as basis to formulate effective economic policies (Asongu, 2013). These studies all utilized the simple sum monetary aggregates that were identified with numerous problems (Barnett et al. 2013).

This study created the Divisia monetary aggregates for Kenya, Malawi, Nigeria, and South Africa and investigate the empirical application of the aggregates in the stability of money demand for the respective economies. In addition, the study also investigates the causality amongst the Divisia aggregates (and simple sum aggregates) with income and inflation for the selected SSA countries. The auto regressive distributed lag (ARDL) method advanced by Pesaran and Shin, (1997) and Pesaran *et al.* (2001), that tolerates model estimation with variables at *I(0),* or *I(1)* or a combination of the two integration orders was employed. Toda-Yamamoto (1995), (henceforth, T-Y) causality approach is utilized to study the causal relationship amongst money, prices and income, using Divisia monetary aggregates and simple sum aggregates for the respective countries.

1.2 Problem Statement

The monetary authorities in developing countries are confronted with numerous policy challenges in terms of choosing the appropriate policies for macroeconomic management. The important role of money can only be effectively carried out if money is measured appropriately (Barnett et al. 2013). The SSA countries central banks do

produce simple sum monetary aggregates which are employed in policy making and in monetary and financial economics researchers. Simple sum aggregates have been identified with certain shortcomings and weaknesses thereby making them a wrong measures of money (Hendrickson, 2014).

Barnett, Chauvet and Tierney (2009), put an argument that from the period monetary assets started paying interests, the traditional sum aggregates appears to have no foundation in the economic theory thereby leading to a series of errors in the monetary theory. They further argued that the bad data obtained from the simple sum aggregates led to a contamination in monetary economics research which resulted into what they termed as `needless paradoxes` leading into a decade's production of misinterpretations in monetary economics research and policy (Barnett & Chauvet, 2011). Belongia and Ireland (2014a) try to establish that a great number of problems in the link between the monetary policy and activities in the economy that was blamed on the instability in money demand function was the result of inaccuracy of the traditional sum aggregates conventionally employed in modelling economic activities.

Researchers have advanced an argument that financial sector reforms could disturb the stability of money demand function particularly to emerging developing economies like the SSA economies (Kumar, 2011). More so studies on the demand for money in SSA economies have shown that there are still conceptual and statistical issues yet unresolved (Dagher & Kovanen, 2011). Previous researches on the money demand function in SSA have overlooked the problem of the monetary and output uncertainty. Ironically, Choi and Oh (2003) provides evidence that monetary and output uncertainties have impact on the money demand function stability apart from the traditional causes of the money demand fluctuations.

The aftermath of the economic depression that followed the global financial crisis led to the emergence of a fragile system characterized by macroeconomic instability particularly in developing countries especially the SSA. The external shocks realized from the crisis resulted into sharp increase in international food and fuel prices and presented a major problem for monetary policy in the SSA countries (Baldini, & Poplawski-Ribeiro, 2011). Theoretical researches and empirical analysis on developing countries have shown that the money demand function of SSA countries in particular has been unstable as a result of financial innovations and financial sector reforms (Nyamongo & Ndirangu, 2013). This is because the monetary policies frameworks used in SSA countries are not prone to countercyclical stabilisation shocks. The demand for money function exhibits instability over the periods, thereby making it less useful in controlling inflation (Asongu, 2014).

When money demand is unstable and witnessed a substantial change over time, it suggests that the income velocity for money will tend to be volatile, thus, quantity of money or monetary stock may not be very good forecaster for economic activity (Bahmani-Oskooee et al. 2015). Thus, monetary aggregation method can be evaluated based on its ability to provide a stable money demand function in an economy.

The remarkable changes in financial innovations in developed countries during the 1980s led to an instability in the money demand function, and these instability forms the basis for abandoning the monetary aggregates as policy targets (Friedmaan & Kutner 1993). For instance, studies of money demand in South Africa such as Jonsson (2001); Tlelima, and Turner (2004) established an instability in the money demand function associated with economic and political transformation of the 1990s. However, recently an empirical evidence from studies like Keating *et al*. (2014) has shown that the instability in the money demand function recorded in the 1980s and the subsequent

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breakdown in the use of monetary aggregates was mainly as a result of the use of the traditional sum aggregates. The assumption of perfect substitutability among monetary components by the sum aggregates make the aggregates unrealistic (Binner et al. 2004, Barnett and Chauvet, 2011). Other studies such as Belongia and Ireland (2014), El-Shagi and Giessen. (2013) have all shown that when correctly measured, money can contribute to the understanding of the dynamics in macroeconomics.

Another problem faced by the SSA countries is slow growth and high and volatile inflation rates. This basically is because a vast number of empirical literatures have established a convincing evidence that a high inflation (with its associated high volatility) distorts the private sector decision making with regards to savings, investments, and output, and ultimately results to a slower economic growth (Darrat et al. 2005). Inflation rate is considered as an indicator for monetary policy success (Clarida, et al. 1999; Goodfriend & King, 2001; Woodford 2003). Problems of unstable inflation rate and slow economic growth are particularly more pronounced in the Sub-Saharan African countries (Kumar, 2011).

Their inflation rates have been on increase and unstable over time. Evidence from the IMF statistics shows that the rate of inflation is on increase over the years. For example, according to IMF data, the inflation rate grew steadily for Kenya, Malawi, Nigeria, and South Africa. In Kenya, the rate moved from 9.8% in the last quarter of 2000 to 23.2% during the last quarter of 2008 and further to 42.9% in the first quarter of 2015. For Malawi, the figures are 8.8%, 22.1% and 69.9% during the respective periods. Similar trend also follows in Nigeria with 7.9%, 20.5% and 45.2% over the review period.

In South Africa, the movement indicate a steady growth in the inflation rate over the period with statistics of 14.3%, 23.1% and 37.3% for the quarters respectively (IMF, 2016). Inflation rates in Kenya have notably been unstable over the past five decades being driven by both demand and supply side shocks (Durevall & Sjo, 2012). Also, Mutuku and Ng`eny (2014) identified inflation as one of the factors negatively affecting Kenyan equity market performance. They suggested that policy makers should focus on policies that can mitigate inflation for the Kenyan stock market to develop. The global oil and food price shocks pushed up inflation in SSA, particularly in countries like Nigeria and South Africa above the respective central Bank`s inflation targets (Asongu, 2014).

1.3 Research Questions

Issues bothering on the usage of monetary or financial aggregates for research as well as policy formulation in an economy have been raised. To address issues raised, following research questions have been formulated;

i. How are Divisia monetary aggregates measured in Kenya, Malawi, Nigeria, and South Africa?

ii. Is the Demand for money function of the selected SSA stable with monetary uncertainty and output uncertainty variables using the Divisia monetary aggregates?

iii. Does money contain information about the national income (GDP), and Inflation in the selected SSA countries?

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1.4 Research Objectives

The general objective of this study is to investigate the performance of money in monetary policy frameworks for the selected SSA countries.

The specific objectives of the study are:

i. To create Divisia monetary aggregates for Kenya, Malawi, Nigeria, and South Africa.

ii. To investigate the stability of money demand function for the selected SSA countries using Divisia monetary aggregates and adding monetary and output uncertainties variables.

iii. To investigate the causality between money and income (GDP), and between money and inflation utilizing Divisia and simple sum aggregates in the selected SSA countries.

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1.5 Significance of the Study

The overall goal of this study is to carry out an investigation into the role of money in monetary policy conduct for developing countries. To a greater extent, studying the economic linkage between money stock and the economy is significant particularly for developing countries like the SSA, as the association will reveal the most suitable monetary policy to adopt and also to enhance its efficacy. This relationship has been a subject to many debates found in empirical studies and no definite conclusion yet on the matter (Nelson, 2013). To this effect, this study is significant at both practical and theoretical applications.

This study constructed Divisia monetary aggregates for the selected SSA countries. Previous attempt to construct similar index for Kenya and Nigeria by other studies were identified with methodological problems and exclusion of some vital components in the monetary aggregates composition for these countries. Gebrigiosis and Handa (2005), Khainga (2014) and Ndjokou (2013) made an attempt to construct the Divisia monetary aggregates for Nigeria, Kenya and the Bank of Central African states (BEAC) and the Central Bank of West African states (BCEAO) countries respectively. Their major shortcomings stem from the data used and the period of study. In their construction only, data on current and savings deposits were used, and they fail to consider the Implicit Rate of Return as advocated by Klein, (1974) in the computation for interest on current account deposits. For instance, in Nigeria only savings deposits are regarded as bearing interest rates. The aggregates are restricted to year 2005 which does not cover the financial transformation era that begun in the same 2005 with the introduction of new banking reforms policy of the Central Bank of Nigeria (CBN).

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More so, the studies do not investigate the comparative performance for Divisia index with traditional sum aggregates. Investigating the effectiveness of Divisia index aggregates for emerging economies like the SSA countries can be very vital in confirming the robustness of the findings for the developed economies. Since the selected SSA economies have undergone a remarkable deregulation and financial innovation beginning in the mid-2000, the simple sum aggregates could have been less suitable as a money supply measure. There is a significant volume of time deposits in the Nigerian financial system bearing different interest rates. The data spans from 1970 to 2000 which does not cover the period of financial transformations beginning in 2005. This study intends to narrow this gap.

Empirical studies on money demand by several authors has shown that monetary uncertainty and output uncertainty could both bear a strong influence on portfolio choice process of an individual economic agent, and thus posses an important effect on the amount of cash balances kept by a household (Atta-Mensah, 2004). This is more pronounced especially in developing countries like the SSA that experience a lot of instabilities and fluctuations in their money and outputs due to policies inconsistencies (Bahmani-Oskooee et al. 2015). Therefore, incorporating the monetary and output uncertainties variables into money demand for developing countries may help in further understanding the behaviour of money demand function in those economies. From available evidence, this study appears to be among the few studies to examine the individual effects of monetary and output uncertainties on the demand for money using Divisia index measures of money.

This issue was not analysed before in the context of demand for money literature of the selected countries, although it has been established that economic volatility has a direct effect on the economic agent`s dynamic portfolio selection (Choi & Oh, 2003). Omission of these variables in the money demand models estimated by earlier studies may lead to econometric problems of misspecification (Choi & Oh, 2003). More so, very few empirical studies that examine the effectiveness of monetary policy in SSA generally and money demand specifically applying the Divisia index money exists. This study filled the gap by introducing a relatively new approach, in the demand for money studies.

This study further extends the current literature more especially on the causal relationship amongst money and income, and between money and inflation using both the traditional simple sum aggregates and Divisia monetary aggregates adopting a

more advanced causality test (Toda & Yamamoto, 1995). Also, the study employs the ARDL method which accommodates variables with *I(0), I(1*) or a combination of the two integration orders, also with a dissimilar optimal lags the series might have, while it is not possible with traditional cointegration techniques (Pesaran et al. 2001).

Future studies looking at monetary aggregation and money demand function stability would find this research work a reference material. The findings of the study will surely be of benefit to the central banks of the respective countries and their governments because they have largely relied on simple sum monetary aggregate in monetary policy design and implementation. Households, firms, and other business concerns would find this study useful towards their portfolio decisions in holding money stock.

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1.6 Scope and Limitations of the Study

The focus of this study is on four SSA countries that maintained an independent monetary policy. These countries are Kenya, Malawi, Nigeria, and South Africa. The study is interested in these countries because the countries share similar socio-economic, financial, and historical characteristics. The study focused on the selected SSA for different reasons. First, the selected economies have witnessed an unprecedented performance in the economic growth and development over the past decades. Furthermore, statistical evidence has shown that the growth rate was at par with the emerging economies averaging about 5-6 % for Nigeria and South Africa (IMF, 2016). Second, the SSA countries' administrations have prioritize financial system modernization strategy enshrined within their expanded economic diversification plan (Hamdi, & Jlassi, 2014).

The selected countries are among the frontier and emerging market economies in the SSA. And they exhibit an active private sector led economic growth considering their deeper financial systems which has been attracting foreign investors into their financial markets. The countries are faced with serious economic challenges that is retarding the economic progress of recent. Inconsistencies in macroeconomic policies and political instabilities are some of the serious impediments to the economic progress of these countries.

Data availability is another reason that motivate the study's selection of the countries. The study constructs both narrow and broad Divisia monetary aggregates for the four SSA countries using the Barnett (1980) Divisia index and estimate money demand model for each of the selected economies using the aggregates to investigate the demand for money function stability for these countries. In addition, the study also investigates the causative link between money and the income, and money with inflation employing simple sum and Divisia aggregates.

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1.7 Organisation of the Thesis

This thesis is organized into five chapters. The first, Chapter 1 is the introduction of the study. Following, Chapter 2 contains a review of relevant literature. It reviewed the theoretic, and empirical literatures on the definition and relevance of money in an economy. Chapter 3 is the methodology of the study, it highlights the methods and econometric techniques used in the study. Chapter 4 reported the thesis results and findings, whereas Chapter 5 concludes the study with summary of findings, implications, and policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Concept and Measurement of Money

Money is at the centre of all modern economic and financial transactions. It facilitates all financial transactions and help avoid the double coincidence of wants problem identified with barter system. A vital question then is what is money? In a simple language, money is defined as everything that is largely acceptable in making payments for goods or services and for settlements of debts obligations (Walsh, 2010). This post a narrow view of money. However, what is considered as money depends on the function money does, that is its function as medium for exchange, its role as unit of account, as store of value and of course a standard of deferred payments. Friedman, & Schwartz (1969) definition of money view money from the role it plays and conceptualize money as what it actually does in facilitating transactions.

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The definition of money has been a topic of debate among researchers and policy makers originating over decades. Scholars offered several types of definitions and also different options for choosing a preferred definition among them. One method of defining money is based on its role in transactions. The role of money is broadly categorized into the medium of exchange and settlement of deferred payments, unit for account, and store for value (Handa, 2009). According to Hurn, (1991), theoretical definitions of money are faced with the issue of statistical separation and measurement. They further assert that definition of money differs among nations and that the identified differences to a larger extent depends on the importance placed on several roles of money. Yue and Fluri (1991), Walsh (2010), and Hancock (2005) all posits

that the medium of exchange role of money is the most important feature for money, because any instrument which does not accomplish such purpose could not be considered as money.

However, this narrow meaning of money is only limited to currency comprising of notes and coins and demand deposits of all types, excluding other financial resources such as savings accounts deposits, time deposits and treasury bills (Gazely & Binner, 2000). Nevertheless, scholars holding another view criticized this approach maintaining the position that it does not apply to practical situations and further asserts that no asset is in all circumstances acceptable as a means of payment (Gowland, 1991). Furthermore, financial innovations and other regulatory changes placed doubts on the usefulness of the medium of exchange definition of money. Financial modernizations and other modifications in the financial structure of a country make this narrow definition to change and further accommodate other financial assets such as savings deposit, time deposits, treasury bills that were previously excluded from the definition.

The financial innovations brought about interest payments on deposits and led to the consideration of money balances held for other motives. Practically, even if there are no interest payments on the transactional balances, money is usually held for other purposes such as precautionary and speculative motives (Keynes, 1936). In fact, these forms the foundation of Keynes liquidity presence theory. Keynes liquidity theory focus more on the store of value function of money instead of medium of exchange as highlighted by the proponents of the transactional approach.

The basic advantage of the store of value use of money is that it represents immediately realisable purchasing power, so that wealth held in this form can be spent or converted into other assets with a minimum delay or inconvenience. Friedman (1982) also placed importance on store for value role of money. He argued that money is just a temporary domicile for purchasing power because it enables individuals to distinct the act of purchase from that for sale. The proponents of liquidity approach pointed out that almost all financial assets can be converted into a means of final settlement, and they further believe that control of the more narrowly defined monetary aggregates may lead to the substitution of narrowly defined money for money-related financial assets.

These definitions clearly show that monetary theory has not provide a single practical definition of money, therefore different empirical criteria have to be evolved to establish the correct and most accurate definition of money. One of the empirical approaches brought forward is that the definition of money is mainly concerned with the policy questions of which monetary aggregate can best elucidate and forecast important macroeconomic variables such as nominal economic growth (Gowland, 1991). This approach performed better in its predictions than the other aggregates which were based on the medium of exchange and liquidity criteria (Handa, 2009).

Another vital criterion in defining money is the monetary authority`s aptitude to control level and growth of money. The degree of control depends on the operational variable and the sensitivity for money to these variables. Quantity of money express that monetary stock is vital in determining the long-term price level. Contrary to that, the monetarists states that in the short-run money influences real activity (Froyen, 2005). Alternatively, there exist a link between money (monetary aggregates), inflation and other macroeconomic variables.

These relationships are targeted at maintaining a stable macroeconomic environment, thereby making money an integral part of monetary policy (Gazely & Binner, 2000). In a more recent framework for monetary policy decsions, there appears to be often no explicit function for the money due to an empirical evidence showing a breakdown in the relationship between money and macroeconomic variables (Binner, et al. 2004). This breakdown caused a change in monetary policy frameworks with most central banks moving towards the use of short-term rate of interest.

The postulation is that monetary policy will influence macroeconomic variables like inflation and gross domestic product more directly without the use of money stock. Although central banks are not targeting money directly in monetary policy implementation, they use money market to influence the short-term interest rates, thereby making money still an essential tool for any macroeconomic model that is aimed at influencing real output growth through factors like investments (Soderstrom, 2001).

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Since monetary theory did not offer a single practical meaning or description of money, various empirical criteria for establishing this definition have evolved over time. However, as financial deregulation was carried out and innovation in the payment technology increased in the past decades, both the relative conduct of the arithmetic sum aggregates in explaining nominal income and the stability of the money made these definitions became doubtful (Barnett, 2012). The further quest for the best definition of money led to explorations in the theory of aggregation.

2.2 Types of Monetary Aggregation

The functional role of money in the economy is based on its accurate measure (Friedman & Kuttner, 1992). The search for the most appropriate meaning and

measure of money resulted into the study of monetary aggregation theory. The theory of monetary aggregation refers to the process of summing together the various monetary components that are regarded as sources of monetary service. The economic aggregation theory also indicates the techniques of selecting monetary assets for the monetary aggregates, and the construction of aggregator functions (Belongia & Binner, 2000). Over the last century, economic measurement has been given a great attention in economic research and policy design. Economic measurements include monetary aggregation and index number theories. However, the most commonly known applications of economic measurements are the Consumer Price Index (CPI) and national accounts. These are accounting forms of measurement (Barnett, 2012).

Economic measurements go beyond the mere addition of individual components to arrive at a figure. This contrast the underlying economic theory (Barnett & Chauvet, 2011). Computations and use of monetary aggregates are essential issues to both researchers and policy makers in the modern monetary and macroeconomic framework.

The policy makers need the aggregates for the design of policies to curb inflation, to enhance economic growth, reduce unemployment rate and sustain stability in the economy. Researchers use monetary aggregates in studying money demand function or in estimating a more complex macroeconomic model of a given economy. Studies on the concept of weighted monetary aggregates becomes more popular in the economic literature in the 1980s.However, its origin can be traced to the work of Chetty (1969). Later studies such as Roper and Turnovsky (1980), Spindt (1985), Rotemberg, and Woodford (1997) and Barnett (1980) follows with the publishing of Barnett (1978) seminal work on Divisia index. Nevertheless, in most empirical studies

Barnett (1980) Divisia monetary aggregates has appeared to be the most popular method preferred in the literature. There are different approaches to monetary aggregation and they are reviewed in the subsequent sub-sections.

2.2.1 Simple Sum Method

This is the most common method of monetary aggregation. It is a method of summing together heterogeneous financial assets to construct aggregates such as the narrow simple money (SM1) and broad simple money (SM2). It is done by identifying the specific aggregates through defining which financial assets to include and then simply sum together the selected components, hence the name "simple sum" (Yue & Fluri, 1991; Barnett, 1984). Barnett (1980) defines the simple sum as a stock of monetary assets needed in governmental or public accounting or in bank accounting as required by banks, but not an appropriate measure of structural economic variables.

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The simple sum monetary aggregates are computed by simply summing up together different monetary components such as demand deposits, savings deposits, time deposits.

This is given as;

$$S_t = \sum_{i=1}^{N} M_{i,t} \tag{2.1}$$

where S_t represents the simple sum monetary aggregate (such as SM1 or SM2), $M_{i,t}$ is the i^{th} money component holding at time period t (example demand deposits, savings deposits) and N indicates the total sum of monetary components being

considered(depending on the definition and composition of each monetary aggregate in a particular country).

Equation (2.1) is a linear measure of the aggregate components without taking their respective weight. It indicates a simple summation of the individual monetary components which implies all numerous components are perfect alternates of one other. An impracticable assumption. The first underlying assumption of simple sum aggregation method get its origin from the orthodox economists postulation that the basic and most significant task for money is that of medium for exchange. The second assumption is that all monetary assets are perfect substitutes, disregarding their respective different levels of moneyness (Serletis & Gogas, 2014). However, their assumption of perfect substitution among various monetary components is the major weakness of the simple sum method (Barnett, 1980). Perfect substitutability implies that the assets holders face a linear indifference curve, signifying that an individual assets holder can maximize his utility by holding either a single monetary or financial asset bearing a least opportunity cost, or having an undefined mixture of monetary assets with each specific asset sharing similar least opportunity cost. In real terms, these monetary asset behaviours are never realistic in real world situations, where individual household keep a diverse portfolio for monetary or financial assets having various opportunity costs (Baumol, 1952).

Researchers have for long identified the shortcomings of the simple sum method of money aggregation. For instance, Fisher (1965) describes the arithmetic simple index as one of the worst form of index numbers in use and proposed the abandonment of the index. Friedman and Scwartz (1982) also criticized the arithmetic simple sum method. They argued against the procedure of simple sum index, where monetary

assets are regarded as having zero degree of moneyness as unrealistic. They rather argue in favour of a procedure where different monetary assets are assigned with a weight that measures the degree of moneyness of each assets component. They further posit that the weight of each assets component will be between zero and one with a weight of one assigned to a component that has the highest degree of moneyness.

Basically, there are two major criticisms of the arithmetic simple sum approach to monetary aggregation in the literature. The foremost criticisms of the simple sum are that they fail to distinguish between components assets in them. Therefore, they consider all individual assets components to be same in terms of their performing the role of money. In other words, the simple sum aggregation hold the assumption of a constant elasticity for substitution between the monetary instruments. Secondly, because arithmetic sum aggregates are arrived at with the use of an adhoc judgements of the employees of central banks globally, considering the components of financial or monetary assets that will form part of the admissible assets to sum up in measuring money. This is referred to as weak separability issue.

For example, according to Chetty (1969), Moroney and Wilbrate (1976) and Boughton (1981) the monetary or financial assets are not perfect substitutes for one another. They further postulated that each monetary asset bears a certain level of `moneyness` attached to it.

2.2.2 Variable Elasticity of Substitution

This is an asset substitution approach to monetary aggregation. The variable elasticity of substitution (VES) originates from pioneering work of Chetty (1969). Applying VES method, monetary aggregates can be constructed by estimating cross-elasticity

for substitution between a particular type of asset with a reference asset that is designated to be the most liquid asset. Estimates of the assets weights are derived from the marginal conditions of the maximized utility function subject to the budget constraint.

From this perspective, Chetty becomes the first to use microeconomic based aggregates theory to provide a definition for money. He for the first time provided an estimate of a neoclassical aggregator function enshrined inside a controlled optimization decision. Chetty utilized the Constant Elasticity for Substitution (CES) utility function as the aggregator function in his analysis. He applied CES function in studying the substitution of money with other related financial instruments. He expressed a CES in utility function form as;

$$U = \left(\beta_1 M^{-\rho} + \beta_2 T^{-\rho}\right)^{-\left(\frac{1}{\rho}\right)} \tag{2.2}$$

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where, U is the utility, M is money asset holdings and T is time deposits for the subsequent period.

Equation (2.2) represents a general function that is expected to provide an appropriate approximation of the actual utility function (Chetty 1969). Using the ordinal utility, a parameter β_1 is assumed to be equal to unity.

Assuming an individual consumer maintains a cash holding of M_0 amount of money and need to allocate his total money holding between M and T. Assuming also that T stands for the money value for time deposits for the subsequent period and i is the

return rate on current period time deposits, a consumer budget constraint can be expressed as;

$$M_0 = M + \frac{T}{(1+i)} \tag{2.3}$$

where M_0 represent total sum of consumer`s cash holding. The consumer`s utility maximisation level given as;

$$U\left[T(1+i), M\right] \tag{2.4}$$

Subject to a budget constraint;

$$M + T = M \tag{2.5}$$

where *T* is volume of current period time deposits. Alternatively, the budget line has a slope represented by $-(1+i)$; therefore $(1+i)$ will be regarded as a ratio for the prices of *M* (money) to *T* (time deposits).

When the consumer maximised his utility function subject to the budget line in Equation (2.3), he obtains the following marginal conditions;

$$\frac{\partial U}{\partial M} = \lambda \tag{2.6}$$

$$\frac{\partial U}{\partial T} = \lambda \Big/ (1+i) \tag{2.7}$$

and,

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$$M_0 = M + \frac{T}{(1+i)} \tag{2.8}$$

where λ is a Lagrange multiplier. Equation (2.6) is divided by Equation (2.7) and obtain;

$$\frac{\beta_1}{\beta_2}\left(\frac{M}{T}\right)^{-\rho-1} = 1+i \tag{2.9}$$

And then take logarithms for both sides, rearrange the terms and add the error term to derive a regression model of the form;

$$\log\frac{M}{T} = -\frac{1}{1+\rho}\log\frac{\beta_1}{\beta_2} + \frac{1}{1+\rho}\log\frac{1}{1+i} + e \tag{2.10}$$

Substituting data for *M*, *T* and i into the model, and holding the usual assumptions concerning the error term, least squares method can be utilized to estimate $\frac{1}{1+\rho}$ together with the intercept.

Conversely, using the intercept term, an estimate of $\frac{\beta_0}{\beta_1}$ can be obtained and further utilizing a rule of normalization the β_1 and β_2 can be estimated.

The elasticity of substitution for money (M) and time deposits (T) can be expressed as; $\sigma = \frac{1}{1+\rho}$. Therefore, using the model a test can be conducted to confirm whether a financial instrument is a substitute or not.

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After obtaining the parameter estimates of ρ, β_1, β_2 (assumed to be unity), then the new monetary aggregate $\left(M^*\right)$ can be derived by substituting the values into Equation (2.10) and obtain,

$$M^* = \left(M^{-\rho} + \beta T^{-\frac{1}{\rho}} \right) \tag{2.11}$$

This method has an important advantage in its ability to estimate directly the level of switch between money and other near money assets which the simple sum method could not do. Chetty (1969) further affirmed that there exists a close substitution effect between money and other monetary instruments, and that their degree of substitution could be ascertained.

The main shortcoming identified with the VES method are that some variables seem to be simultaneously related since their amounts are determined simultaneously in the optimisation procedures. Secondly, a problem arises from the non-stationarity of the values of the assets considered for the monetary aggregates (Gebregiosis & Handa, 2005). The construction of the VES are limited in their usefulness because of the form of their aggregation function specification, and also by the use of cost instead of the user cost of assets, which is directly used in computing the level of substitution among money and near money assets.

2.2.3 Currency Equivalent

The Currency Equivalent (CE) is similar to the simple sum method only that a simple weighing mechanism is added in the CE index. The CE is time-varying weighted averages of the stocks of different monetary assets with weightings which depend on

each assets yield relative to that of a benchmark zero liquidity. It is a utility-based monetary aggregate.

The CE index has the advantage of a simpler interpretation compared to the other methods. The approach also has an attractive property of putting the assets that do not yield interest such as currency and travellers cheques together and adding them with weights of unity. These monetary assets are summed up with weights of between zero and unity and assets with higher returns receiving lower weights.

Intuitively, given that high yield assets provide lower liquidity services. However, the benchmark assets do not add anything to the CE aggregate. Unlike the simple sum method which fails to adjust to the new monetary assets resulting from improvement in financial innovation, the CE method can easily take care of the changes in financial environment. Introduction of new assets into the financial system such as interest-bearing accounts, can easily be added to the CE aggregate without much complication. The issue of ascertaining whether a financial asset is liquid enough to be added in the CE monetary aggregates is solved by reference to the individual assets interest yields (Rotemberg & Woodford, 1991).The CE and Divisia index differs in a similar way with the traditional sum index. While CE index is stock measure, though distinct from that of simple sum stock measure, Divisia type index is a flow measure. In an explicit term, the CE measures monetary wealth stock whereas the Divisia type index measures monetary services flow.

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2.2.4 Divisia Index

The weaknesses found in the traditional measures of money such as the simple sum aggregates and its effects on the previously established money demand relations in the

late 1970s and early 1980s open up interest in further investigation into the role of money in the economic activities of a nation. Researchers resorted to developing a micro foundation for money demand theory.The research focus shifted from the analysis of an economic agent`s willingness in holding money considered as a separate problem to wider money demand theory on the basis of concurrent households and business unit's manufacture and consumption choices.

Barnett (1978, 1980) traced the failure of monetary aggregates in policy implementation to the exact limitations identified with the simple sum aggregation procedures. Under the simple sum method, different monetary assets were given an exact and intertemporally fixed weight. Central banks faced with imprecisions and inconsistencies in applying simple sum type aggregates as their main policy variables discarded the use of money as a monetary policy target entirely. Barnett (1980) proposed and advocated the adoption of Divisia index aggregates which are theoretically accurate on the basis of economic aggregation and the index number theory.

Moving away from the traditional way of computing the quantity of money available in a country, the Divisia index as proposed by Barnett (1978, 1980), do assess the utility an individual consumer derives by having a portfolio of various monetary assets. Money according to this analysis is regarded just like other goods, a consumer durable asset which yield monetary services to the consumer. The services to be derived from holding a monetary asset are usually done by various monetary or financial assets having various liquidity level which tends to directly correspond the quantity of monetary or financial assets in possession. Modelling monetary assets is derived from an individual representative`s maximizing behaviour. An individual consumer

maximizes his utility from the combination of real monetary or financial assets, other non-financial goods or services based on his own budget line. The micro aggregation approach to demand for money treats monetary or financial assets as a durable good providing an array or flow of monetary services to individual consumer.

To derive an individual aggregation of monetary assets, assume the individual household representative is confronted with challenge of assigning his earnings between consumption of commodities, leisure, plus other services of financial resources. He has to select from an array for consumption goods (cg), the leisure amount (ℓt), and several other services from monetary assets (x) to maximize his utility *U* given by:

$$U(cg, \ell t, x) \tag{2.12}$$

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Subject to a budget constraint,

$$q_c^1 + \rho_m^1 + \omega\ell = Y \tag{2.13}$$

where cg is the consumption goods, ℓt stands for leisure time, x is the monetary asset services as earlier specified. *Y* is income while prices are identified as wage rate; q is consumption goods price and ρ opportunity cost or user costs for a monetary asset (Barnett, 2012).

A consumer is expected to handle a two-stage decision making process. At the first decision making approach, the consumer budgets his expenditure among a different expenditure category made up of consumption goods, monetary services and leisure based on their respective price indices. Secondly, the individual consumer shares his

total expenditure on each category of the expenditure among the separate goods within each class (referred to as decentralization).

The dual stage approach in solving the individual consumer selection issues will be made possible only when a utility function made to be separable weakly in monetary asset services. This implies that the utility function must possibly be expressed using monetary services aggregate function denoted as $u(ms)$ being distinct disagreement from the individual consumer`s utility function:

$$U = f\left(cg, \ell t, u\left(ms\right)\right) \tag{2.14}$$

where U represents the monetary sub utility function. The monetary sub utility function, $u((ms_1,...,ms_n)$ is the aggregation function that measures the monetary services amount that is derived from keeping monetary assets. Going by the above analysis, if $ms_1^*,...,ms_n^*$ indicates the maximum quantities of the monetary or financial assets an individual user decides to choose, it then signifies that the aggregator function which determines the monetary aggregate of the form;

$$M^s = u\left(ms_1^*,...,ms_n^*\right) \tag{2.15}$$

However, the precise procedure of this aggregator function is typically unknown. It was Barnett (1980) using Diewert (1976) who found that the aggregator function at the maximum quantities of $M^s = u\left(ms_1^*,...,ms_n^*\right)$, can be rounded up by a given statistical index number. Using the inter-temporal utility approach, Diewert (1976) provides the theoretical foundation for durable and non-durable commodities.

Barnett (1978) derives the user cost for monetary or financial assets which provides a method for the preparation of an illustrative consumer`s choice issues regarding consumer goods, relaxation with the services of monetary or financial assets. Barnett, call it a Divisia index drawing from Francois Divisia a French Economist who proposed the said index in 1925 (Barnett, 1978). Barnett (1980) applied Divisia index to produce a monetary aggregate based on the weight of each component in the aggregates. The Barnett`s Divisia index separated transaction function for money from other functions. Our analysis in this research will draw from the Barnett (1980) Divisia approach to monetary aggregation.

Among the highlighted monetary aggregation methods, Barnett (1980) argued that Divisia is superior. Barnett has demonstrated that Divisia index share a common features with the Fisher ideal indices because the two fit into the common group for superlative index, therefore, they move collectively. Barnett (1980) further pointed out that Divisia index is ideally the most useful index for policy making because it is the most easily understood type of index number among the Diewert`s (1976) superlative index numbers. In support of that argument, Ishida (1984) show that Divisia index is the best statistical index. User cost is the main distinguishing feature of the Divisia index with other indexes. The concept of user cost is elaborated as follows.

2.3 Concept of User Cost of Money

Divisia index is built on the theory for consumer demand and economic aggregation theory. It handles monetary assets as a consumer household durable just like other consumer durables such as automobiles, lap top computers, television, and the likes. These are basically kept for the stream of utility they do render through monetary

services they offer. The service price for a given financial assets reflects the rate of interest foregone in order to derive the assets`s own services. Here foregone interest solely depends on the variance amongst the amount of interest collected through keeping a monetary instrument with that of the higher foregone benchmark interest rate, conceptualized as return rate over a pure investment own capital, offering zero monetary or financial services (Barnett et al. 2013).

The user cost measures the prices of the monetary assets which are regarded as durables. It approximates the value for financial asset`s service stream over a single currency unit of the asset detained. The income foregone from holding a given monetary asset instead of an asset that generates higher return tends to be proportional to their own or hire rate. Currency outside banks and demand deposits do not earn explicit returns and therefore have the highest user cost (Belongia & Ireland, 2015). Accordingly, they acquire the biggest weights in the measure for Divisia. From another point, pure store for wealth instrument such as liquid cash get zero weights.

Construction of a user cost becomes subject to a choice of benchmark asset. According to Goldfeld *et al.* (1976), a benchmark asset cannot be easily identified, defined or it may not even exist. Therefore, with that constraint, the value and quality of the Divisia monetary aggregates is predisposed by the chosen benchmark asset. However, Barnett (1982), show that the benchmark asset is the one that is held only for accumulating and transferring wealth across time and its rate of return should be the highest in the economy.

The benchmark asset is a non-monetary asset and thus, provides no transaction services (Barnett 1978). Majority of the studies on Divisia monetary aggregates

utilized the highest available interest on a given set of monetary assets (Dahalan et al. 2005). Barnett *et al.* (2013) agree on this point and further note that the function of benchmark asset is to establish a non-monetary substitute. It is suitable for this to be a dissimilar asset in every period, since the maximization is repetitive every period. Practically, the benchmark rate for a monetary asset is conceptualized in a certain manner that a realized or obatined user costs of the assets appears to be positive. This method of selecting the benchmark rate will avoid the problem of negative user costs (Serletis & Gogas, 2014).

Therefore, it is for this reason that the benchmark rate is made to dominate all rate of return of monetary asset components.

2.4 Theoretical Framework

Barnett (1978, 1980) theory for monetary aggregation as revised in Barnett *et al*. (2013) serves as the guiding theory in the construction of the Divisia monetary aggregates and their application to the money demand analysis. The study applied the Barnett *et al* (2013) monetary aggregation theory in constructing the Divisia index money aggregates and the quantity of money theory, Keynesian, and Friedman demand for money theories in investigating the empirical link between the Divisia money aggregates and the variables influencing the money demand function in the selected SSA countries.

2.4.1 Divisia Monetary Aggregation Theory

Barnett (1978, 1980) first introduced the index number theory into monetary theory. He merged the economic index number theory and the monetary theory using Diewert`s (1976) unifying approach in generating “superlative” approximations to an

exact aggregate from consumer theory of demand for money. As a result, this approach produced what is known as the Diewert-Superlative measure of monetary services flow which a consumer receives from his portfolio holding of monetary assets.

Barnett (1978, 1980) applying principle of microeconomics hypothesis and the index number hypothesis derives the Divisia monetary index. Barnett (1980) made an assumption that a consumer can maximize his utility from choosing the optimum value for monetary assets and other consumption goods, in which monetary assets too are regarded as consumable durable goods. In that respect, a consumer optimizes his or her own intertemporal utility over a given planning horizon for a *T* time period in each period. Thus, his or her intertemporal utility function is given as;

$$MaxU\left(m_t,...m_{t+T};v_t,...v_{t+T};A_{t+T}\right) \tag{2.16}$$

where, for all the s contained in $\{t,t+1,...t+T\}\, m_t$:

$M_t=\left(m_{1s},...,m_{ns}\right)$ is the vector of real stocks on n monetary assets.

$v_s=\left(v_{1s},...,v_{ns}\right)$ is vector of quantities of h non-financial goods and services,

A_{t+T} Is the real stock for benchmark monetary asset, kept during the last period for planning horizon at the date $t+T$

T represents a consumer`s own planning horizon.

This is however, depends on the below multi-period budget constraints for s constraint in $\{t,t+1,...t+T\}$:

$$\sum_{i=1}^{h} p_{is}v_{is}=w_s l_s+\sum_{i=1}^{n}\left[\left(1+r_i,s-1\right)p^*_{s-1}m_{i,s-1}-p^*_s m_{i,s}\right]+\left[\left(1+R_{s-1}\right)p^*_{s-1}A_{s-1}-p^*_s A_s\right] \tag{2.17}$$

where P_s is the $hx1$ vector of expected goods and services prices at date S, W_s is the wage rate at date S, while l_s is the amount of labour supplied during period S, r_s is $(r_{is},...,r_{ns})$ vector of expected nominal return on monetary istrument i at date S, and P_s^* is the true cost of living index at date S, R_s is the nominal holding period yield for benchmark asset, and A_s is the real quantity of the benchmark asset which appears in the utility function only at a last period of a planning horizon that is $t+T$.

The real benchmark asset A_s under this assumption offer zero monetary services except in the last period but is maintained in the function solely for transferring wealth inter temporally (Barnett, 1980). Different assets can represent a benchmark asset in each period, but basically its main function is to provide an alternative non-monetary asset.

In this case, the representative economic agent maximizes his inter temporal utility function through selecting the optimal value of; $(m_t,...,m_{t+T};v_t...v_{t+T};A_t...A_{t+T})$ within a specified budget constraint. The Barnett (1980) model expressed that to optimize a particular consumer`s problem as stated above, the followings are produced:

$$\frac{dU(m_t,q_t)/dm_{it}}{dU(m_t,q_t)/dm_{jt}}=\frac{\pi_{it}}{\pi_{jt}} \tag{2.18}$$

$$\pi_{it}=p_t^*\left(\frac{R_{it}-r_{it}}{1+R_t}\right) \tag{2.19}$$

where $m_t^*=(m_{1t}^*,...,m_{nt}^*)$ represents the present period, optimum financial assets held;

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$q_t^* = (m_{t-1}^*, ..., m_{t-T}^*; x_t^*, x_{t-1}^*, ..., x_{t-T}^*; A_{t-T}^*)$ Stands for the optimum vectors for all the other choice variables and for the previous periods of financial assets, and π_{it} represent a nominal user cost or price of the present period financial asset.

Barnett (1980) asserts that the intertemporal utility function represented as U has a very weak separability in the present time consumption for goods and financial assets. This assumption made it easier to re-write the utility function thus;

$$U\left(f\left(m_t\right), m_{t-1}, ..., m_{t-T}; v_t, ..., v_{t-T}, A_{t+T}\right) \tag{2.20}$$

The substitutability function from Equation (2.20) $f\left(m_t\right)$ is the monetary quantity aggregator function. Only current period monetary assets are included in this function. It therefore measures the quantity of the current financial services which a consumer obtains from keeping a financial asset, $m_1, m_2, ..., m_n$.

Assuming a utility model that is considered weakly separable in the present financial assets in addition to being linearly homogenous, the dual-stage model for budgeting for the consumer behaviour signifies the presence for a monetary aggregation function. At an initial stage, a consumer optimizes his utility by allocating his budget across a very wide category of assets, which includes; monetary assets $\left(m_t\right)$ and other non-monetary assets like good and services $\left(v_t\right)$, thereby driving their optimal expenditures. In the next stage, consumer assigns his own wealth among each class while optimum expenditures got assigned within a current-period financial asset.

However, for financial assets, the consumer selects the optimum current period financial or monetary assets $m_t^* = \left(m_{it}^*, ..., m_{nt}^*\right)$ in this second stage subject to the

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optimal sum expenditure for the first stage chosen monetary assets. The current period optimal quantities of monetary assets solve the following maximization problem;

$$Max \;\; f\left(m_t\right) \;\; \text{subject to} \sum_{i=1}^{n} m_{it}\pi_{it} = y_t \tag{2.21}$$

From the preceding discussions, the specific aggregation function is ususally unknown. This therefore, signifies the need to place some specific restrictions over the type of a utility function.

Barnett (1980) provides another way for estimating the stated aggregator function using the index number theory. This can be used to produce a statistical based index number having zero unknown parameters and is specification-free. It is further advanced that in continued period, the well-known money stock Divisia index, which Barnett (1980) advocated can be used to track aggregator function exactly without any errors. This is expressed by the following differential equation;

$$\frac{d\log\left(M_t^{D}\right)}{dt} = \sum_{i=1}^{n} w_{it}\,\frac{d\left[\log\left(M_{it}^{*}\right)\right]}{dt} \tag{2.22}$$

Where, w_{it} is the monetary share given by;

$$w_{it} = \frac{M_{it}^{*}\pi_{it}}{\sum_{j=1}^{n} M_{jt}^{*},\pi_{jt}} \tag{2.23}$$

Nevertheless, opposed to the continuous time, in discrete time there is no exact statistical index representing a random aggregation function. But Diewert (1976) has defined a class of index numbers which he called a superlative index numbers and they are exact for second –order approximations to an unknown economic aggregator functions.

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These superlative index, according to Barnett, is the exact for a second-order approximations for unknown aggregator functions. Barnett (1980) further explained that a Tornqvist-Theil type Divisia index that make provision for a discrete time period approximation for the maximum Divisia continuous period of time quantity index falls within the category of the superlative class as defined by Diewert (1976). It is expressed as;

$$M_t^D = M_{t-1}^D \prod_{i=1}^{n} \left(\frac{M_{i,t}^*}{M_{i,t-1}^*} \right)^{\frac{1}{2}\left(w_{it} + w_{i,t-1}\right)} \tag{2.24}$$

where M^D is the Divisia index money aggregate.

$$\log M_t^D - \log M_{t-1}^D = \sum_{i=1}^{n} \varpi_{it} \left(\log m_{it}^* - \log m_{i,t-1}^* \right) \tag{2.24}$$

where $\varpi_{it} = \frac{1}{2}\left(\omega_{it} + \omega_{i,t-1}\right)$

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Equation (2.24) suggests that Divisia index growth rate can be an arithmetic weighted average for growth rate of monetary assets. It is theoretically derived from the economic aggregation theory and first-order condition of utility optimisation. Hence the Divisia money index try to distinguish between the transactional roles for money with other distinct functions of money. The index also assesses the satisfaction level that a consumer attains by keeping a portfolio of various monetary or financial assets rather than just taking a measure of the quantity of money held in a particular country.

Monetary assets differ in their ability to facilitate transactions because not all monetary assets are perfect substitutes as the simple sum approach assumed. Considering that

notes and coins offer quite different transaction services from the interest-bearing deposits, these monetary assets should bear different weights using the Divisia index. The distinguishing feature in Barnett`s Divisia index approach is the user cost of money as expressed in equation (2.25). According to Barnett (1978), Monetary asset's user cost can be defined as the discounted value for the foregone interest by holding the liquidity yielding monetary instruments instead. The monetary asset user cost is given thus;

$$P_{it} = P_t^* \left(\frac{R_t - r_{it}}{1 + R_t} \right) \tag{2.25}$$

where, r_{it} is the earnings on the i^{th} asset, R_t is the expected period holding yield on benchmark asset, and P_t^* is the actual cost of living index.

Using the user cost theory, Barnett (1980) derived the aggregator or composite function which measures the quantity or amount of monetary services a consumer received by holding a monetary asset. Barnett further established that the aggregator function of a consumer at his optimal utility level can be computed using a statistical index called the Divisia index. User cost procedure assumed that benchmark asset bears zero liquidity or no money services, rather, it is kept only for transfer of wealth. Theoretically, R is considered as the maximum estimated holding period earning in an economy. Practically, it is often defined in such a manner that a user cost for the monetary assets is positive (Barnett et al. 2013).

This study will use the Barnett (1980), Barnett *et al.* (2013) approach to construct the Divisia money aggregates for selected SSA countries. No available study has constructed the Divisia monetary aggregates for the SSA before now. The Divisia index weight each component asset based on their different degree of moneyness which can take care of financial innovations comprising the changing relative

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component of the assets. As it reflects general costs with benefits for every monetary asset component in order for its usage to enhance consumption, Divisia index therefore, is in principle very good from the monetary theory view point. Additionally, none among the unrealistic assuptions of the simple sum type aggregation technique are enforced by the Divisia index aggregation method (Barnett, 2012). Another important advantage of Divisia type index is its ability to take care of the exact quantity of monetary services as the different weights employed to create the index number are a user cost assessed value shares (in place of a price).

This connotes that a variation in the element of a particular monetary or financial assets component results to a variation in the aggregate`s Divisia index, and also, the degree of the variation in the Divisia index is precisely the same with that of a monetary services flow triggered by the monetary component asset variation.

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2.4.2 Theories of Demand for Money

This section will survey the theoretical postulations for money demand demand. The basic features for money that serves as a foundation for all theories by macroeconomists and monetarists are three; first, money is utilized as a modern acceptable medium for exchange, and a traditional unit of expressing prices and debts. This function led to the formulation of transaction models whose assumptions are based on the notion of a known level of transaction and that net influxes are handled with others and regarded as indeterminate.

More so, medium of exchange function of financial instruments help to boost economic efficiency through the reduction in the foregone cost in exchanging physical

services and other related goods. The additional feature of financial or monetary assets is that of a value store. This attends the objective for the purchasing power preservation. Although some assets might serve as a value store, they are by no means different from money because they may have a return for capital gain or loss. Such assets include equity and bonds which may have some transaction costs to be converted into money.

Alternatively, individual have the willingness to keep money for the feature of convenience with liquidity the monetary asset possesses. Thirdly, another feature of cash or its equivalent is that of the role for a unit for account, meaning prices can be expressed in monetary terms. Economists generally reached a consensus that the money demand is basically the demand of real cash balances (Lucas & Nicolini, 2015). With the dynamic nature of economies, financial assets that usually serves as medium of exchange role keeps changing overtime, just as the change in elasticity of substitution between monetary assets.

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The theoretical foundations of money demand in the existing literature lay emphasize on the transactions purposes, speculative purposes, and the precautionary purposes for holding money and are well expressed in the literature. Relevant theories among which are; the classical quantity for money theory, Keynes (1936) postulations under the liquidity preference hypothesis, Baumol (1952) and the Tobin (1969) inventory approach theories, Friedman (1956) restatement for quantity theory proponent's arguments, and that of the Cambridge monetarists version. The theories address a wide range of hypotheses but significantly share a similar important variable as determinants of money demand across virtually all of them (Arango & Nadiri, 1981). These theories share common factors (variables) as scale variables and opportunity

cost variables. Sriram (2000) contends that a general consensus in money demand empirical analysis is that all empirical studies on the subject matter is inspired by a combination of theories. From a general perspective, the theories established the association of the stock of money demanded by an economic agent with a set of identified variables thereby connecting money to the real economic sectors (Arize, 1994).

Subsequent sub-sections discuss the various theories and postulations on the demand for money function.

2.4.2.1 Quantity Theory of Money Approach

This theory was traced to the works of orthodox economists; Fisher (1911) and the Pigou (1917), and they express function of money as medium of transaction. The underlying position of the quantity theorists is that any variation in money supply will lead to an equal and exact alteration in the level of price. Money is assumed to be neutral having no influence on real economic variables. Fisher (1911) in his equation of exchange expressed the institutional details for payment mechanism. Pigou on his side emphasized on the concept of individual`s money holding which is denoted as the Cambridge Approach. These are discussed below:

2.4.2.2 The Irving Fisher's Exchange Equation

The Fisher`s exchange equation is expressed as;

$$M^{s}V = PT \tag{2.26}$$

where, M^S is money supply, V is money`s velocity for transaction, P is level of price, T is transactions volume. Equation (2.26) places importance on transaction money demand, and the equation is just an identity because it is a truism that amount of money multiplied by a total number of times is used to purchase goods is equivalents to quantity of goods and services multiplied by their prices.

Fisher made two assumptions; first that velocity for money is fixed in the short- run and is built on the idea of velocity can only be influenced through the organisations and of course through technology which changes gradually over a time period. Secondly, just as with other classical scholars, Fisher also maintain the position that the two variables; adjustable wages with prices do guarantee the production, Y in order to reach a level of full-employment, and it is assumed constant also in the short-run.

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Putting together the two assumptions and further taking a look at the Fisher's equation, it is expressed as;

$$MV = PY \tag{2.27}$$

From the assumption of constant V and Y , then any change in M must lead to a change in P in order to maintain the equality relationship amongst MV with PY. Basically, this is the quantity of money postulations/ theory. Any alteration in money stock supply, M results to exact alteration in level of price P .

Fisher`s theory is limited by the fact that velocity cannot be constant even at the short-run level (Keynes, 1936). Velocity cannot therefore be independent of money supply changes in an economy. In reality, any variation in the supply of money is not fully

absorbed by the level of price changes. This view also fails, for reason that vast empirical evidence failed to support direct proportional relationship among the two variables; money supply and price level (Friedman & Meiselman, 1963).

2.4.2.3 The Cambridge Money Demand Approach

The Cambridge approach is ascribed to the Cambridge University Scholars; Pigou (1917) together with Marshall (1920), who built up divergent view regarding quantity of money theory approach. The scholars introduced the concept of utility into the quantity theory using individual behaviour, and argued that money, apart from being accepted as a medium of exchange, also yields a utility. They expressed their demand for money as;

$$M^d = l.PY \text{ or } \frac{M^d}{P} = lY \tag{2.28}$$

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where, $l = \frac{1}{v}$ indicates the percentage of nominal income an individual is willing to hold as money. The Cambridge approach formulated their quantity theory by incorporating the money market equilibrium assumption of the classical economists. In line with the classical ideas, they assume a level of full employment for real income, Y and a fixed income velocity, V . Here the level of price moves proportionately with the quantity of money thereby making money to be neutral.

2.4.3 The Keynesian Approach

In contrast to the postulations of Fisher (1911) and the Cambridge approaches, Keynes (1936) posits that money velocity is not constant over time. He introduced into the

money demand analysis, the role of interest rate and also pointed out the function of money for being a store for value in addition to its function as a means for exchange. Using his liquidity preference theory, Keynes identified three reasons for holding money; transaction, precaution, and lastly the speculative motives.

The transaction motive of Keynes was built on a similar paradigm with the quantity theory regarding the function of money as a means of settling transactions. In his postulation, there is a stable and positive association amongst the transactions money demand and income level. To take care of uncertainty regarding future payments an individual plan or have to make a plan, and people keep additional money to take care of unexpected needs. Precautionary money demand by individuals is solely defined by the transactions volume he anticipates doing in the future, his income level and to some extent, the interest rate.

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Keynes major contribution to the demand for money theory is the speculative money demand which places importance on store for value role of money, which according to Keynes, negatively depends on interest rate. He postulated a world of two categories of financial assets; financial bonds and money. While money can be regarded as a seamlessly liquid instrument, it does not earn interest. For that Keynes categorized all those non-interests bearing assets as money. Bonds are made up of all interest bearing financial assets. The interest bearing monetary instruments posses less liquidity but bears interest earnings. The future rate of interest determines the price of bonds individuals are willing to pay.

Individuals tend to keep money in anticipation of a rise in interest (and a corresponding reduction in bond prices), and vice versa. In addition, Keynes introduced the

"Liquidity Trap" concept into the money demand analysis. Under Keynes liquidity trap, interest elasticity for money demand at a lesser level of interest tend to be infinite. Keynes corroborates Fisher`s idea on stability for transaction money demand. He holds the believe that money demand in an economy is usually controlled by the individual`s speculative and unsteady behaviours, thereby making it unstable. Critiques of the Keynes explanation for speculative demand of money condemned his assumption that individuals should keep their liquid assets either in money or bond form, but not both. Tobin (1958) put forward an argument that individuals always spread their assets holdings to minimize risk.

Joining together above three categories for money demand as Keynes suggested, the Keynesian liquidity preference framework that explains total money demand function is expressed as:

$$\frac{M^d}{P} = f(r, Y) \tag{2.29}$$

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where; $\frac{M^d}{P}$ is the demand for real balance, r is the nominal interest, and Y real income. From equation (2.19), $f_1 < 0, f_2 > 0$, where f_1 signifies a partial derivative for f (.) in respect of its ith argument. This implies that money demand (real money balances) has a negative relationship with nominal interest, r , and a positive relationship with real outpu, Y .

2.4.4 The Friedman`s Approach to New Quantity Theory

Friedman (1956) postulations of the quantity theory differs with the Keynes and other classical scholars. He did not consider the reasons for keeping money by people but

rather consider money as a type of wealth instrument. According to him, motives of individual in choosing several types of financial instruments to keep their possesions in terms of wealth has been the underlying problem in money demand explanations. He incorporated the theory of asset with transaction demand for money hypothesis in the framework of the neoclassical microeconomic consumer and also producer behaviours theories. Friedman (1956) posits that demand for cash balances also be treated just like demand for normal goods. Money is viewed here as a durable commodity providing flow of services that are not observable.

Friedman (1956) categorized wealth into both human with material. He defined human type wealth as the current discounted price for labour earnings, and material wealth comprises both the monetary and physical wealth of an individual. An individual`s total wealth is made up of the summation of five components; money, real assets, equity, human capital and bonds. Friedman advocated the use of human type and non-human category wealth ratio as representation for the level of volatility of wealth for an individual. He viewed money demand as dependent on wealth with other assets which individuals hold and their expected rate of return.

Having problem in obtaining data for human and total wealth, he instead utilized permanent level income to serve as representative for the total sum wealth. Permanent income, according to Friedman is stable and defined as the people`s average of expected long term revenue. When businesses are expanding, the temporary revenue at that period of boom is higher than people`s permanent income. Permanent income is considered key in the role of money in accordance with Friedman`s theory.

Friedman expressed the individual wealth holder`s demand for money as;

$$M^d = \left(\frac{M}{P}\right)d = f\left(Y^p, r_1, ...r_n, \pi, \omega\right) \quad (2.30)$$

where; M^d is real demand for money, Y^p is permanent income in real terms, P is level of price, r_i is the ith asset yield expressed in real terms, π is the expected inflation rate and ω is human type wealth to non-human type wealth ratio.

Contrary to the Keynes postulations, Friedman reached a conclusion, money demand is insensitive to rate of interest and also permanent income serve as the sole factor influencing money demand, such that when enduring income is steady, money demand also is steady. Therefore, the velocity for money foreseeable. In late 1970s, and early 1980s, the decline in money velocity in US questioned the monetarist believe regarding a predictable link between money and the nominal GDP. Friedman (1989) postulated that the observed velocity decline during the period was solely caused by the rise in volatility of money growth resulting from the new change in Federal Reserve operating system. In a clearer term, Friedman`s volatility proposition states that raising instability of money stock growth raises the level of anticipated instability and thereby rises the demand of money (and thus decreases income velocity). Thus, in line with Friedman, the ineffectiveness of the US monetary policy during early 1980s even reinforces rather than weakens the case for the monetarist hypothesis of a continuous growth rule of money supply.

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2.5 Empirical Literature Review

Considering the key functions of money in any economy, couple with a vast number of approaches used to measure money, it is vital to review empirical monetary aggregation approaches and how they affect or influence the economy. The two most

popular methods emphasized and mostly studied in the existing literature are the conventional simple sum and the Divisia index approaches. Several studies have sought to empirically compare them in terms of performance and theoretical foundations. Shunk (2001) argued that monetary aggregates can be compared in terms of their ability to estimate an accurate money demand model or their efficiency in performing the role of an indicator in forecasting broader economic activities. More so, the information content and the control ability of these monetary aggregates is equally an instrument used to assess their own performance as highlighted in the following sections. Since the Divisia type monetary aggregates are more closely connected to the liquidity services rendered by money, so their relationship to money and income might be closer and stable than the simple sum measure aggregates (Belongia & Ireland, 2014b).

This section reviews empirical literature on the role of monetary aggregates in an economy. It is separated into sub-sections. Sub-section 2.7.1 discuss the empirical application for simple sum and the Divisia monetary aggregates, Sub-section 2.7.2 review the empirical literature on the functions of monetary aggregates in money demand stability with emphasis on traditional sum and the Divisia index monetary aggregates. Sub-section 2.7.3 review the empirical literature with focus on information content for the monetary aggregates.

2.5.1 The Simple Sum versus Divisia Monetary Aggregates

Comparing the usefulness and applicability of various monetary aggregates is important because if an aggregate is found to have a closer and more predictable connection with economic activity, it could be useful for monetary policy purposes

(Dahalan et al. 2005). In the early 1980s many of the advanced countries dropped the monetary targeting framework because of the simple reason that the financial innovation has made the relationship between money (expressed in simple sum) and income unpredictable.

The failure of monetary aggregates to provide a reliable clue concerning the posture for monetary policy and output forecasting made the usage of monetary aggregates in economic analysis almost discarded. However, after the beginning of the 2008 financial crisis, short-term interest rates crashed down to their lower bound making the analysis of monetary aggregates regain attention (Belongia & Ireland 2015). The monetary aggregates produced using the Divisia measure are better because they stand out to be the optimal measure of liquidity services rendered by various monetary assets having diverse opportunity costs (Chen & Nautz, 2015).

Unpredictability in empirical relations was mainly due to the fact that traditional simple sum type measures for money are inadmissible aggregates on the basis of index-theoretic foundations. Therefore, this implies that issues with assessments for money in an economy in the recent years might be more from bad measurement propositions not because of an instability in the connection between the real money and the economy (Habibullah, 1999). Along the same line, Belongia (1996), argued that most of the monetary puzzles of the 1980s would have been resolved if Divisia monetary aggregates would have been used. The findings of the previous studies that established this failure were however questioned recently. Studies employing the Divisia monetary aggregates have changed significantly the initial findings of instability between money and income arrived at by previous studies.

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This made it possible for Divisia aggregates to offer additional information content in monetary analysis compared to the traditional simple sum aggregates. Of particular interest, moving from one class of monetary or financial assets into another one may significantly alter the liquidity position of the economy, and also the Divisia aggregate. Serletis and Gogas (2014) studied the US money demand stability. They established a steady demand function for money using the Divisia aggregates and further show that previous conclusions on the US money demand function instability can be associated to a wrong approach in measuring of the monetary aggregates.

Divisia monetary aggregates are produced for many developed and few developing nations and several theoretical postulations have been made over the last decades (Barnett, & Gaekwad-Babulal, 2014). The dichotomy between the arithmetic sum type money aggregates and Barnett (1980), Divisia index type monetary aggregates is interest rate being paid to monetary components. Monetary assets are paid an interest rate that is usually above zero. Variations in the earnings of various monetary assets components in the money supply composition relating it to other individual component earnings and the yield on benchmark rate made the Divisia aggregates growth rate differ from that of the simple sum aggregates (Barnett, 2012).

Despite the solid theoretical foundation of Divisia index, almost all central banks still globally make use of simple sum type aggregates, with an assertion that both Divisia index and simple sum index provides more or less an identical result. However, recent empirical studies were strongly supporting the clear-cut variances between robustness of the Divisia with simple sum type aggregates. Belongia and Ireland (2015) established that it can not be correct to describe small differences in the statistical estimates of the two monetary type aggregates as “insignificant differences” because

the simple sum method of aggregation was not built on any theoretical base or have any statistical properties.

There are mixed findings among studies regarding advantage of the Divisia index money aggregates over the simple sum type aggregates. Considerable number of scholarly works did prove empirically, dominance of Divisia aggregates over the simple sum. Studies supporting that includes; Studies by Chou (1991) and Swofford and Whitney (1991) on the United States, Ishida (1984); Hirayama, & Kasuya (1996); and Ishida & Nakamura (2000) for Japan, Yue and Fluri (1991); Fluri & Spoerndli (2000) for Switzerland, Spencer (1994); Ford & Morris (1996) and Belongia and Chrystal (1991); Chrystal & MacDonald (1994) for the United Kingdom, Fase (1985); Janssen & Kool (1996) for Netherlands, Clements (1982); Cleveland, Kaufmann & Stern (2000) for the Australia; Siklos (1995) for the New Zealand and Serletis and King (1993), Siklos, & Barton (2001) for Canada. Others are; Habibullah (1999); Dahalan *et al*. (2005); Leong, Puah, Mansor, & Lau (2010) for Malaysia. Also, Darvas (2015); Barnett and Alkhareif (2015); Qiao, & Albert (2000); Serletis and Koutas (1998); Reimers (2002); Sianturi, Tanjung, Leong, Puah, & Brahmana (2017); Chen and Nautz (2015); and Anderson *et al*. (2015) among others.

Serletis and Robb (1986) established that the simple fact that Divisia aggregates appears to have closer relationship with the liquidity services rendered by money, then their relationship with money supply and total output will be closer and steady than the simple sum type aggregates. Belongia and Ireland (2012), from a theoretical perspective and using a theoretical model indicates that the traditional simple sum monetary aggregates can inconsistently move together with a model-implied “true” measure, while the Divisia monetary type measures provide the actual signals.

Barnett and Tang (2016) study the Chinese Divisia monetary aggregates and nominal GDP targeting. They established that Divisia monetary aggregates are relevant in GDP targeting either as an immediate target or as an indicator. Darvas (2015) investigated the influence of money in the 12 Euro Area countries using the constructed Divisia monetary aggregates. Applying the Structural Vector autoregressive (SVAR), he found that Divisia shock has an important impact on both income and inflation.

Dahalan *et al*. (2005) constructed the Divisia index aggregates for Malaysia and relate the aggregates with traditional simple sum type. They found that Divisia type aggregates proof to be most appropriate monetary aggregates for Malaysia, and that they are more stable in demand for money function compared to the simple sum aggregates. Qiao, & Albert (2000) constructed Divisia index aggregates for China and relate them with the simple sum type monetary aggregates by estimating the long run money demand. They show that traditional simple sum monetary aggregates lack adequate support for the perfect substitution assumption. The Divisia monetary aggregates distinguishes between the roles of money as medium for exchange from its other functions. Divisia monetary aggregates could serve as a reasonable alternative to the traditional simple sum monetary aggregates.

However, other studies established a contrary result. They presented an evidence that the simple sum aggregates performed better than the Divisia monetary aggregates. Among these studies are Driscoll *et al.* (1985) for Austria; Kitchen (1985) and Bailey *et al.* (1982) for the United Kingdom; Herrmann, Reimers & Toedter (2000) for the Germany; Barnett *et al.* (1984) and Thornton and Yue (1992); Darrat *et al*. (2005) for the United States.

Nevertheless, the different and diverse results arrived at in the case of US and the UK is rather worrisome. Darrat *et al*. (2005) show that the conflicting conclusions arise as a result of the potential problem in construction of Divisia Money aggregates. Specifically, deriving the correct measurement of user cost is not an easy task. Herrmann *et al*. (2000) on their part argued that a properly weighted monetary aggregate behaves differently from the conventional simple sum monetary aggregate does not mean that it will prove to be of use as a monetary indicator in a circumstance where the other measures failed. However, studies like, Fackler *et al*. (1990); Hendrickson (2014) further posits that the Divisia aggregate`s main contribution is that it represents the appropriate measure of money which can be tested against a given theory.

Meanwhile Belongia and Ireland (2014b) stressed that whether or not Divisia aggregate performed better than the simple sum aggregates is eventually an empirical question. Other studies support the assertion of Fackler *et al*. (1990). For example, Chrystal and MacDonald (1994) investigate role of Divisia index aggregates for the US, Australia, UK, Germany, Switzerland, Japan and Canada. They provide an evidence in support of Divisia monetary aggregates over traditional simple sum. They pointed out that in US, the credibility of the simple sum aggregates has been greatly undermined compared to the Divisia monetary aggregate even during the period in which financial innovation is greatest. Their major findings are that it is a serious measurement fault in almost all of the earlier literatures on money.

Hendrickson (2014) also found a similar result using the US data for Divisia monetary aggregates. He concludes that using alternative measure of money (Divisia aggregates) the money demand for US is stable over the period. Serletis and Koutas (1998)

employing the Divisia monetary aggregates data for US, investigated the monetary neutrality and found that Divisia money is neutral in the long run and line with the monetarists and Keynesian economic theory. They observed that between 1960s and 2005, the US monetary aggregates diverse from their Divisia counterparts more at the time of high uncertainty than during a time of stability. Chen and Nautz (2015) found that the German simple sum and the Divisia counterpart behave quite differently in explaining the German Great recession. They argued that the information content of money can be restored if monetary analysis is done using the Divisia aggregates instead of the traditional simple sum.

In emerging and developing countries, Barnett and Tang (2016) studied Chinese Divisia monetary index and established that the Divisia index aggregates encompass more indicator information as compared to the simple sum type monetary measures. Ndjokou (2013) constructed Divisia index monetary aggregates for Central Bank of West Africa, BCEAO member countries and compare the performance for simple sum monetary aggregates with Divisia index aggregates. His findings show that inflation is better explained by the broad Divisia money (DM2) while GDP could be explained better using the broad simple sum (SM2). The above analysis show that few developing countries constructed and empirically tested the Divisia monetary aggregates on the money demand function. This is particularly evident in the SSA countries where the attempt to study the Divisia aggregates produce mixed and often inconclusive results.

Hendrickson and Salter (2016) re-investigates the empirical methods used by the earlier studies employing both Divisia index aggregates and simple sum. They arrived at three main conclusions; first, his study establishes a stable demand for money

function for each Divisia aggregate across samples. Second, the study provide evidence that money is very vital in forecasting the nominal income and price fluctuations using Divisia index aggregates.

However, according to Hendrickson, the same result cannot be obtained using a simple sum type aggregates. Thirdly, the outcome shows that real cash balances posses a positive and important effect on output gap, which contradicts the mainstream models for monetary policy analysis. Thus, Hendrickson further concludes that the previous findings are probably driven by mis-measurement.

2.5.2 Demand for Money Function Stability

Demand for money function stability is a key issue in the macroeconomic theory and policy designs. The steadiness in money demand for any nation is a necessary condition for achieving correctness in the prediction for money stock`s effect on real economic series (Friedman, 1982). If demand for money function is not stable, its predictive feature for policy purposes will be limited (Handa, 2009).

The ineffectiveness of monetary aggregates in the late 1970s and early 1980s to provide a stable and predictable money demand model relegated the use of money stock aggregates for policy purposes and thus monetary targeting as an anchor for monetary policy was abandoned. The main argument for these policy change stem from the notion that the monetary aggregate targeting has failed to stabilize the money demand function which is paramount in monetary policy formulation. A stability in the demand for money is a requirement for the pursuance of both monetary policy and macroeconomic planning (Belongia, 1996). A steady money demand acts as stabilization policy that relies on countries central bank's ability to alter money stock

supply to its own demand so as to avoid monetary turbulences from obstructing the real output. Stability in the money demand is critical for monetary policy execution irrespective of whether the central bank targets money supply or interest rate (Sriram, 2000). Until 1970s a strong evidence has been established with empirical proof that supports the stability for money demand (Friedman, 1997).

Nevertheless, after the 1973, rapid change in financial modernization, has also altered the composition of money and to a certain extend the definition of money. This led to a considerable instability in empirical money demand (Serletis & Rahman, 2015). An instability in money demand sounds a question of whether the existing theories and the empirical analysis are sufficient. Furthermore, the instability in money demand function has important implication for monetary policy conduct since it present suspicion on the effectiveness of the demand for money function as an instrument to offer direction for policy makers. Specifically, because the demand for money has become unsteady, velocity of money becomes very difficult to predict (Hendrickson, 2014).

Studies on stability for money demand presented an inconclusive finding. While studies like Goldfeld *et al.* (1973), Bahmani-Oskooee and Rehman (2005), Sriram (2000), Lutkepohl *et al.* (1999) established a stable function for money, others such as Friedman and Kuttner (1992), conclude that demand for money is not steady over the study period. For a set of 20 developing countries Kumar (2011) established that financial innovations affect the stability of money demand.

Scholars debated that the link between money supply, prices, income, and the balance for payments is explained by the money demand and that the connection plays a

significant role in macroeconomic theories (Batuo, Mlambo & Asongu, 2017). Serletis and Robb (1986) provides an empirical evidence that support the use of Divisia index aggregate instead of simple sum.

Their argument was based on their conclusion that the Divisia monetary aggregates follows a more consistent path and displays greater parameter stability that will reflect greater theoretical consistency compared to the simple sum aggregates. Supporting this conclusion, Barnett (1997) also argued that the Divisia index estimates the demand for money function far better than the simple sum, also in terms of credibility and stability of the parameter estimates and forecasting accuracy.

There are mixed findings regarding the use of Divisia monetary aggregates in money demand function. Studies such as Fase and Winder (1994); Spencer (1994); Belongia and Chrystal (1991); Ishida and Nakamura (2000); Dahalan *et al.* (2005); Hendrickson (2014); Serletis and Gogas (2014); Basher and Fachin (2014); Barnett and Alkhareif (2015); Qiao, & Albert (2000); Puah *et al.* (2008); and Barnett and Tang (2016) all show that Divisia index type aggregates are better in performance compared to the arithmetic simple aggregates in demand for money function stability and in explaining the role of money in influencing economic activities. More so, Fase and Winder (1994) show that the demand for money function in the European Union nations is more stable when the Divisia index is applied instead of the simple sum approach. Ishida and Nakamura (2000), also found a better stability function using the Divisia M2 instead of simple sum M2.

Dahalan *et al.* (2005) compared the stability for money demand in Malaysia employing both Divisia money type aggregates and simple type sum aggregates applying the error

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correction model on the data. The study investigated short run dynamics amongst Divisia index money demand and determinants like income, inflation, foreign interest rate and wealth. They conclude that Divisia monetary aggregates was the most appropriate monetary aggregate to trail money demand in the Malaysian economy, and it should be utilized for monetary policy implementation.

Serletis and Gogas (2014) study the money demand for the US employing the Divisia monetary aggregates and established a long-run and one-to-one correlation amongst real money and income. Hendrickson (2014) examines the stability for money demand adopting the simple sum type and Divisia index aggregates and find a stable money demand relationship only with the Divisia model. They establish an evidence of a closer connection between the fluctuations in growth rates for Divisia index monetary aggregates and that of the real output growth than those for the simple sum measure aggregates. Regarding the inflation-income link they show that there exists a stronger co movements between inflation and growth at a lower frequency. The correlation amongst Divisia money with inflation continue to be strong throughout the sample period. Their conclusion provides evidence that the long-term movements in money growth and price fluctuations in US are better established when Divisia index aggregates are employed in place of simple sum measures.

Belongia and Chrystal (1991) studied the stability of demand for money function for United Kingdom and established that Divisia index monetary aggregates are more closely connected to the nominal gross domestic product growth and exhibit a stable money demand function. Spencer (1994) also confirmed this finding. Hendrickson (2014) employing the Divisia monetary data from the US Federal Reserve and using Granger causality test the US money demand function stability for simple and Divisia

index money aggregates and established a stable money demand function for only the Divisia monetary measures.

They further established a single way directional causality running from the money growth to the nominal income growth for traditional simple sum and the new Divisia aggregates prior to 1979, but only for the new Divisia index aggregates thereafter. Serletis, and Gogas (2014) employing the US quarterly data studied the stability of money demand for US using Divisia monetary aggregates and established a long run stable association in US money demand.

Barnett and Alkhareif (2015) constructed the Divisia index monetary aggregates in respect of Saudi Arabia and utilizing the constructed aggregates they estimated the money demand function for Saudi Arabia. They found that the narrow simple sum money and narrow Divisia money are identical because of the perfect substitutability of the monetary components. For broad aggregates, Divisia aggregates perform better in comparison with simple sum type aggregates in explaining the money demand function of Saudi Arabia.

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However, studies such as Gebregiosis and Handa (2005); and Ndjokou (2013) found a different result. Gebregiosis and Handa (2005) constructed a series of monetary aggregates including the VES aggregates and Divisia index for Nigeria and compare them with the simple sum aggregates. The study concludes simple sum type monetary aggregates outperformed both the VES and the Divisia money in demand for money stability. While Ndjokou (2013) established that traditional simple sum type measures are better for the BCEAO member countries.

This contradicts other studies findings. The reason for that is however clear, as the components used in constructing the aggregates are narrow and does not capture the financial structure of the economy. The study constructed the both the VES and Divisia aggregates using only three components of money; currency in circulation, demand deposit and savings deposit. The Divisia aggregates are computed based on the weight average of the components not based on user cost of the assets. Currency and demand deposits yield no interest and therefore has a high degree of moneyness. In the category, only savings deposits earn interest. Other vital components of money are omitted, such as term deposits, treasury bills, and other interest yielding instruments. The study projects a narrow Divisia money aggregates which has no difference with the simple sum aggregates because all the monetary components in the aggregates does not earn interest and carry virtually same weight in the computation. The aggregates are constructed using the weighted log-linear summation of the monetary components.

2.5.3 Information Content of Monetary Aggregates

Monetary aggregates are generally used as gauges of unobservable economic activity. This is because monetary aggregates in some way convey information concerning current position of the economy (Habibullah, 1999). Therefore, one vital feature of a monetary aggregate is that it encompasses information related to certain key macroeconomic variables such as the gross domestic product or national income.

Information content help policy makers to make well informed decisions that will have a positive impact on the economy. Information that can be derived from monetary aggregates can also be utilized for forecasting purposes on macroeconomic variables like inflation (Serletis & Rahman, 2013). The essence of information content is that

the more information the aggregates can bring forward, the better it will assist policy makers to make more informed decisions on economic issues. Considering the popular view that inflation is a monetary phenomenon, vital information regarding the future price and inflation trend can be understood from the quantity of cash balances kept by the public. For the central banks to solve appropriately any inflationary pressure that may come up in the future, there is need to produce correct and reliable projections of inflation with low forecasting errors.

Therefore, a monetary aggregate that performs this role accurately is the most appropriate for that economy. Barnett (1984) reported that Divisia index money aggregates give better stability for a parameter estimate and better forecasting correctness in the case of US. Swofford and Whiteney (1991) provided further evidence by comparing these monetary aggregation methods adopting a vector error correction type model of inflation and money growth. They reached a conclusion that the Divisia monetary aggregates has a smaller average forecasting error in all but one case. Chou (1991) also corroborates these findings and concludes that Divisia index aggregates yield lower forecasts mistakes for the US.

Bailey *et al.* (1982) asserts that the simple sum aggregates have destroyed much of the information available suggesting that the monitoring of the currently defined simple sum aggregation is a suboptimal means of ascertaining future movements of nominal income changes in the UK. According to Sims (1972), the information content analysis for monetary aggregates is closely related to the Granger causality test in the voluminous literature on the money-income relationships. Sims (1980) further asserts that Granger causality test of incremental information content have an important posture on the effectiveness of money aggregates as indicators. Habibullah (1999) uses

the Granger causality test to unravel the information content for the monetary aggregates for 10 Asian countries. The Granger causality analysis based on Granger (1969) requires that all variables be stationary at level. He concludes that monetary aggregates can be a useful indicator for monetary policy purpose in the majority of the countries studied. More interesting is that the Divisia monetary aggregates shows potential roles as intermediate indicator for policy purpose of Malaysia, Myanmar, Philippines, and Thailand.

Evidence of superior forecasting power of Divisia index monetary aggregates over the simple sum is provided by Gogas *et al*. (2013); Anderson & Jones. (2011); Darvas (2015); Barnett and Tang (2016); Barnett and Chauvet (2011); Reimers (2002); Hendrickson and Salter (2016); Barnett and Arkhareif (2015); and Gogas & Takli (2013) show that Divisia aggregates are both theoretically and empirically superior to the simple sum type aggregates in forecasting and evaluation standards. The wide disparity between simple sum aggregates and Divisia monetary aggregates can be viewed as a signal for an impending recession in an economy. Also similar to the forecasting power of the monetary aggregates, it is equally important for a monetary aggregate to be an indicator for future economic situations. Judd and Scadding (1982) argued that countries where financial deregulation, in particular where interest rate liberalisation has been the main key financial reform, there is a function for Divisia monetary index aggregates to act as monetary indicators for policy purposes.

Several empirical studies like the Barnett & Serletis (2000), Barnett and Tang (2016), Gogas, *et al*. (2013), and that of Belongia & Ireland (2014b) established that the Divisia index aggregates can be used to forecast the movements of key economic variables and that Divisia index type of aggregates do outperform the traditional simple

sum type of aggregates. Schunk (2001) concludes that unlike the traditional simple sum measure monetary growth level, a rise in Divisia index money growth instability is linked with a very low average rate of growth for the real economic activity, and the optimal monetary aggregation will additionally improve the understanding of the way money impacts on the overall economy. Also, Barnett & Chauvet (2011) find that Divisia index aggregates performs much better than traditional sum type aggregates in case of United States nominal GDP now casting.

This study uses the Toda and Yamamoto (Toda & Yamamoto, 1995) non-causality approach to Granger causality to study the information content for the selected SSA countries. The advantage of Toda and Yamamoto over the traditional Granger causality is that Toda Yamamoto approach accommodates variables at level, first difference and even second difference (Toda & Yamamoto, 1995).

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2.6 Monetary Uncertainty and Output Uncertainty

Friedman (1984), advanced an argument that volatility in the stock of money growth, increases the level of anticipated volatility leading to an increase in cash holdings by the public. With this postulations by Friedman, volatility in money supply is then identified as another variable influencing the demand for money function (Bahmani-Oskooee & Baek, 2016). Later in 2003, Choi and Oh (2003) introduced a theoretical model identifying monetary uncertainty and output uncertainty as another factor of demand for money. Volatility in output make public to face an uncertain labour market in future, thereby increase their money holding. On the other side, increased economic or monetary volatility can create a substitution type effect moving from the cash to a

low volatile non cash assets, implying that both output and monetary uncertainties could affect the money demand (Choi & Oh, 2003).

Researchers have argued that conventional money demand specification appears to be highly restrictive (Janson & Kool, 2000). Atta-Mensah (2004) put forward and argument that when an individual economic unit`s willingness to keep monetary instruments arises by his or her portfolio of investments, then the optimum amount of financial assets kept by each individual can be to a larger extend affected by the economic uncertainty (Atta-Mensah, 2004). In this situation, a risk-averse investor will prefer to retain safe liquid financial assets in place of uncertain assets (like long period maturity bonds and stocks) during the period of rising output uncertainty. Alternatively, money demand and output volatility can be related in a positive way. However, in a situation where output volatilities brought a pessimism regarding the future worth of money, the nominal financial instruments become more risky thereby make an individual to move out from holding of nominal assets including liquid cash to a more tangible financial asset like commodities or gold. Under this circumstance, a negative association exists. This further suggest that omitting the output uncertainty variable from the money demand model will results to an erroneous finding with a great implication on policy design and implementation (Jackman, 2010).

Meanwhile, because output uncertainty could not be observed directly, scholars have put forward different arguments as to the most appropriate conceptualization of the concept and the best variable to use as a proxy for macroeconomic uncertainty (Azim Özdemir, & Saygılı, 2013). In economics, the term uncertainty is considered as investor`s loss in confidence with regards to the effective functioning of the economy. More so, it is commonly linked with the shocks that exerts some instability in

macroeconomic series. In certain instances, a slow reduction in investor's confidence will be observed over a period of time together with a conforming rise in the economic uncertainty concerning the future performance of the nation. This may happen only if severe shocks in the exogenous variables continue over an extended time horizon.

The importance of incorporating a measure of uncertainty in macroeconomy environment into the orthodox money demand hypothesis becomes necessary. This is due to the fact that an individual economic agent may keep money in form of a wealth stored or they may decide to utilize them for transaction purposes. In view of that, a risk-averses entrepreneur could prefer to retain a safe, liquid financial instrument rather than holding a high-risk assets like bonds or stocks for safe keep of their wealth when faced with a rising perception of risk. The theoretical foundations of this prepositions are found in studies including; Choi and Oh (2003); Attah-Mensah (2004) and Lemke & Greiber, (2005). Also, Choi and Oh (2003), proposed a theoretical model that proof the important role of monetary and output volatility on the demand for money function. Volatility in output make household to face an uncertain labour market in future, thereby increase their cash holding.

From the other side, increased monetary or output uncertainty could cause a substitution type effect moving from cash to other low volatile non-cash assets, signifying that the two measures of uncertainty could exert a negative influence on money demand as well (Bahmani-Oskooee & Baek, 2016). Different studies on the effects of monetary and output uncertainties on demand for money function presented a diverse and inconclusive results. Another problem associated to this study is whether monetary aggregates influence inflation and output growth.

Instability in the domestic macroeconomy may exert an effect on the amount of cash balances that an individual is willing to keep (Plosser, 2014). An instance is, a rise in the risk on interest rate in sort of instability equally rises the risk of holding a financial asset with fixed rate of return. In such circumstances, an individual substitute the fixed earnings security asset with more of money. In the same manner, a rise in inflation volatility made nominal wealth assets more riskier, for the reason that their real value translated into goods and services tends to be unpredictable (Gan, 2014). The concept of economic uncertainty was recently introduced to the economic literature (Bloom 2014).

Measurement of economic uncertainty has been a challenge in the literature because is not observable but rather one that is deduced from other variables. Uncertainty is a covert variable. It is possible to measure it directly in several approaches using methods that stress distinct features of uncertainty faced by an economy faces overtime. Certain measures emphasis on macroeconomic instability-including the instability in stock market earnings, spreading in unemployment projections. Economic theory provides a clear way where uncertainty can exert an influence on money demand (Friedman, 1983). An instance is when firms in the country are faced with high uncertainty, they lower their investments demand and slowed down projects activities while gathering new information.

This is so because investment decisions are quite often very costly to reverse (Seletis & Rahman, 2015). The feedback of households to the effects of tremendous uncertainty appears to be the same to the effects on industrial firms, because individual households will lower their use of durable goods while waiting for a period of lower uncertainty to return.

From other angle, businesses hiring policies are also affected negatively by greater uncertainty, signifying costly alterations of personnel. This negatively infer on the household earnings and impact negatively on their demand for money (Bahamani-Oskooee et al. 2012; Matson & De Pereti, 2014). Household uncertain expectation of the behaviour of certain economic variables such as price changes, income changes may have influence on the amount of money or monetary instrument they may decide to hold (Choi & Oh 2003). Along the same line, an increase in inflation uncertainty in the form of prices volatility make it possible for all assets in nominal value more riskier due to the fact that their worth from the angle of tangible goods or services tends to be unpredictable. Therefore, within an environment that has unstable inflationary pressures, individual economic unit will change from holding assets that are in nominal value inclusive of money to holding other valuable instruments like gold or other commodities (Bahmani-Oskooee, & Gelan, 2009).

Following Bahmani-Oskooee *et al.* (2013), deriving from Choi and Oh (2003), the study will incorporate monetary uncertainty variable and output uncertainty into the conventional money demand model. Incorporating the two uncertainty series to the money demand model for SSA countries is crucial because there has been a great changes in the country's output resulting from various economic and financial restructurings that includes adoption of certain trade liberalization and price measures which has significant monetary uncertainty (Submitter, Basu, & Bundick, 2014).Thornton (2008) studied Friedman (1984) money velocity hypothesis and identified two ways that the money growth variability influence velocity. First through the real income behaviour while the second is through money demand behaviour (taking care of by the supply of money). In this research work, macroeconomic uncertainty is interpreted to connote periods characterized by a rising negative

thoughts of an economic unit concerning the condition of the country`s economic well being.

Developing economies such as the SSA need a steady economic environment in so as to carry on with their development efforts. Considering the narrow and immature financial markets in the region, exogenous shocks will be so disturbing for the economies. Therefore, entrepreunuers in those economies tends to be more worried about the horible shocks in comparison with the advanced economies. Nonetheless, it is expected that a shock-induced instability to exert significant influence on holdings of cash balances in emerging economies since it will cause huge portfolio changes from the capital markets to the money markets. Variability in economic activity wear away confidence in the upcoming economic viewpoint and encourages people to remain with liquid assets.

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2.7 Money and Economic Activities

The monetary aggregates can be useful to explain the changes in national income if changes or movements in the monetary aggregates influence a change in income level (Handa, 2009). The relationship between monetary aggregates and national income is very important to policy makers and monetary authorities because they try to influence the economic activities using the supply of money and rate of interest during monetary policy implementation. Accordingly, if there exist a causal relationship between money and national income that will make the monetary policies more effective (Bahmani-Oskoee et al., 2015).

The relationship between money, income and prices is at the centre of debate among different economists more especially between the monetarists and the Keynesians.

While the monetarists regarded money supply as a vital factor influencing the movements in outputs and prices. Thus, the path of causality goes from money to output and prices without a reaction effect. Contrary to that, the Keynesians postulated that fluctuations in income leads to variations in the supply stock for money via the money demand. Therefore, the path of the causality goes from income to money with no reaction effect.

Thus, co-movements of supply of money, level of prices, and the national income exerts a very significant implication in the analysis of a country`s macroeconomic performance (Sims 1972). The underlying proposition is that an upsurge in the supply for money will at initial stage lead to a rise in real output before it affects a rise in the price level. However, the increase in real output will die down more rapidly than the price level (Chow and Shen, 2005).

Alternatively, there is a possibility that the supply of money may be autonomous of income and prices, and considered as an exogenous factor, it may affect income and price level. From the other view point, income and prices might be the main determinants for money supply, thereby reflecting endogeneity in the supply of money (Mishra et al. 2010). Therefore, the supply of money bears both an endogenous as well as exogenous properties.

The supply of money is established exogenously through changes in real sector in short run and in the very long run supply is being exogenously determined (Cagan, 1989).

Keynesians hypothesized that movements in output level cause fluctuations in the volume of money through the money demand signifying existence of a one directional causation from output to money. In fact, money has no important role in the income or price movements. Similarly, fluctuations in prices are mainly as a result of structural

factors (Chimobi, 2010). On the other side, the monetarists disprove the Keynesians views, and provided evidence that movements in money supply can cause variations in output and prices. A growth in the supply for money leads to an upsurge in income during the short run period, but for the long run only prices are affected by it. Therefore, causality direction moves from money to income and then prices with no a reaction effect (Mishra et al., 2010).

From the above scenario regarding these theoretic opinions and postulations of macroeconomics, it is imperative that the subject of short and long run causation amongst money, prices and income be re-investigated. The connections amongst money, output, and inflation has been the main emphasis of an extensive discussions and analysis. A great part of debates between the neo Keynesians and that of neo classicals is placed on the comparative efficiency of monetary policy in manipulating a given nation.

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The debate is quite unsettled, past empirical findings on role of money in implementation of monetary policy frameworks is still unclear.

Sims (l972, 1980); Thoma, (1994);Thornton and Batten (1985); Stock and Watson (1989); Ball and Romer (1990); Cover (1992); Christiano *et.al*., (1999); Mishkin (2009); Siregar and Ward (2002); Gilman and Nakov (2004); Ravn and Sola (2004); Bernake *et al.* (1999); Hossain (2005); Rafiq, and Mallick (2008); Dickinson, and Jia (2007); Mallick, & Sousa (2013); Jawadi and Sousa (2013); Precious, & Makhetha-Kosi, (2014); Anowor, & Okorie (2016) and many others present evidence of monetary effects. While results for the money neutrality are stated, among others, by the studies like, Feige and Pearce (1979); Sims (1992); Litterman, and Weiss (1985);

Geweke (1986); Friedman, and Kuttner (1993); King and Watson (1997); Cochrane (1998); Serletis and Koustas (1998); Ganev *et.al.* (2002); Starr (2005); and Lee and Yang (2012). While considerable evidence exists on the relationships among money and the economic activity in developed nations, literature on developing countries is quite limited.

Sims (1972) seminal paper on money-income causality first provide a proof of one-way directional causality from money to income utilizing US post-war data. However, in his study, the hypothesis on income to money causality was rejected. Within a period of eight years afterward, Sims (1980) established an opposite outcome; that the money supply has not yielded any important role in illustrating the real output variations. The causal association between money, income and prices becomes a subject of focus by economists more especially in the aftermath of the publication of the Sims` (1972) seminal paper. Sim employed the US post-war quarterly data under a bivariate econometric framework found a proof of a single directional causality from money to income as hitherto postulated by the monetarists.

However, later studies could not arrive at Sims conclusion. For instance, in studies by Barth and Barnett (1974) using data for Canada replicated the Sims test and found a bidirectional causality between money and income. Most of these studies attempted to establish the long run association as well as the impact of monetary policy on income and prices for different countries more especially the advanced countries over a specified sample period providing a conflicting evidences and issues (Samargandi, Fidrmuc, & Ghosh, 2015).

In a similar study, Hafer and Hein (1982) and Abdullah and Rangazas (1988) challenged Sims` findings. Both studies established a one-way causality from money to output without a reverse causation from income to money. Abdullah and Rangazas highlighted the significance of choosing the suitable lag length and the importance of regressand series employed in the model. Looking at the first issue, the authors questioned the very short lag length of 4 quarters utilized in the Sims model. They further emphasized that the monetary impacts on output needs longer lag lengths, at times up to 15 quarters period. Regarding the usage of the explanatory variables, Abdullah and Rangazar pointed out that since money is the sole variable employed in Sims model, the outcome could be solely because of discrepancies in money; independent of a correlation with all the other variables. In similar studies, Williams *et al,* (1976), employing similar method obtain an evidence for a single way directional causality going from income to the money for UK which appears opposite to Sims results.

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Meanwhile, Dyreyes *et al*., (1980) found proof of one way directional and two way directional causality between money and income in Canada and US respectively. Subsequently, Friedman, and Kuttner (1992) first offered a proof showing that a hitherto established robust relationship amongst money and the overall economic activity was just an artefact of only two decades; that is 1960s and the 1970s. When the same relationship was estimated with a data extending to the 1980s, they argued that the earlier strong relationship amongst money and the aggregate income were not as significant as earlier postulated and that money demand do exhibit uncertainty (Friedman & Kutner, 1992). They further established that the power of money in explaining the variations in output and prices was replaced with the short-term interest rate movements. Much later, studies of Bernanke, and Blinder (1992) strengthened

these results by investigating position of US Federal funds interest in monetary stock transmission system.

They also conclude that any use of money is decreased once the interest rate is used in the experimental framework. They further argued that for any relationship money may take with aggregate economic activity before the 1980 had been extremely and perhaps inherently weakened by the financial inventions period (Belongia & Ireland, 2015). Afterward, many studies have placed focus on testing the causality between money and income using the Granger (1969) causality test. For instance, focusing on other studies Hayo (1999), and that of Walsh (2003) carried out a review of this enormous studies, putting emphasis on the contradictory findings established by several studies indicating that is rather impossible to arrive at a strong inference regarding the function of money in any given nation. An identical result was earlier on reported in the studies of Stock, and Watson (1989).

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The reason for relinquishing monetary aggregates in monetary policy implementation did not emanate from theoretical perspectives but rather from empirical because the already established linkage between the money and inflation becomes questionable with the emergence of new interest bearing monetary instruments in both capital and financial markets. This innovation rendered the monetary aggregates inaccurate and less relevant (Gogas et al. 2013).

However, studies on the association between money and other economic variables using Divisia monetary aggregates provided a different result. Belongia (1996) argued that the breakdown in the relationship between money and the macroeconomic variables was attributed to an erroneous application of simple sum monetary

aggregation approach. Belongia (1996) replicated the models used by five other research works on the subject whose findings denied the common position about the connection between money and other economic activities. The conclusion was that in the minimum of 4 of considered 5 cases, replacement of Divisia index measure for money with the simple sum aggregates reversed earlier results reported by these studies. Belongia (1996) conclude that the problem of money measurement is at the center of the assumed failure in the relationship between money with macroeconomic activities. Schunk (2001) also supported these findings and conclude that the Divisia index is more suitable for pursuing the conduct of the vital macroeconomic series like income and the prices.

In a similar and recent studies, Belongia and Ireland (2015) empirically established that the orthodox understanding may have been made on the basis of findings that are not fully robust. Similar analogies were made earlier on. For example, in a study by Thoma, and Gray (1998) importance is placed on the role of outliers in the statistical data starting from 1974 in arriving at the conclusions obtained by the Friedman, and Kuttner (1992), together with that of Bernanke, and Blinder (1992) which connect interest rates with economic activity. Added to that, studies by Belongia (1996) and that of Hendrickson, & Salter (2016) have replicated several parts of the Friedman, and Kuttner (1992) through only substituting simple sum type aggregates with Divisia index aggregates.

Afterwards, estimating same relations over virtually the same time periods having affected only this change, these scholars established that monetary stock still share a strong association with the overall economic activity and also money demand still displays stability. Due to the simple sum measure`s inability to adopt pure substitution

effects, as highlighted by the studies of Barnett (1980, 2012) together with that of Belongia, and Ireland (2012), the authorized money supply statistical data provided by the US Federal reserve contains a measurement fault of unknown size in their own construction which will effect any economic inference drawn.Getting where an information content for monetary aggregates emanates from, and in what way it can efficiently be put into use for design of monetary policy still remains as significant today as it was some centuries back when the Bernanke, and Blinder`s (1988) paper was published.

Simple sum aggregates produced by the central banks are most likely a faulty measure for money computed on the basis of impracticable assumption for perfect substitutability of the individual assets components. This assertion is referred to as Barnett critique which was first drawn by Chrystal and MacDonald (1994). The critique has a strong effect on the results provided by macroeconomic models, and by implication the outcomes of studies utilizing the simple sum measures are misleading (Barnett, 2012).

Belongia (1996) examined the empirical validity for the postulated Barnett critique through re-examining of many studies on money by substituting the traditional sum aggregates with Divisia index aggregates in the models. He concludes that the original results obtained by previous studies are completely different. Divisia monetary aggregates have been used in many studies like the Barnett, *et al.* (1992), Chrystal, and MacDonald (1994) that investigated the association among money and output, Schunk (2001) concentrating on predictive content for money, Serletis (1991); Serletis and King (1993); Yue and Fluri (1991). Similar recent empirical studies include;

Darrat *et al.* (2005), Barnett, *et al*. (2009), Belongia and Ireland (2012) and Serletis, *et al*. (2013).

Ishida (1984) find that the downward trend in Divisia M2 velocity was much weaker in comparison to simple sum counterpart for Japan. This according to Ishida infers that the association between the Divisia M2 with national income is steadier than the one between the simple sum aggregate, M2 and national income. Thus, a combination of the broad Divisia M2 aggregate would be used sideways with the simple sum broad money aggregates in the conduct of monetary policy.

Serletis and King (1993) analysed the long-run relationship between money, prices and income in Canada using the cointegration method. They concluded that the Divisia aggregates was more useful in determining the long-run relationship with nominal income. Keating, Kelly and Valcarcel (2014) indicate that having a SVAR type model with the Divisia monetary aggregates functioned as well just like the model built with Federal funds interest prior to the recent global financial crisis. It also functioned equally well with sample of data that comprises a zero lower bound period when US Federal rate could no longer be utilized. Employing distinct structural vector autoregressive model, studies by Belongia, and Ireland (2014b) established a support for including money into the United State`s monetary policy rule. The authors equally documented money demand and the system shocks emanating from money supply which led to a considerable response by output and prices.

Darrat *et al*. (2005) also re-examined the connection between money and the macro economy using the cointegration method. They compared the simple sum and Divisia index aggregates. Their conclusion reveals that cointegration is overwhelming when

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the Divisia aggregate is used in place of the simple sum aggregate where the cointegration is weak. In the case of Divisia aggregates, even when there was a shift in the policy coupled with a rapid financial innovation in the post 1980 period, there was still cointegration. Matson and Mattson & De Peretti (2014) concludes that a unidirectional causality from GDP to real money is established without a feedback effect. Also, there is absence of causative connection amongst money and economic activities over the study period.

Thus, any monetary aggregate which exhibit stronger causal association between money and national income will determine the most appropriate aggregation approach in that particular economy. Barnett (1997) has contended that several gaps in a link between monetary policy and economic activities which was ascribed to instability in money demand actualy mirror the inaccuracy of the simple sum monetary aggregates utilized to model the economic activities. If true, then failure in basing current policy choices on the Divisia index type aggregates might prove to be problematic as policy choices ought to be founded on the best evidence available, particularly in times for economic disorder.

2.8 Money-Inflation Nexus

The traditional role money plays in an economy in empirical investigation is the analysis of the capacity for the monetary aggregates to forecast or envisage nominal levels of income and price. There is a consensus amongst policy makers, researchers, and financial experts that a zero or low inflation remains the suitable long run target of monetary policy (Kabundi & Schaling, 2013). Nevertheless, there is no consensus on the right approaches to be implemented to accomplish price stability.

The key proposition in monetary theory is that over a long period, the growth in money has a strong correlation with inflation (Gali, 2015). From the quantity theory postulations, this association should be on one-to-one basis. In addition, assuming a stable demand for money, there should be a solid correlation amongst real money and the real output since additional money is necessary for a rise in the volume of economic activities. A huge number of studies were undertaken that investigated the causal association amongst money, income, and inflation by applying diverse empirical methods and diverse money measures. For example, in US, Lucas (1980) established a strong association between narrow money aggregate M1 with the nominal GDP that becomes unstable over the mid-1980s and the 1990s periods. However, Teles and Zhou, (2005) ascribed this instability to a regulatory change and technological innovations like the ATMs.

In the US also, Estrella, and Mishkin (1997) runs a 3 variables VAR type model with inflation, nominal output growth and the stock money growth utilizing a data sample covering 1960-1995 period. They again estimated a model using the sub- sample starting from October 1979 coinciding with time of an emergency meeting for Federal Reserves where it approved an intermediary goal aim for M1. Expansion in money stock is weight through the monetary base and the M2. They undertook a Granger causality analysis to investigate whether the expansion in money can predict the growth in nominal income and inflation. The Granger causality analysis indicate that, for the whole sample, monetary base is valuable in forecasting income growth and the inflation dynamics.

The predictive power of the monetary aggregate could be evaluated from its ability to predict short or long-run price dynamics more accurately. Anderson and Kavajecz

(1994) argued that money aggregates exists mainly as pointers and or targets of monetary policy and, so a significant empirical criterion in judging them is the relative aptitude of the alternatives to predicts economic activity.

In an effort to investigate the performance of money aggregates as a predictor for economic activity, Serletis and King (1993) used Granger causality tests to compare significance of alternative aggregates. They conclude that Divisia aggregates is a better predictor of economic activity. In a similar study, Fluri & Spoerndli (2000) realized a mixed finding using the VAR type models in the case of Switzerland. Their results indicate that the Divisia money, M1 forecasts short- run inflation more than simple sum money, M1, but that it fails to forecast the long-run inflation more precisely. Janssen, and Kool (2000) established Divisia money are superior pointers for actual growth and inflation in case of Netherlands as compared to its traditional sum counterparts, with broad Divisia (M3), presenting best out of sample prediction for inflation.

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However, for the sub sample, none of the two variables is significant in forecasting nominal growth in income or inflation movements. The preceeding analysis entail that the money aggregates were not suitable as an information serie later than 1979 (Hendrickson & Beckworth, 2013). Valle and Pereira (2010), established the existence of a strong connection between M2 broad money and MZM money components development with price fluctuations. Benati (2008) analyse the connection amongst inflation and monetary growth rates for M1 and the M2 in US during the sample time frame of 1870-2004. Hung & Thompson (2016) using the simple sum aggregates establishes a steady correlation amongst money growth and inflation at a very low frequency. Inflation has a negative effect on the output growth.

Scholars view on the factors causing the rising inflationary trend in SSA also varies. For example, Thornton, (2008), Barnichon and Peiris, (2008) contended that increase in the money supply growth rate or the gap between money supply and estimated money demand is the key cause of inflation in SSA. Thornton (2008) further found that money supply is significantly more important in explaining inflation movements in countries with high inflation than those with low inflation.

The conclusions on the money-inflation relationship has led to money becoming less important as a monetary policy tool and consequently the abandonment of monetary targeting in most countries.

2.9 Literature Gap

Despite the theoretical and empirical inferences of the Divisia monetary aggregates method of monetary aggregation as a suitable measure of monetary services, the studies have been mostly limited to the advanced countries. An empirical testing of the performance of Divisia index monetary aggregate in the emerging countries, more especially the SSA countries is lacking. It can be beneficial in establishing the robustness of the conclusion arrived at in the case of the advanced nations. The uncertainty presented by financial innovation to the monetary policy atmosphere requires a revisit of the central bank's conventional meaning of money. All these changes and innovations cannot be captured by the simple sum monetary aggregates that are being used for policy decisions (Dahalan et al. 2005). Barnett (1978, 1980) used economic aggregation together with an index number theory to produce monetary aggregates that are consistent with the Diewert (1976) set of superlative quantity index numbers. Barnett`s type monetary aggregates corresponds to the Tornqvist-Theil

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Divisia quantity index for discrete time. Barnett`s indices are named after a French economist Francois Divisia, who first introduced the continues time-based index in 1925 used in the aggregation of goods. It is expected that Barnett (1980) Divisia index will take care of these variations via their dissimilar weighting technique as against the traditional simple sum approach that is based on identical weights for all monetary components.

Existing empirical studies on Divisia aggregates show that many studies were carried out on developed countries (Darvas, 2014). While some established the superiority of Divisia monetary aggregates (Barnett 1997; Belongia and Ireland, (2013); Darvas (2014); Serletis and Rahman (2015); and Habibullah, 1999), others found a contrary result (Ndjokou, 2013). The level of financial sector development in the developed countries differ with the developing countries particularly the SSA countries. Studying the SSA monetary aggregates will further open up on the appropriate aggregates to use in policy design and implementation. The SSA countries central banks has sought to enhance their monetary policy effectiveness through the use of alternative frameworks but Divisia index was not tested as a substitute or compliment to existing simple sum index. Constructing Divisia monetary aggregates for the selected countries will stimulate a policy debate on their significance in economic policy.

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While numerous studies have attempted to investigate the money demand stability at both indicidual and collective country cases, their main focus is on the simple sum aggregates. Their results are often mixed and inconclusive. Several studies have shown that financial sector reforms affect the stability of money demand more especially to emerging economies like the SSA. Such studies include Nell (1999), Wesso (2002), Bahmani-Oskooee and Kutan (2010), James (2005) and Narayan (2007). Therefore,

investigating the problem of whether the money demand in SSA is stable after financial sector reform adopted in the late 1980s is very vital for monetary policy design.

For instance, Choi, and Oh article for 2003, established that the US money demand puzzle of the 1980s were largely due to misspecification of the money demand function rather than the real economic behaviour. Incorporation of the output and monetary uncertainty into the money demand function renders the income elasticity consistent with cross-sectional evidence and help to resolve the puzzles. Yet there has been no attempt to address this issue, particularly for developing countries such as the SSA that have undergone a rapid financial liberalization. This study intends to narrow that gap in the literature.

Nonetheless, available evidence from the literature has indicated that there exists relatively a limited number of research works that attempted to study the effect of output and money uncertainties on money demand stability. More so, from the few number of researches available, the empirical findings appear to be mixed implying that different effects exist among various nations. For example, examining the issue of European economies, Bruggerman (2003), discovered that there is no relationship between economic uncertainties with money demand. Contrary to this finding, Choi and Oh (2003), established that demand for cash balances in United States is positively connected to economic volatility but negatively connected to the growth in money uncertainty. On the other view point, Attah, Mensah (2004) draw a conclusion that economic instability could lead to a higher narrow money M1, and meaningfully decreases the broad M2 money for Canada. The inconsistencies in findings across these research works implied the necessity for specific country modelling. Along this

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line, this study examines the economic influences of Output and money uncertainties for a selected SSA countries.

For developing countries, few empirical studies also established the causal link amongst money and output. These among others includes; Sharma *et al*. (2010); Al-Fawwaz & Al-Sawai'e (2012); Chen, Tang & Li, (2009); and Muhd-Zulkhibri (2007). Study by Sharma *et al.* (2010) established an evidence of money-income trade off in short run only, while for long run, the money supply controls only prices and not income using data for India. Their findings further established that income and price movements does not Granger cause variations in money supply thereby indicating the exogeneity of the money supply. In a similar finding, Al-Fawwaz & Al-Sawai'e (2012), using data for Jordan found no short term association amongst money supply (M1) with GDP growth.

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They concluded that monetary policy had no visible effect on the macroeconomic variables in the case of Jordan, while arguing that there exists a causal association emanating from money supply to inflation rate, with a very little degree. Chen, Tang & Li, (2009) study the influence of money on the Chinese economy and established evidence that support the Friedman`s postulations that output responds to money shocks at initial stage, but the effect is short lived, and prices respond later but the effects lasts longer.

For Malaysia, Muhd~Zulkhibri (2007) investigated the causal link among monetary aggregates, income, and prices. Employing a vector autoregressive and Toda Yamamoto methodologies, he found a two way directional causal relationaship amongst, monetary aggregates of M2, M3 and income, a result that is in line with the

theoretical postulations of the monetarists, while there exist a single way causal effects moving from monetary aggregates M1 to income. Also, the findings suggest that both narrow and broad money aggregates exhibit a strong single way causality going from money to prices with no evidence for the reverse causality.

Other studies such as Bengali *et al*. (1999); Bilquees, Mukhtar, & Sohail (2012) established a single directional causality from the money to prices for the Pakistan economy. Masih, and Masih (1998) also found a single way directional causality moving from money to the prices utilizing data from South –East Asia. Causality is also found to go from money supply to the price movements in Malaysia as documented by Ghazali *et al*. (2009). The results obtained by these studies confirm the monetarist claim. However, on the contrary, Al-Jarrah (1996) found money to be Granger caused by prices in Saudi Arabia. Mishra *et al.,* (2010) also found a single way directional causality from prices level to the money supply in India.

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In a more recent study, Asongu (2014), study the African countries documanted that is not always easy to separate a path of causality among money and the income. Despite the inconsistent phenomena, he further argued that it is good to study the path of causality between money and income for the purpose of articulating active or inactive monetary policy. Asongu again emphasized that while money may not be a main explanatory cause for income variations in some African countries, and therefore, a sound monetary policy may not remove business cycles, it can aid to decrease harshness of the cycles.

In case of Sub-Saharan Africa, the analysis of money-income and money-inflation causality is limited to a few studies: including Saxegaard (2006); Nogueira (2009);

Ngalawa and Viegi (2011); and Asongu (2016). However, since these studies are beset with a number of methodological and theoretical shortcomings their findings do not provide reliable estimates as basis to frame effective economic policies, because all the studies are based on the traditional sum aggregates created by the reserve banks. The simple sum aggregates are identified with a lot of shortcomings (Serletis and Gogas, 2014; Barnett & Serletis 2000). Hence, this study is set to investigate the dynamic causal association between money stock, income, and the level of prices in Kenya, Malawi, Nigeria, and South Africa considering the methodological limitations of the existing literature. To test the causal analysis the study employs the Toda-Yamamoto (1995) Granger causality techniques.

Greater number of studies cited above employed the traditional cointegration and causality analysis between money and income and money and inflation have been identified with certain established limitations. In the first instance, the approach used for testing long run cointegration association requires all series to be integrated of order 1 or I(1) and any conclusion that can be drawn about the money-income, and money-inflation relationship is restricted on the assumption that all the series are of I(1) integration order. When the series are not the order of I(1) or bears a dissimilar orders, then no investigation for a long run association is commonly conducted.

Nonetheless, it is assumed that the unit root for integration and cointegration results posses a little power against alternative hypothesis, those tests could be inappropriate and could equally be associated with a pre-testing bias (Pesaran et al. 2001; Toda & Yamamoto, 1995). More so, as explained by the Toda-Yamamoto article, conditional F-statistics employed in testing Granger causality might not be valid since the test has no standard distribution in a situation where the time series statistical data are

integrated or are cointegrated (Giles & Williams, 1999; Toda & Yamamoto 1995). More so, such instability of findings may be traced to the measurement inaccuracies in monetary aggregates arising from unsuitable aggregation methods (Hendrickson, 2014).

In addressing the prevailing inconsistencies in the causal direction between money and income, and money and inflation, a Toda-Yamamoto causality is tested based on the monetary theory model. This will address the inadequacies of the past studies that employed Granger (1969) causality approach with the aim of getting a better inference and to further establish whether the findings will be different. The comparison of Divisia index aggregates and simple sum type aggregates in money-income, and money-inflation causal relationships has not been used in the context of the Toda-Yamamoto methodology.

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2.10 Chapter Summary

The chapter reviews related theoretical and empirical literatures. The review shows an inconclusive and mixed finding on the functions of money stock in the economy. The reviewed literature failed to establish the reason for the inconsistencies in the literature findings. In summary, the review exposes the following gaps in the literature. First, on the shortcomings of the traditional simple sum aggregates and construction for an alternative monetary aggregate; the Divisia index monetary aggregates. Second, investigating the effectiveness of Divisia index monetary aggregates in the stability for money demand. Third, examining the impacts of output and money uncertainties on money demand function stability. And lastly examining the causal link between money

supply and economic activities, and money supply and price fluctuations in selected SSA economies.

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CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter discuss the statistical and econometric techniques utilized to achieve the outlined objectives of the study. It highlights the method of Divisia monetary aggregates construction, methods of data collection, data analysis, and estimation procedures for the study. The chapter is organized as follows. After the introduction, Section 3.2 highlights on the Divisia monetary aggregates construction, while section 3.3 discusses the Monetary and output uncertainty variables construction. Section 3.4 specifies the model for the study. Section 3.5 discusses the justification for the variables specified in the model. Section 3.6 discusses the data type and method of collection. Sections 3.7 highlights the methods of analysis for the study, while Section 3.8 covers the analysis for the variables under study using the Toda-Yamamoto method. Section 3.9 is the conclusion.

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3.2 Construction of Divisia Index Monetary Aggregates

The Divisia index method for monetary aggregation captures the overall flow of the monetary services in a particular country through weighting individual monetary components based on their contribution to the aggregate flow for the monetary services (Serletis, 2006). Several Developed countries like the US, UK, Canada, New Zealand, and Germany have constructed their respective Divisia index monetary aggregates. For the developing and emerging economies like Malaysia, the GCC countries, Saudi Arabia all had their aggregates constructed by various studies. There are few studies on the construction of Divisia monetary aggregates for the SSA, especially for

countries like Kenya, Malawi, Nigeria, and South Africa that have recorded a substantial transformation in their financial sector resulting from different reforms implemented by the respective nations. These transformations affects the composition of monetary aggregates due to development in the financial system and coming up of new money or near money financial assets. Definition of money differs from one nation to another and the composition also keep changing with the advancement in the financial sector (Darvas, 2014). This therefore make it imperative to construct a Divisia monetary aggregates for each country in accordance with their definition and composition of money.

Drawing from Barnett (1980), and following Barnett *et al*. (2013), and Darvas (2015), the Divisia monetary aggregates for Kenya, Malawi, Nigeria, and South Africa were constructed as follows; First as Barnett (1980) proposed a Tornquist-Theil Divisia index of the form;

$$\frac{D_t}{D_{t-1}} = \prod_{i=1}^{N} \left[\frac{M_{it}}{M_{it-1}} \right]^{\left(\frac{1}{2}\right)(S_{it}+S_{it-1})} \tag{3.1}$$

where,

$$S_{it} = \frac{\pi_{it} M_{it}}{\sum_{j=1}^{N} \pi_{jt} M_{jt}} \tag{3.2}$$

From the Equations (3.1) and (3.2), D_t is the quantity of the Divisia index, S_{it} represent the share for the $i-th$ money component, π_{it} , user cost for good i in a

given time period, t. Barnett (1978) first derived the real user cost of money which he is expressed as follows;

$$\pi_{it} = p_t^* \left[\frac{R_{B,t} - r_{i,t}}{1 + R_{B,t}} \right] \tag{3.3}$$

where p_t^* is the cost of living index, $R_{B,t}$ is the benchmark rate, and r_{it} is the asset component's own rate of return for asset i . Equation (3.3) is the user cost of a monetary asset.

By taking logarithms for Equation (3.1), it becomes simple to realize that for a Divisia monetary index, the rate of growth (i.e its logarithm change) for the aggregate is a share weighted average for component`s quantities growth rates as shown in Equation (3.4).

$$\log\left(D_t\right) - \log\left(D_{t-1}\right) = \sum_{i=1}^{N} S_{it}^* \left(\log\left(M_{it}\right) - \log\left(M_{it-1}\right)\right) \tag{3.4}$$

where, $S_{it}^* = \left(1/2\right)\left(S_{i,t} - S_{i,t-1}\right)$

Equation (3.4) is used to create Divisia Index monetary aggregates for the Kenya, Malawi, Nigeria and South Africa over the period 2000Q1 to 2015Q3. Both the Divisia index aggregates and their simple sum equivalents were normalized to 100 during the first quarter of 2000 for ease of comparison (Dahalan et al. 2005).

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3.2.1 Implicit Rate of Return on Demand Deposits

Conventionally, demand deposits do not yield any explicit interest in most of the countries including the SSA. While acknowledging the fact that banks in most cases don't pay explicit interest on current accounts deposits, it has been argued that banks do extends some financial services in form of complimentary gifts, offering of special services, easy access to credit facilities more especially to large depositors. These services amounted to an implicit interest (Dahalan et al. 2005).

Studies like Laidler (1993) argued that the underlying assumption for free interest on the demand deposits is not tenable and it may result to a discrepancy in amount of money demanded. Certain scholars argued that this kind of zero price type of competition has given room for banks to evade the laws that prohibit payment of explicit interest on demand deposits.

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Klein (1974) established that the demand deposits implicit rate of return can be computed thus;

$$R_{\text{int}} = (1 - CRR) R_{alt} \qquad (3.5)$$

Where, R_{int} is an implicit return rate, CRR is the maximum cash reserve ratio, R_{alt} is rate of return for a substitute assets (91-day Treasury Bills rate).

Barnett (1978) user cost computation method was founded based on certainty theory, therefore it requires that all the composite assets must bear no risk. Alternatively, the deposit owners are expected to have an advance knowledge of the interest arte of all the monetary assets.

3.2.2 Interest on Foreign Currency Deposits

For some SSA countries like Kenya, some data on demand deposits, savings deposits and time deposits are denominated in foreign currency. Nevertheless, the interest rates on deposits denominated in a foreign currency depends on the anticipated currency devaluation rate during the period within which an economic agent hold the deposits. Here it signifies that its own return is not free from risk. The solution of this problem has two different dimentions; first is to remove the assets from the index computation and, secondly, to include the assets but with some alterations. Following Musi (1990), we use the second option by modifying it as described in the preceeding paragraph.

The yield on foreign money denominated deposits is conceptualized as a product of one added to its own yield rate times one adding to the anticipated rate of currency devaluation during the time (Howard & Johnson, 1983). The yield rate for every asset is specified in the following equations.

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$r_{1t} = e_t$ For demand deposits (3.6)

$r_{2t} = r_{st} * e_t$ For Savings deposits (3.7)

$r_{3t} = r_{lt} * e_t$ For Long term deposits (3.8)

Where e_t represents expected currency devaluation rate, r_{st} is interest rate on the savings accounts held in foreign money, and r_{lt} is rate of interest on the long-term money deposits held in the foreign currency. Therefore, the real interest rates to be employed for their corresponding user cost calcualtions are; r_{1t}, r_{2t} and r_{3t} .

Considering that e_t cannot be observable, so a representation for the e_t need be utilized. Numerous other measures of e_t might possibly be adopted. One such option is to compute e_t on the basis of a historical path for currency rate of exchange that also allow equations (3.6), (3.7) and (3.8) to be computed straight away. Amongst the measures one the best model for the exchange rate is that of a random walk time series based model, such a model is adopted in generating an exchange rate expectations, thus the rate of currency devaluation for the time period t will be anticipated to equal a currency devaluation rate that was experienced during the period $t-1$, so that;

$$e_t = \frac{E_{t-1}}{E_{t-2}} \qquad (3.9)$$

Where, E_t is the actual exchange rate (domestic currency/foreign currency).

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3.2.3 Computing the Benchmark Rate of Return

The theoretical postulations for the Divisia index indicate that to calculate the monetary asset`s user cost, it is necessary to obtain a benchmark return rate. The rate for benchmark is theoretically defined as that rate of interest on real capital which offers zero liquidity services or additional financial services and it is exclusively used for intertemporal wealth transfer, it is only an investment income (Anderson et al. 1997). It is usually the highest returns rate over the class of monetary assets. Barnett *et al*. (1984) first used the envelope method to compute the benchmark return rate. This is done by taking the highest rate from among the treasury bills rate and all other asset components denominated in local country's currency at each period.

Barnett (1980) shows that a benchmark return rate is required for the purpose of deriving components weights for the Divisia index money aggregates and additionally to compute the money`s user cost. This kind of benchmark asset can hardly be visible, so to solve this, scholars and policy makers embraced several other methods in oerder to estimate the benchmark rate. A most commonly utilized postulation is to sum together a spread over a maximum return (at every point in time) refered to as an envelope method and in several instances, the individual monetary stock components are put into consideration. The spread that has been added to a maximum yield to obtain a benchmark rate is termed as the liquidity service premium.

To calculate the benchmark rate using the envelope method for Kenya, Malawi, Nigeria, and South Africa we follow envelope approach as postulated by Anderson et al. (1997), and is given as;

$$R_{it} = \max\left\{rdd_t, rstd_{it}, rfcd, rtb_{it}, rstl_{it}\right\} + c \qquad (3.10)$$

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Where, R_{it} is the benchmark rate, rdd_t implicit return rate is return over demand deposits, $rstd_{it}$ represents vector for interest rates on savings and fixed term deposits, $rfcd_t$ is return on foreign currency deposits, rtb_{it} represents a vector of the interest on a 91-day treasury bills, and $rstl_{it}$ is vector of returns on short term loans, while c is a constant set at 0.001(Dahalan et al. 2005).

Incorporating constant term in the equation ensures that the returns rate on any monetary asset is below its benchmark rate. The constant is included to make sure that benchmark rate is always higher than yield rate of any financial asset. According to Barnett *et al*. (2013), the benchmark rate cannot be less than the monetary asset`s own

interest yield. Therefore, the benchmark rate can never be lower than the upper envelope value at any point of time. Barnett *et al*. (2013) included the low risk commercial banks short term interest rates of 31 to 365 days' period in the list of the benchmark envelope rates. The less than one year low risk loan rate on commercial banks loans is most often the maximum of the interest rates in the upper envelope. The interest on short term commercial banks loan is chosen as the upper limit for the rate of interest that a bank can offer on any category of its deposits. Rationally, a bank cannot give higher interest on its deposits above what it earns on its short term credits extended to its customers (Chen & Nautz, 2015). Based on that we also included the short term commercial banks loan rate in the envelope for benchmark rate computations.

3.3 Monetary Uncertainty and Output Uncertainty Variables Construction (The GARCH method)

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The Generalized autoregressive conditional heteroskedasticity (GARCH) method is used in the construction of the monetary uncertainty and output uncertainty variables. GARCH technique permits for the variance in the focus variable, say S to vary over time. The model is built on the assumption that the variable S is presumed a random series taken from the conditional density model of the form; $f\left(S_t \mid S_{t-1}\right)$. Underneath this standard assumption, the prediction of S and its change are none constant, and also depends on the previous information.

From a simple GARCH, the assumption is S itself move along the first-order autoregressive process, that is $S_t = \lambda_0 + \lambda_1 S_{t-1} + \varepsilon_t$, where ε_t is a white noise error term with $E\left(\varepsilon\right) = 0$ with a $V\left(\varepsilon\right) = h^2$.

A conditional mean for the S_t is $\lambda_0 + \lambda_1 S_{t-1}$, whereas the unconditional mean is zero. To project the variance of variable S, the conditional variance for ε_t, which is a time changing variable, has to be computed. From following specifications, the theoretical derivation of GARCH model will be set thus;

$$S_t = \lambda_0 + \lambda_1 S_{t-1} + \varepsilon_t \tag{3.12}$$

$$\varepsilon_t \mid \varphi_{t-1} \square N\left(0, h_t^2\right) \tag{3.13}$$

$$V\left(S_t \mid \varphi_{t-1}\right) = V\left(\varepsilon_t \mid \varphi_{t-1}\right) = h_t^2 \tag{3.14}$$

$$h_t^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + ... + \beta_q \varepsilon_{t-q}^2 + \vartheta_1 h_{t-1}^2 + \vartheta_2 h_{t-2}^2 + ... + \vartheta_p h_{t-p}^2 \tag{3.15}$$

where, φ_{t-1} comprises all obtainable information and h_t^2 is a conditional variance. Equation (3.12) expresses the model for time varying variance h_t as a function of a constant term and the lagged error squared e_{t-1}^2. The GARCH (p,q) model developed in Equation (3.15) is used to generate predicted value of h_t^2 as a measure of volatility of S.

The first step to estimate the GARCH Model equation (3.15) is to test if there is an existence of an autoregressive conditional heteroskedasticity (ARCH) effect in the S. The ARCH effect states that the variance of the current error term is a function of the variance of error term in the previous periods. For that the following ARCH (q) equation is usually estimated.

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$$\hat{\varepsilon}_t^2 = \beta_0 + \beta_1 \hat{\varepsilon}_{t-1}^2 + \beta_2 \hat{\varepsilon}_{t-2}^2 + ... + \beta_q \hat{\varepsilon}_{t-q}^2 + \varepsilon_t \quad (3.16)$$

To test for the presence of ARCH effect, the Langrage Multiplier (LM) is usually applied. The mean Equation (3.13) is first estimated. The estimated residuals $\hat{e}_t$ is saved and their squares $\hat{e}_t^2$ are obtained also. To test for first order ARCH, the squared residuals at time t are regressed on its lagged values $\hat{e}_{t-1}^2$. Once the squared error term is obtained Equation (3.15) can be estimated using the Maximum likelihood technique (Engel, 1982). The Maximum likelihood technique has the advantage of estimating both the mean and variance functions simultaneously.

$$\hat{e}_t^2 = \beta_0 + \beta_1 \hat{e}_t^2 + v_t \quad (3.17)$$

where v_t is a random term.

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The $F-test$ can be used under the hypothesis that; $H_o : \beta_1 = \beta_2 = ...\beta_q = 0$

where; H_1 : at least one β coefficient is statistically significantly different from zero. A few number of significant estimated figures of βs can lay support for the existence of the ARCH type effect. Once the ARCH effect is found, Equations (3.14) and (3.15) are then computed simultaneously.

The GARCH own order is confirmed by significance for the β s and ϑ s in the equation (3.15). In many cases an order for GARCH (1, 1) condition is adequate (Enders, 2008).

In line with similar studies on volatility variable generation such as the studies by Bahamani-Oskooee *et al.* (2013), we equally built an assumption of a GARCH (1,1) order model and specified it as follows;

$$h_t^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \vartheta_1 h_{t-1}^2 \qquad (3.18)$$

Equation (3.18) yielded significant coefficients (see appendix 2 for the GARCH (1,1) estimates results).

3.4 Model Specification

This section specifies the estimable models for the study. Following subsection 3.5.1 explains the model for money demand stability while the subsequents subsections 3.5.2 and 3.5.3 discussed the models for Money-income and money-inflation Granger causality respectively.

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3.4.1 Demand for Money Function

A stable money demand is largely considered as necessary for a conduct of efficient and effective monetary policy because it facilitates a policy driven change in money aggregates to assume a predictable impact on income, interest rate and eventually price (Ball, 2012). The demand for money is indeed one of the areas in the economics literature that has gained consideration of researchers in the recent decades.

On a broader perspective, the money demand theories regard two set of common variables in explaining the demand for money; the scale variables and opportunity cost variables, they only differ in the particular role attached to each variable. To that effect, there emerged a common agreement from the existing literature that empirical studies

on money demand are usually inspired by a mixture of theories rather than just one single theory (Goldfeld & Sichel, 1990). A general specification of money demand function begins with a functional form as;

$$\frac{M^d}{P_t} = f\left(SC, OC\right) \tag{3.11}$$

where, $\frac{M^d}{P_t}$ is real money demand and it depends on a considered scale variable denoted as SC and representing economic activity. And secondly, OC represents an opportunity cost for holding stock of money. M^d is a proxy for a chosen financial aggregate in its nominal form and P_t is the price at a given time t (Laidler,2013).

The empirical examination into the money demand behaviour in the SSA nations can be considered within the framework of the existing theories where the demand for money function is specified on the basis of scale and opportunity cost variables. Income and rate of interest were identified as the scale and opportunity cost variables respectively. Nobel Laureate Mundel (1963) and other studies such as Arango and Nadiri (1981) provides justification for including exchange rate in the money demand function making reference to currency substitution literature.

However, the main focus of the existing studies on money demand function centred on identifying the variables that influence the money demand apart from income and rate of interest, testing for integrating and cointegrating features of the concerned variables, and investigating the money demand stability (Akinlo, 2006).

This study is distinct from other previous studies on money demand function in two major ways. First it considers employing an alternative and more theoretically established monetary aggregates- Divisia aggregates in the study of money demand for the selected SSA countries. Secondly, the study incorporated two new variables in the money demand function model; monetary uncertainty and output uncertainty based on the study of Choi and Oh (2003). These key issues were not considered by the previous studies on money demand in the SSA.

This research follow Choi, and Oh (2003) ; Bahmani-Oskooee *et al.* (2013) and extend the money demand specification to include the monetary uncertainty (MOU) and output uncertainty (OUU) measures into the function. Based on the identified framework, an augmented money demand function is developed and specified in a semi-log linear form as;

$$\ln DM_t = \alpha + \beta_1 \ln GDP_t + \beta_2 ITR_t + \beta_3 \ln EXR_t + \beta_4 \ln CPI + \beta_5 \ln MOU_t + \beta_6 \ln OUU_t + \varepsilon_t \quad (3.19)$$

where DM_t is a measure of monetary aggregates (Divisia aggregates) at time t, GDP_t is a measure of income, ITR_t is interest rate; a foregone cost serie that measures the foregone cost for keeping money, EXR_t is domestic currency rate of exchange. ln Indicates natural logarithmic transformation to enable the interpretation of coefficient as elasticities and to smoothen the time series on the respective variables. Thus equation (3.19) is the long run money demand equation. It is expected that the estimates of β_1 to be positive and β_2 to be negative.

Depreciation or a fall in the local currency value in terms of other foreign money is expected to raise the domestic money value for foreign assets held abroad by domestic residents, it will therefore cause a rise in demand for domestic cash balances resulting from this wealth effect. However, a depreciation may also result into a decline in the domestic money demand if it induces an expectation of further depreciation (Bahmain-Oskoee et al., 2013). Therefore, a computed value of β_3 either be negative or positive. The estimates of β_4 is also expected to be negative as inflationary anticipation will negatively affect the holding of cash balances (Akinlo, 2006).

Following Choi and Oh (2003) output uncertainty is defined as real output volatility and monetary uncertainty is the nominal demand of money volatility. A computed coefficient of β_5 and β_6 could either be negative or positive. Stability of Money demand needs that any shift away from the equilibrium position are temporary. When there is a stability in money demand, ε_t has to be stationary having a zero mean. When the ε_t exhibit stationarity, the series identified in the money demand model are considered to have cointegrated (Bahmani-Oskooee & Galan, 2009).

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From equation (3.19), an ARDL specification for money demand can be derived to display both the short-run and the long-run dynamic relationships between Divisia money and its determinanats at levels. Therefore, the ARDL representation of equation (3.19) can be expressed as;

$$\Delta \ln DM_t = \varphi_0 + \sum_{i=1}^{p} b_i \Delta \ln DM_{t-i} + \sum_{i=0}^{q_1} c_i \Delta \ln GDP_{t-i} + \sum_{i=0}^{q_2} d_i \Delta ITR_{t-i} + \sum_{i=0}^{q_3} e_i \Delta EXR_{t-i} +$$

$$\sum_{i=0}^{q_4} f_i \Delta \ln CPI_{t-i} \sum_{i=0}^{q_5} g_i \Delta \ln MOU_{t-i} + \sum_{i=0}^{q_6} h_i \Delta \ln OUU_{t-i} + \alpha_1 \ln DM_{t-1} + \alpha_2 \ln GDP_{t-1} + \alpha_3 ITR_{t-1} +$$

$$\alpha_4 \ln EXR_{t-1} + \alpha_5 \ln CPI_{t-1} + \alpha_6 \ln MOU_{t-1} + \alpha_7 \ln OUU_{t-1} + \varepsilon_t \qquad (3.20)$$

Where Δ is a first difference operator and ε_t is identically and independent distributed and random white noise error term. Following the propositions of Pesaran et al. (2001), a bound teststing procedure is followed to test the existence of a longrun relationship by establishing whether the variables are cointegrated or not. The statistics are computed in the Wald test version to provide the F-statistic which is asymptotically distributed and non-standard under the null hypothesis of no cointegration relationship between the variables under investigation, regardless of whether the independent variables are purely I(0), I(1) or mutually cointegrated. Alternatively, it can be said that the F-statistic can be derived by imposing exclusion restrictions on the lagged variables in levels from the estimations of equation (3.20).

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3.4.2 Money and Income Relationship Models

To under take the Toda-Yamamoto Granger test, we follow Wolde-Rufael (2005) procedure and expressed our models as a VAR equation system as follows; For the Divisia money-income causal relationship;

$$\ln DM_t = \varphi_0 + \sum_{i=1}^{k} \varphi_{1i} \ln DM_{t-i} + \sum_{j=k+1}^{d\max} \varphi_{2j} \ln DM_{t-j} + \sum_{i=1}^{k} \beta_{1i} \ln GDP_{t-i} + \sum_{j=k+1}^{d\max} \beta_{2j} \ln GDP_{t-j} + \lambda_{1t}$$

(3.21)

$$\ln GDP_t = \delta_0 + \sum_{i=1}^{k} \delta_{1i} \ln GDP_{t-i} + \sum_{j=k+1}^{d\max} \delta_{2j} \ln GDP_{t-j} + \sum_{i=1}^{k} \alpha_{1i} \ln DM_{t-i} + \sum_{j=k+1}^{d\max} \alpha_{2j} \ln DM_{t-j} + \lambda_{2t}$$

(3.22)

Where, the series are as defined in equation (3.19). From equation (3.21), Granger causality from $\ln GDP_t$ to $\ln DM_t$ signify that $\beta_{1i} \neq 0 \ \forall_i$; in a similar way equation (3.22) shows that $\ln DM_t$ Granger cause $\ln GDP_t$, if $\alpha_{1i} \neq 0 \ \forall_i$.

For the simple sum-money Toda-Yamamoto Granger causality model;

$$\ln SM_t = \varphi_0 + \sum_{i=1}^{k} \varphi_{1i} \ln SM_{t-i} + \sum_{j=k+1}^{d\max} \varphi_{2j} \ln SM_{t-j} + \sum_{i=1}^{k} \beta_{1i} \ln GDP_{t-i} + \sum_{j=k+1}^{d\max} \beta_{2j} \ln GDP_{t-j} + \lambda_{1t}$$

(3.23)

$$\ln GDP_t = \delta_0 + \sum_{i=1}^{k} \delta_{1i} \ln GDP_{t-i} + \sum_{j=k+1}^{d\max} \delta_{2j} \ln GDP_{t-j} + \sum_{i=1}^{k} \alpha_{1i} \ln SM_{t-i} + \sum_{j=k+1}^{d\max} \alpha_{2j} \ln SM_{t-j} + \lambda_{2t}$$

(3.24)

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Where, SM_t is simple sum monetary aggregates at time t. All other series are as defined in the equation (3.23) and expressed in their natural logarithms. From equation (3.24), Granger causality from $\ln GDP_t$ to $\ln SM_t$ signify that $\beta_{1i} \neq 0 \ \forall_i$; in a similar way equation (3.24) shows that $\ln SM_t$ Granger cause $\ln GDP_t$, if $\alpha_{1i} \neq 0 \ \forall_i$.

3.4.3 Money and Inflation Relationship Models

To undertake the money-inflation Granger causality and in line with Wolde-Rufael (2005), the following model is expressed in VAR system as follows; For Divisia monetary aggregates;

$$\ln DM_t = \varphi_0 + \sum_{i=1}^{k} \varphi_{1i} \ln DM_{t-i} + \sum_{j=k+1}^{d\max} \varphi_{2j} \ln DM_{t-j} + \sum_{i=1}^{k} \beta_{1i} \ln CPI_{t-i} + \sum_{j=k+1}^{d\max} \beta_{2j} \ln CPI_{t-j} + \lambda_{1t}$$

(3.25)

$$\ln CPI_t = \delta_0 + \sum_{i=1}^{k} \delta_{1i} \ln CPI_{t-i} + \sum_{j=k+1}^{d\max} \delta_{2j} \ln CPI_{t-j} + \sum_{i=1}^{k} \alpha_{1i} \ln DM_{t-i} + \sum_{j=k+1}^{d\max} \alpha_{2j} \ln DM_{t-j} + \lambda_{2t}$$

(3.26)

Where, the series are as defined in equation (3.25). From equation (3.26), Granger causality from $\ln CPI_t$ to $\ln DM_t$ signify that $\beta_{1i} \neq 0 \ \forall_i$; in a similar way equation (3.26) shows that $\ln DM_t$ Granger cause $\ln CPI_t$, if $\alpha_{1i} \neq 0 \ \forall_i$. For the simple sum-inflation relationship;

$$\ln SM_t = \varphi_0 + \sum_{i=1}^{k} \varphi_{1i} \ln SM_{t-i} + \sum_{j=k+1}^{d\max} \varphi_{2j} \ln SM_{t-j} + \sum_{i=1}^{k} \beta_{1i} \ln CPI_{t-i} + \sum_{j=k+1}^{d\max} \beta_{2j} \ln CPI_{t-j} + \lambda_{1t}$$

(3.27)

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$$\ln CPI_t = \delta_0 + \sum_{i=1}^{k} \delta_{1i} \ln CPI_{t-i} + \sum_{j=k+1}^{d\max} \delta_{2j} \ln CPI_{t-j} + \sum_{i=1}^{k} \alpha_{1i} \ln SM_{t-i} + \sum_{j=k+1}^{d\max} \alpha_{2j} \ln SM_{t-j} + \lambda_{2t} \quad (3.28)$$

Where, SM_t is simple sum monetary aggregates at time t. All other series are as defined in the equation (3.27) and expressed in their natural logarithms. From equation (3.28), Granger causality from $\ln CPI_t$ to $\ln SM_t$ signify that $\beta_{1i} \neq 0 \ \forall_i$; in a similar way equation (3.28) shows that $\ln SM_t$ Granger cause $\ln CPI_t$, if $\alpha_{1i} \neq 0 \ \forall_i$.

The normal Granger type of causality analysis was centred on assesing how the previous values of money variables can help previous values for income in explanation fo the current value of income as portrayed in the equation (3.23) to (3.24) (Granger,

1969). Also, along the same line, equations (3.25) to (3.26) investigate how preceding values of money series are important in aiding to explain the preceding values of inflation. The null hypothesis of equations (3.27) to (3.28) is a situation that, money cannot Granger cause income. A dismissal of the null hypothesis is projected by the significance of F-statistics, which happens to be a Wald statistic for a joint hypothesis that estimated parameters for lagged values equivalent to zero (Asongu, 2014).

3.5 Justification of the Variables

The previous section established the theoretical and empirical measurement of monetary aggregates and provides both the theoretical framework and empirical link among the variables in the money demand function. This section briefly discusses the measurement and operational use of the variables employed in the research drawing from the theoretical background and empirical justification of each variable.

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3.5.1 Gross Domestic Product (GDP)

In economics literature, gross domestic product is often defined as total value for all the goods and services produced within a geographical territory of a particular economy in a given time say one year. The GDP of a country is computed by taking the overall market value for all final commodities and services manufactured in that country during a particular year. This is given as an aggregate sum of consumption, investment, with government expenditure plus the value of exports, less value of imports. It is the known popular measure of national income, output and growth in an economy. Income is the leading and most significant determinant of money demand. It is considered as an instrument in measuring level of economic activity. According to literature, the sign of income in the money demand function is mostly considered

positive which signifies that when real income rises, it will leave a positive influence in real demand for money in an economy and vice versa (Jawadi & Sousa, 2013).

Such important relationship between the demand for money and income is buttressed by numerous researches also in developing countries; Bahmani-Oskooee and Gelan (2009); Bahmani-Oskooee and Rehman (2005); Omanukwe (2010), Arize and Nam (2012); Knell and Stix(2006); Kumar *et al*. (2013); Doguwa *et al*.(2013); Kelikume *et al.* (2015),Kumar *et al.*, (2013), Lieb and Candelon (2015), and Nelson (2013). The demand for money is connected to the volume of transactions where the quantity of transactions has a direct and proportional relation with level of real income (Walsh 2010). Following the studies of Dahalan *et al.*, (2007), Darvas (2015), Godfield and Sichel, (1990); Dritsakis, (2011); Herwartz *et al*. (2016) among others, income is proxied by the real GDP. The study adopts the World Bank measure of real GDP. According to World Bank, real GDP is measured as a weighted total of all gross value added produced by residents in a country and added to product taxes after taking way subsidies not captured in the value of the goods (World Bank, 2016). Therefore, the following hypothesis will be tested.

Ho: There is no relationship between income (GDP) and monetary aggregates in Kenya, Malawi, Nigeria, and South Africa.

3.5.2 Interest Rate

Interest rate is the amount of money paid to the lender by the borrower for using the borrowed funds during a stated period of time. It is considered as a cost of borrowing. In this study, the interest rate is the rate paid on savings deposits, time deposits and treasury bills by the financial institutions in the domestic economy.

Different relationships (positive or negative) existing between money demand and interest rates have been supported by diverse theories (Belongia & Ireland, 2006). For example, the portfolio theories for money demand the postulated that, a rate of interest will lower down money demand. Money is regarded as a wanted asset in the financial portfolios, eventhough it pays no interest rate compared to other interest bearing assets. If there is a fluctuation in the rate of interest, worth of money does not vary while the bond`s value change (Chukwu, 2009). The use of interest rate as opportunity cost variable is deemed more appropriate as the foregone cost of keeping money. Interest rate is one of the important determining factor in demand for money function (Abdullah et al. 2010). As an opportunity cost variable, when interest rate increases, money shift away from the hands of households to interest earning instruments. The level of country`s financial development and sophistication determines the kinds of interest bearing financial instruments available to the households. Scholars view also varies on which interest rate to choose.

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Theoretically, it should be the rate available on the closest substitute of money since this should best represent the opportunity cost of holding money (Handa, 2009). Conversely, the closeness of substitutes varies with the definition of money which itself varies as innovations in very liquid assets take place. Even with a constant definition of money, the choice of the closest substitutes for money changes through time. Short run commercial debts seem closer substitutes for money than long rates and therefore more relevant. On the other hand, long rates are better representative for the average return rate on a capital in the economy and incorporate expectations of future inflation rates.

Whether the total variation in interest rates on non-financial instruments reflects a variation in the money`s opportunity cost is solely dependent on what is actually happening to the own interest rate for money. In a situation where deposits are not yielding interest, then money`s own explicit interest is virtually zero, and therefore total movements in the interest on other non-financial instruments show a movement in opportunity cost. An urgent circumstance applies when bank deposits give out interest rates that are low and sticky.

Provided bank deposits began to give out competitive interest rates on money, then the difference between the money`s own interest rate and interests on other monetary assets indicate an opportunity cost for holding money. Added to that, when bank deposits do not pay interest or when banks give out an offer of premium interest for various conditions and rules, then theory propose that the interest rate for money could be identified using the deposit rates weighted averages (Dahalan et al. 2005). Theoretically, the spread of money`s interest rate and the interest rate applied on bank loans will also affect the money demand because spending over and above one's income should be financed only through disposal of liquid assets or through loans. The choice of interest rate may be limited to a small number of series by the availability of data over a long period (Knell & Stix, 2006).

After the coming out of Keynes general theory, attempts were made to show a positive relationship between interest rates and velocity of circulation of money, signifying an inverse association between interest rates and the demand for money. This was to demonstrate that a rise in the money stock would produce a fall in the velocity, reducing the impact on nominal income. Other studies (González et al. 2014; Strohsal & Winkelman, 2015) sought to distinguish between idle and active balances and then

to relate idle balances to interest rates, on the assumption that interest rates only influenced idle balances and had no role to play in the transactions or precautionary demand for money. The relationship between interest rate and money holding is still not clear form the available empirical researches.

Empirical findings have established a negative impact of interest rate on the money demand. In developed countries (Barnett & Chauvet, 2011; Serletis & Rahman, 2014; Darvas, 2015) established the negative relationship. Serletis and Gogas (2014), examine the US balanced growth hypothesis using the Divisia money and traditional simple sum money aggregates. Using a 3-month treasury bills rate they established that interest rate influence on demand for money function is negative and significant.

Psaradakis *et al*. (2005) studied the causal relationship between real money and real activity in the US economy using the long term (one year) interest rate established a negative association between interest rate and money demand function in the US over the study period. Belongia and Ireland (2014b) also investigated the role of interest rate in monetary policy measurement in the US and found that interest rate is the most suitable opportunity cost serie in the US demand for money model.

Developed economies are characterized with a highly advanced and fully integrated financial markets, where interest rate`s role is well defined. However, Darvas (2015) estimated the correct response to money, user cost and interest rate shocks in the Euro area using Divisia monetary aggregates. They found that interest rate response to Divisia money is positive and significant. The study concluded that money exerts a greater influence on output, interest rates and prices in Euro Area.

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For developing countries most of the empirical studies concur with the findings in the developed countries that interest rate variable estimate is significant and negative in money demand. Bahamani-Oskooee, *et al.*, (2013); Owoye and Onafowora (2007), Bourreau *et al*. (2015); Dube (2013), and Dahalan *et al.*, (2007) all found a negative association between interest and demand of money function. Dube (2013) studied the stability of broad money demand in South Africa using foreign rate of interest as a foregone cost variable. His study also established a conventionally significant and negative association between rate of interest and money demand in South Africa. When interest rate increases household may hold less money and instead prefer to convert their cash into interest yielding instruments.

The theory that inflation influences the nominal rate of interest one for one is known as the Fisher effect; it follows from the Fisher identity and the assumption that inflation does not affect the real rate. A rising growth rate of money stock lowers the real money balances. This rise in money stock growth also increase the expected inflation leading to a rise in nominal rate of interest. This rise in opportunity cost for keeping money lowers the amount of real money balances that an individual wish to keep. Based on the foregoing, the following hypothesis will be tested.

Ho: No relationship between the interest rate and monetary aggregates in Kenya, Malawi, Nigeria and South Africa.

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3.5.3 Exchange Rate

Exchange rate can be defined as the amount of local currency (Say Nigerian Naira) per foreign currency, say U.S Dollar for example. Alternatively, it is the value of foreign currency in terms of local currency that measures the substitutability of the foreign currency with local currency. When there is a decrease in the value of local currency (depreciation), household may shift their monetary portfolio holdings to foreign currency that commands higher and more stable value. The exchange rate portrays the substitution effect between local and foreign currencies (Plosser, 2014). Mundell (1963) for a first time suggested the incoporation of the variable exchange rate into the standard function of money demand. It is used to measure the currency substitution effect in the demand for money function.

The empirical results on connection between exchange rate and demand for money is mixed. Some studies found a positive influence of currency exchange rate on money demand function such as, Clarida *et al*. (1999); Cobman and Kang (2012); Hendrickson (2014); Singh and Kumar (2010); Bahmani-Oskooee and Rehman (2005); Thornton (2014); and Jawadi and Sousa (2013) established that rate of domestic currency exchange has a negative and substantial effect on money demand, while Chimobi, (2010); Kelkume *et al*. (2015), Lieb and Candelon (2015), and Nelson (2013) found an insignificant results.

It has been argued that instability in demand for money relation may be elucidated by the currency substitution since foreign money may act as a substitute for domestic money in economic agent`s portfolios either directly or indirectly (Bahamani-Oskooee et al., 2013). Direct currency substitution occurs when economic agent shifts into

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foreign currency when they anticipate expansionary monetary action by the authorities. Occasionally, agents may lose faith completely in the domestic currency and seek to hoard foreign currency. Indirect substitution takes place through the capital market; assume economic agents revise upwards the expected returns on foreign bonds. Selling domestic bonds and buying foreign bonds puts mounting pressure on domestic interest rates and possibly downwards pressure on foreign rate of interest.

Having a specified demand for money, and in a floating exchange rate mechanism, a given money supply, interest rate will not move. Thus, the augmented demand for foreign bonds leads the exchange rate to increase (that is the home currency depreciates) to a point where the anticipated future fall compensates for the virtual fall in the attraction in foreign bonds. This fall in the value of the domestic currency promotes inflation (Bahamani-Oskooee et al., 2014). With fixed exchange rates, the problem does not arise. Capital exports happen, the local money supply drops and the foreign money supply upsurges until foreign and local interest rates vary by a quantity stating the relative attraction of foreign and domestic bonds.

In this study, it is specified in the money demand model as an independent variable. Rise or fall of foreign exchange rate is ascribed to depreciation or appreciation in domestic currency against foreign currency (Bahmani-Oskooee et al., 2013). The following hypothesis is posited based on the above arguments. From the above analysis, mixed and inconclusive results appear to dominate the findings of studies on the association between exchange rate and demand for money function. The following hypothesis is posited based on the above arguments.

Ho: There is no relationship between exchange rate and monetary aggregates in Kenya, Malawi, Nigeria and South Africa.

3.5.4 Inflation

Inflation can be conceptualized as a continuos or sustained rise in the overall prices of commodities and services, or from another angle it can be defined as a persistent or incessant reduction in the currency value. Numerous things should be put into consideration regarding this definition. First, inflation denotes a movement in the overall price levels. It does not mean just a change in one price relative to the other prices. Such type of variations are common even when the general level of prices remains stable. Secondly, the increase in price level need be somewhat significant and persists over a time period longer than one day, week, or month. However, if the increase is a sustained fall instead, it is termed deflation.

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Numerous measures for inflation do exist, since there are several dissimilar price indices linking diverse sectors of an economy. Two commonly known measures for which inflation rates are stated in several nations are Consumer Price Index (CPI) that measures the rate of change in prices of goods and services purchased by consumers, and the GDP deflator, which measures prices of locally manufactured goods and services.

This study utilizes the definition and measurement of inflation by the World Bank. Accordingly, it is measured through the Laspeyers index formula computed through the consumer price index and it depicts the percentage change in the average cost of a

commodities such as goods and services which may vary at a given time interval or defined overtime (World Bank, 2016). On the association between inflation and demand for money, the following hypothesis is drawn.

Ho: There is no relationship between inflation and monetary aggregates in Kenya, Malawi, Nigeria, and South Africa.

3.5.5 Monetary Uncertainty

Monetary uncertainty is the volatility of money supply (Choi & Oh 2003). Recent studies on demand for money attempt to incorporate economic uncertainty variables into the money demand models. A study by Choi and Oh (2003), first derived theoretical demand for money function and incorporated the monetary uncertainty in the money demand function. The study using the US data established that the demand for money function becomes stable if money growth volatility is included in the model.

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In a similar finding, Greiber and Lemke (2005) adopting the Choi and Oh (2003) model show that unaccounted elements of certain series like the volatility and the returns on stocks, strong relationship between bond and stock earnings, corporate bonds spreads together with certain sentiment indicators has a substantial positive impact on the demand for money in the case of US and Euro Area countries. Atta-Mensah (2004) examined the stability for money demand in Canada. His study show that output volatility and monetary volatility are vital in the stability of money demand function in Canada.

Literature has proved that uncertainty has a negative effect on economic growth (Bahmani-Oskooee et al. 2015). This is because the output growth rate bears a negative

correlation with the macroeconomic uncertainty (Atta-Mensah, 2004). Studies on effect of output and economic volatility on demand for money function are few in the literature (Gan 2014). The few studies presented a mixed result on the relationship between the two uncertainty variables and money demand. Studies such as Bahmani-Oskooee *et al.*, *(*2015), Arize *et al.*, (2005) and Choi and Oh (2003) found a negative and significant effect of the two uncertainties on money demand function for the US in long run period.

Others have a contrary finding where both the output and money uncertainty exerts a negative influence on money demand function in both short and long run period. These includes studies such as Bahmani-Oskee *et al*. (2012) and Lemke and Greiber (2005). Despite high volatility nature in macroeconomic and financial structure of developing countries, there is no study on the influence of output and money uncertainties on money demand function in African countries particularly the SSA.

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There are limited number of studies that empirically explore the economic impacts of monetary uncertainty on money demand functions (Choi & Oh, 2003; Bahmani-Oskooee, 2014). Most of the studies were conducted in developed countries and they presented a mixed and inconclusive results (Bahmani-Oskooee et al., 2015). These studies did not consider the use of an alternative and more theoretically founded monetary aggregation; Divisia aggregates on money demand. From the preceding arguments, a null hypothesis is set thus;

Ho: There is no relationship between monetary uncertainty and monetary aggregates in Kenya, Malawi, Nigeria, and South Africa.

3.5.6 Output Uncertainty

Measuring uncertainty in economics has been projected in different ways. Gan (2014) put it that scholars use risk and uncertainty as the similar and will be proxied by a measure of volatility. It was argued that shocks to economic series which serve as an index of economic activity bears a strong influence on the portfolio choice processes of an economic agents, and so have an important bearing on the quantity of money held by households (Bahmani-Oskooee and Xi 2011). Output uncertainty in this study is defined as the real output volatility and (Choi & Oh 2003).

Choi and Oh (2003) put forward the theoretical foundation for the incorporation of output volatility measure into the money demand function. They provide the justification for its inclusion into the demand for money model and empirically established that the output uncertainty could exert a positive or negative influence on the demand for money function (Choi & Oh, 2003). According to Choi and Oh (2003), rise in either output uncertainty will results to a substitution effect by moving away from monetary to other forms of assets that are less volatile thereby indicating a negative estimate of the variables. From the other point, the same rise in the output volatility will make the general public to be extra cautious and thereby encourage them keep liquidity therefore the positive coefficient estimates of the measure. A general volatility in any given nation could exert an effect on the quantity of money an individual economic agent is ready to maintain (Choi & Oh, 2003). For instance, when there is an increase in the interest rate risk, in form of an interest rate volatility that will equally increase a risk for holding securities that bears short-term fixed interest rates. Under such circumstances, economic agents substitute these interest-bearing securities for more money.

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Adding the output uncertainty variable into the money demand function is particularly relevant for the developing SSA, this is because there have been a significant change taking place in their output resulting from economic and financial reforms, comprising the introduction of key price and trade liberalization measures, which has a significant monetary uncertainty. The addition of a measures for volatility into the money demand function is rather a new invention, and very few studies have really examined the empirical strength of such models.

It is quite often argued that a financial sector reform may lead to instability in money demand and the recent developments in the monetary and financial system couple with an increase in the openness of the Sub Saharan African (SSA) countries might make the money demand to be unstable. If the demand for money function exhibit instability and presents a remarkable shift over time, then the income velocity of money will be unpredictable and as such the quantity of money may not be a good predictor of economic activities (Sriram, 2000).

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Ho: There is no relationship between output uncertainty and monetary aggregates in Kenya, Malawi, Nigeria, and South Africa.

3.6 Data

This section discusses the type and source of data used in the Divisia monetary aggregates construction and in empirical models for analysis.

3.6.1 Data Used in the Construction of Divisia Aggregates

The production of Divisia index monetary requires some statistical data on amounts and prices of the monetary assets components involved. The asset's own price is the rental rates for the individual asset (user costs).

We adopted the definition of monetary aggregates in Kenya, Malawi, Nigeria, and South Africa as provided by the Central Bank of Kenya (CBK), Central Bank of Malawi (CBM), Central Bank of Nigeria (CBN), and South African Reserve Bank (SARB) respectively.

The definition and composition of the countries narrow and broad monetary aggregates are as shown in table 3.1 below.

Table 3.6.1 1 Data Used in Construction of Divisia Monetary aggregates

Country	Money	Asset Component	Rates of Return
Kenya	DM0	Money with the public outside banks	Zero
	DM1	Demand deposits	Implicit rate of return using Klein`s(1974) approach
	DM2	Savings deposits	Savings deposits interes rate
		Time deposits	Time deposits interest rates
	DM3	Deposits denominated in foreign currency	Implicit rate of return Using Musi`(1989) approach
Malawi	DM1	Currency outside banks	Zero
		Demand deposits	Implicit rate of return using Klein`s(1974) approach
	DM2	Savings deposits	Savings deposits interes rate
		Time deposits	Time deposits interest rates
Nigeria	DM1	Currency outside banks	Zero
		Demand deposits	Implicit rate of return using Klein`s(1974) approach
	DM2	Savings deposits	Savings deposits interes rate
		Time deposits	Time deposits interest rates
South Africa	DM0	Notes and coins outside banks	Zero
	DM1A	Chqs and transmission deposits of private sector	Implicit rate of return using Klein`s(1974) approach

	DM1	Other demand deposits of private sector	Implicit rate of return using Klein`s(1974) approach
	DM2	Savings deposits	Savings deposits interes rate
		Time deposits	Time deposits interest rates
	DM3	Long-Term deposits	Long-Term deposits interest rate

Source: Author`s compilation from respective country`s Central Banks

From the above definitions, the statistics required for creation of Divisia money aggregates for respective countries are; amounts of currency in circulation, demand deposits, savings, and time deposits (short, medium and long term), foreign currency deposits. Others are; an implicit rate of return on demand deposits, returns on savings and time deposits (short, medium, and long term), foreign currency deposits and 90-day Treasury bills. All data are obtained from the Central Bank of Kenya (CBK), Reserve Bank of Malawi (RBM), Central Bank of Nigeria (CBN), and South Africa Reserve Bank (SARB) for Kenya, Malawi, Nigeria, and South Africa respectively.

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3.6.2 Data Used for Models Estimation

This study employs quarterly time series data for the period 2000Q1 to 2015Q3 for the four selected SSA countries; Kenya, Malawi, Nigeria, and South Africa. The variables under consideration are money supply, gross domestic product (GDP), interest rate, exchange rate, inflation. The data were obtained from World Development Indicators (WDI) of the World Bank, International Financial Statistics (IFS) of the International Monetary Fund (IMF). Data for the monetary uncertainty and output uncertainty are constructed using the GARCH method.

Annual data were interpolated into quarterly data using the Gandolfo (1981) interpolation method. The Gandolfo method is preferred because it has been extensively acknowledged and adopted in several available empirical studies. Studies

that utilized this method includes; Habibullah (1998), Baharumshah and Rashid (1999), and Tang and Chua (2012). More so, Smith (1998) carried out a Monte Carlo examination to assess the effects of the linearly interpolating method on cointegration tests and he establish that the interpolated variables are not a source of any bias in the estimates of cointegrating vectors even when the sample size is small. Furthermore, the interpolation method has the advantage of being able to produce higher frequency data variables for time series analysis.

In deriving the interpolation formula, the observed values are integrals. Therefore, the rule of thumb is to integrate the quadratic function to obtain the quarterly formulae. Gondolfo (1981) proposed a quarterly formulae interpolation based on the following conditions in any year t;

$$y_t^{(1)} = 0.0546875y_{t-1} + 0.234375y_t - 0.0390625y_{t+1} \tag{3.29}$$

$$y_t^{(2)} = 0.0078125y_{t-1} + 0.265625y_t - 0.0234375y_{t-1} \tag{3.30}$$

$$y_t^{(3)} = -0.0234375y_{t-1} + 0.265625y_t + 0.0078125y_{t+1} \tag{3.31}$$

$$y_t^{(4)} = -0.0390625y_{t-1} + 0.234375y_t + 0.0546875y_{t+1} \tag{3.32}$$

Where y_t, y_{t-1}, y_{t+1} , are the current, lags and lead values of the variables in the equation at time t (annual). In other words, three continuous annual observations of variable $y(t)$ are adopted in each of the equation.

However, Asterious and Hall (2007) caution on the dependence on converted data such as the disaggregated data. Based on that the study employed the exponential smoothing

technique as reported in a Bowerman and O` Connel (1979). Exponential smoothing is the smoothing method that centres on a weighted average historical data figures with additional weight attached to current figures. It is a recursive based technique in which new smoothened series are updated for each new observation. It is one of the most practically appropriate forecasting techniques available (Goodwin & Wright 2010). This is due to its ease and transparency as well as its capability to adopt in several situations. It also had a solid theoretical base (Hyndman et al. 2013)[1].

3.7 Methods of Data Analysis

This section explained in detail the various methods used in the data analysis and estimation procedures. These includes the models used in stationarity tests, model estimation and diagnostics test procedures.

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3.7.1 Stationarity Analysis

A vital fundamental step to run a time series econometric analysis is first to unearth the features of the statistical data to be used. Examining each variable is vital because the variable's properties must be considered first when building a model for estimation. This is because some features may have effect on the statistical inference employed in building the model and also in analysing the economic system. Economic time series are tested for unit root to check whether shocks on the series have a permanent or temporary impact on its behaviour. If a series contains a unit root, it then suggests that shocks due to that series will have an everlasting effect. Analysing individual time series variable is vital because the features of the individual variable

[1] For detail explanation on the types and application of Exponential smoothing see for example De Lurgio (1998).

have to be taken into consideration in modelling the data generation procedure of a system of potentially associated variables (Lutkepohl & Kratzig, 2004). Some of the features of the variables may have an influence on the statistical inference utilized in the modelling and analysis of an underlying economic issue.

Alternatively, if the series is stationary a shock will only lead to a temporary deviation from the long run growth path of the series (Enders, 2004). The seminal paper of Nelson and Plosser (1982) first established the evidence in support of unit root hypothesis. Since then, the unit root hypothesis has attracted a considerable attention in both economics and statistics. Stationarity of a variable is a required condition to estimate an econometric model. A variable is said to be stationary when it bears constants mean; covariance, and the auto-covariances in each of the specified lag (Lutkepohl & Kratzig, 2004).

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Two different unit root tests; ADF and P-P tests were employed to test for the stationarity of the individual variables under consideration in this study. They are discussed in the subsequent sub-sections.

3.7.1.1 Augmented Dickey-Fuller (ADF) Unit root test

The most common method of testing the traditional unit root test is the Augmented Dickey-Fuller (ADF) test developed by Dickey and Fuller (1979; 1981).

The underlying principle of the traditional unit root test centres on whether an economic time series are influenced by a temporary or permanent structural shock. The ADF model basically focuses on an estimate of α , under the null hypothesis that; $\alpha = 0$ against an alternative of $\alpha \langle 0$

An ADF test can be tested using three different equations;

$$\Delta X_t = \alpha + \gamma X_{t-1} + \sum_{i=1}^{k} \beta_i \Delta X_{t-i} + \varepsilon_t \tag{3.33}$$

$$\Delta X_t = \alpha + \lambda t + \gamma X_{t-1} + \sum_{i=1}^{k} \beta_i \Delta X_{t-i} + \varepsilon_t \tag{3.34}$$

$$\Delta X_t = \gamma X_{t-1} + \sum_{i=1}^{k} \beta_i \Delta X_{t-i} + \varepsilon_t \tag{3.35}$$

Where; Δ is a first difference operator, X_t is economic variable under investigation, t is the time trend, α is the intercept, X_{t-1} is the lag variable under consideration, ΔX_{t-1} is the first difference lagged variable commonly considered to take care of serial correlation problem (Dickey & Fuller, 1979), k is the number of lags length selected based on the Akaike Information Criteria(AIC) or Schwarz Bayesian Criteria (SBC), ε is a white noise error term with zero mean and a constant variance i.e. $\varepsilon_t \sim iid\left(0, \sigma^2\right)$.

Accordingly, Equation (3.33) conduct a unit root test of a time serie having only an intercept. Equation (3.34) considers unit root test with a variable having both an intercept and a time trend. Equation (3.35) test a unit root of a variable in the absence of both intercept and time trend, reflecting a pure random walk equation. Failure in rejecting a null hypothesis $\left(\alpha = 0\right)$ signifies that variable under consideration is non-stationary, otherwise rejecting the null hypothesis indicate that that serie is stationary $\left(\alpha \angle 0\right)$. Likewise, when student t-statistic is lower than the calculated critical values at a given level of significance, it entails that the null hypothesis, $\alpha = 0$ is outrightly

rejected, and an alternative $\alpha \angle 0$ is considered instead, indicating that the variable is stationary (Dickey & Fuller, 1979).

The order of integration, symbolized by d is an important feature of the properties being exhibited by a time serie. The most commonly used values of d are 0, 1 and 2. If X_t is integrated of 0 that is $I(0)$ denoted as; $X_t = I(0)$ If the variable being tested is stationary at level, it is represented by an order of integration $I(0)$. If the serie contains a unit root but integrated of order one process, it is denoted as $I(1)$ and the serie in consideration is transformed and taken the first difference, it then becomes stationary.

In other words, failure to reject the null hypothesis at $I(0)$ may necessarily lead to further test whether the serie has a first unit root i.e whether the variable is $I(1)$. This requires first differencing to make the serie stationary.

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3.7.1.2 Phillips-Perron (PP) Unit root test

The Phillips-Perron (PP) unit root test is a non-parametrically modified test over the Dickey Fuller unit root test. The DF modification is done by correcting for the auto correlation and heteroskedasticity in the stochastic error term ε_t. The PP test utilized the Newey-West (Newey & West, 1987) heteroskedasticity and serial correlation consistent covariance matrix estimator. The P-P test is robust to general forms of heteroskedasticity in the stochastic error term ε_t. The test has the advantage that the user is not constrained to specify the lag length for the regression model. The P-P test model is specified as;

$$Y_t = \mu + \delta Y_{t-1} + \varepsilon_t \tag{3.36}$$

3.7.2 Auto Regressive Distributed Lag (ARDL)

To investigate the relationship between Divisia index monetary aggregates, the income, exchange rate, interest rate, inflation, monetary uncertainty and output uncertainty in selected SSA countries, this study will employ the autoregressive distributed lag (ARDL) bounds testing approach of cointegration developed by Pesaran (1997); Pesaran and Shin (1999) and further extended by Pesaran *et al.* (2001). The ARDL approach to cointegration has become popular in recent years due to the low power and other problems associated with other methods (Oztuek & Acaravci, 2011).

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It is based on the estimation of an unrestricted error correction model (UECM) which has many advantages as compared to the previous cointegration methods being used. From the demand for money function model specified in equation (3.29), the ARDL) procedure, otherwise refered to as the bound cointegration test model can be derived following Bahmani-Oskooee *et al*. (2013), as follows;

$$\Delta \ln DM_t = \varphi_0 + \sum_{i=1}^{p} b_i \Delta \ln DM_{t-i} + \sum_{i=0}^{p} c_i \Delta \ln GDP_{t-i} + \sum_{i=0}^{p} d_i \Delta ITR_{t-i} + \sum_{i=0}^{p} e_i \Delta \ln EXR_{t-i} +$$

$$\sum_{i=0}^{p} f_i \Delta \ln CPI_{t-i} \sum_{i=0}^{p} g_i \Delta \ln MOU_{t-i} + \sum_{i=0}^{p} h_i \Delta \ln OUU_{t-i} + \alpha_1 \ln DM_{t-i} + \alpha_2 \ln GDP_{t-i} + \alpha_3 ITR_{t-i} +$$

$$\alpha_4 \ln EXR_{t-i} + \alpha_5 \ln CPI_{t-i} + \alpha_6 \ln MOU_{t-i} + \alpha_7 \ln OUU_{t-i} + \varepsilon_t \tag{3.37}$$

Where, Δ is the first difference operator, φ_0 symbolize a drift component and it represents the white noise component residuals. All other variables are as defined in equation 3.29. Equation (3.37) is an error-correction model (ECM).

The initial step in ARDL estimation is to establish the lag order of lag among the series in the models. Specifying the appropriate order of the lag in ARDL makes the residuals of the estimates uncorrelated (Sims, 1992). There are different techniques of determining the lag length in a certain model. These includes; Final Prediction Error (FPE), Sequential Modified Likelihood Ratio (LR), Scharz Information Criterion (SC), Akaike Information Criteria (AIC) and Hannan-Quinn Information Criteria (HQ). The stated methods may provide a different orders of selection, but the main target is to adopt the one that gives the best possible outcome in line with the existing economic theory (Enders, 2008). The Pesaran *et al.* (2001) approach is utilized to test our models for the four selected SSA countries.

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When Equation (3.37) is estimated, F-test will be carried out to evaluate the joint significance of the lagged level series as an indication of long run cointegration. This can be on the basis of the F critical values documented in Pesaran *et al.* (2001) and Narayan (2005) F-tests values[2]. To realize long run cointegration amongst series under study, the computed F-statistic value has to be higher than the Pesaran *et al*. (2001) or Narayan (2005) `s upper bound region critical figures.

There is another advantage for the Equation (3.37). This is highlighted in the process that all short and long run impacts of all the variables are estimated with the use of just

[2] Narayan (2005) provides critical values for the F-test statistics for smaller samples sizes of 30 to 80 observations.

one step through estimating the sole equation. Clearly, the short run effect is determined with the use of results from the estimates of the individual coefficients allotted to the first order series. For the long run relationships, inferences on the long run imfluence are drawn from coefficients parameter estimates for the $\alpha_1 - \alpha_7$. The statistic for F-test is founded the postulations of no or absence of cointegration between the variables in a specified model against the presence of a long run cointegration and is represented as; $H_0 : \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = \alpha_7 = 0$ null hypothesis for no cointegration

Against;

$H_1 : \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq \alpha_5 \neq \alpha_6 \neq \alpha_7 \neq 0$

an alternative for existence of cointegration among the variables.

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3.7.2.1 Procedures for ARDL Analysis

The initial step in ARDL method is to estimate equation (3.34) using ordinary least squares (OLS) method so as to test for the presence of a long run association among the group of variables in the model (Pesaran et al., 2001). This can be done by carrying out an F-test for the joint significance for the coefficients of lagged level series. The null hypothesis of no cointegration; $H_0 : \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = \alpha_7 = 0$ is tested against the alternative of cointegration; $H_1 : \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq \alpha_5 \neq \alpha_6 \neq \alpha_7 \neq 0$.

Two distinct sets for critical value bounds of F-statistic were produced by the Pesaran *et al.*, (2001) and in Narayan (2005). When the calculated F-statistic stays below the lower bound critical value, the null hypothesis for no cointegration cannot be rejected.

Otherwise, if the computed F-statistic surpasses the upper bound critical value, the null hypothesis is rejected, suggesting a long run cointegration association among the series in the model. Conversely, if the calculated F-statistic value falls inside the bounds, the test is inconclusive (Pesaran et al. 2001).

3.7.2.2 Justification for Using ARDL

The ARDL technique for cointegration has many benefits over traditional cointegration procedures like the Engle and Granger, (1987), Johansen (1988), and Johansen and Juselius (1990) techniques (Hill et al. 2011): First, the ARDL technique can be utilized whether the variables are I(1) and/or I(0), whereas Johansen cointegration methods necessitate that all the series in the system be of identical order of integration. This implies that ARDL can be useful regardless of whether variables under study are exclusively I(0), or fully I(1) or jointly cointegrated. Secondly, while Johansen cointegration procedures need a very large statistical data samples for it the purpose of validity, the ARDL technique is statistically the best methodology to establish the presence of cointegration relation in a relatively small samples size data (Narayan, 2005). Thirdly, the procedure of ARDL allows that variables might have different optimal lags lenghts, while it is not possible in the case of the orthodox cointegration techniques.

Finally, ARDL technique utilize only one reduced form equation, while the orthodox cointegration techniques estimate the long run relationship within the context of a system equations.

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3.7.2.3 Diagnostic Tests

For the post estimation analysis, we check the diagnostic tests for all the models. The first step is to observe the diagnostic test statistic from lag-estimates that preceded our long run results and that of the model`s short run dynamics. Under the diagnostic tests analysis, we observe the Langrange multiplier (LM) test for the residual serial correlation, next is the Ramsey`s RESET test employing the square for the fitted estimates of a right functional form. The normality test for a normally distributed residual, is based on the test of skewness and the kurtosis for the generated residuals of the estimates. The test for heteroskedasticity is built on the squared residuals of the regression over the fitted squared values. In situations when the corresponding diagnostic tests proof to be significant statistically, this suggests the existence of respective biasedness in the specified model (Enders, 2005). A statistically robust model devoid of the problem of serial correlation, heteroskedasticity, functional form or non-normality further confirm the power of the ARDL models.

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3.7.2.4 Models Stability Tests

After passing through the diagnostic test, the stability of the ARDL model is tested using the famous CUSUM and CUSUMSQ stability test proposed by Brown *et al*. (1975). The CUSUM and CUSUMSQ tests are applied to the residuals of the optimum error correction model (Pesaran et al. 2001). An important requirement for the Brown et al stability tests is that the sample be fragmented with adequate observations prior to and after the break point. Thus, the two stability statistics; CUSUM and CUSUMSQ are subsequently updated through the movement of one observation from one

particular period to the other. The stability statistics are therefore plotted against the break points or the break dates.

For the overall coefficients to be stable, the plots for these statistics must stay within a five percent level for significance (indicated by a dual straight line having an equation provided in Bown *et al.* (1975)). An unstable parameter may potentially make the results to be biased (Dritsakis, 2011).

3.7.3 Toda and Yamamoto Causality Analysis

Since the seminal work of Granger (1969) on causality tests, researchers across different fields have continued showing interest in investigating the causal relationships among variables. The concept of causality itself has been defined and conceptualize in a different approach by different scholars. According to Granger (1980) the concept was defined by several philosophers from both science and social sciences viewpoints.

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From this angle, causality scientifically measures the degree to which one variable exerts influence on changes in another variable. It is often observed by determining the influence of previous values of a variable on another. This can be observed by determining the influence of previous values of a variable on another variable. Nevertheless, instantaneous causal relationships only happen due to slow information generating process and due to omission of a vital causal variable in the model (Ganger, 1969).

Granger (1969) established that causal relationships occur on the basis of certain underlying assumptions. First, the present and past phenomenon can exert influence

and cause future occurrences, but the past or previous events cannot be caused by future events. Secondly, the multivariate stochastic variables have no association with superfluous information. Thirdly, there exist a constant causal relationship throughout the period. Fourthly, there is also an existence of linearity of predictors among the variables and that only stationary variables are considered in the model. Investigating the causal relationships among variables is very important because it help to avoid making decision under uncertainty. The knowledge of the causal effect will enable appropriate policy prescription and recommendations. It also contributes in an experiment that leads to a good decision-making.

Toda and Yamamoto (1995) suggested a Modified Wald test (MWALD) which takes care of the issues identified with the conventional Granger causality analysis by disregarding any likely or anticipated non-stationary or a cointegration among variables when running the causality test. The T-Y method fits in a standard VAR system model at levels of the series (instead of being at first difference, as expected in Granger causality analysis) thus reducing the risks related with the likelihood of erroneously finding the integration order for the series (Enders, 2004).

The underlying impression of this causality technique is to artificially augment a correctly spcified VAR order, k , by a highest (Maximum) order of integration, say d max. When this is completed, a $\left(k + d\max\right)^{th}$ VAR order is estimated and the coefficients of the previous lagged $d\max$ vector are overlooked (Zapata & Ranbaldi, 1997). Application of T-Y method guarantees that the usual test statistic of Granger causality has the standard asymptotic distribution where binding inferences can be made. To investigate the causal link between Divisia index aggregates and the income;

Divisia money with price increases; simple sum money and income, simple sum money and price increases, the study will use the bivariate VAR (m+*d*max).

3.7.3.1 Procedures for Toda Yamamoto Analysis

The Toda Yamamoto process is employed to test for causality among the variables; money (Divisia index and simple sum aggregates) and income (GDP) and also money (Divisia index and simple sum) and inflation. There are three procedures involved in Toda- Yamamoto (1995) test for causality. First step is determination of the maximum order of integration for each of the variables in the model ($d_{\max}$). Secondly, is to identify the optimal order of the lags through estimating a VAR model in levels and selecting the optimal order of the lags accordingly. Thirdly, the VAR model together with the additional $d_{\max}$ lags is re-estimated, in which the order of the VAR transforms to $m + d_{\max}$.

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3.7.3.2 Justification for using Toda Yamamoto Causality

Although cointegration indicates presence or absence of a long run relationship, it does not specify the direction of causality among the variables (Hill et al.2011). However, as discussed above, the common way of testing causal relationship among variables is the popular Granger-Causality test introduced by Granger (1969).

It was observed that conventional Granger test for making inference on leads and the lags from within a differenced series will result to a spurious outcome, the F-test therefore can not be valid except the series in levels are also cointegrated. According to Toda and Yamamoto, (1995), Zapata and Rambaldi, (1997), the traditional Engel and Granger (1987) and Johansen and Juselius, (1990) tests for non causality among

economic time series are so unwieldy and sensitive to the figures of the parameters in finite samples and so their results are not reliable. The limitations of this method are highlighted in Toda and Philips (1994).

Considering the shortcomings of the Granger type causality procedure, Toda Yamamoto (1995) proposed a method demanding an estimation of an augmented VAR that guarantees an asymptotic distribution for the Wald test statistic (that is an asymptotic X^2 distribution), and the methodology is robust to the integration and co-integration properties for the procedure.

The Toda Yamamoto causality method is referred to as a long run causality analysis. To run the analysis, there is need to define the maximal integration order, dmax that is anticipated in the specified model and create a VAR at their levels having a sum of p=(k+dmax) lags. Toda Yamamoto show that for d=1 the lag choice technique is constantly valid as k(1=d). When d=2, then the process is equally valid except if k=1. Moreso, according to the TY method, the MWald value is valid irrespective of whether a variable is I(0), I(1), or I(2), cointegrated or non cointegrated of any random order.

The TY approach takes care of the difficulties associated with the power and size features of the traditional unit root and cointegration analysis in testing for Granger causality. To lessen the risk related with incorrectly classifying the order of integration and cointegration features among the series, the TY method stipulates a vector autoregressive model at levels. The correct order for VAR model, k is augmented by a highest order of integration of variables, dmax, where the test statistic for Granger causality bears the standard asymptotic distribution to draw valid conclusions.

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The TY technique avoids the bias identified with unit roots and cointegration tests (Zapata & Rambaldi 1997; Clarke & Mirza, 2006); because it does not need pre testing of cointegrating features of the system. The test; MWALD statistic is valid as long as the order of integration of the procedure does not exceed the actual lag length of the model (Toda & Yamamoto, 1995).When the variables under study are not stationary, or contains mixture of stationary with non stationary series, and are also cointegrated, the standard Granger causality test on an unrestricted VAR model expressed at levels on the basis of asymptotic will not be valid, since the distribution of the test statistics are non standard.

A better option is the Toda-Yamamoto Granger causality testing approach. The use of this approach is based on the argument that causality should be tested within the jurisdiction of an acceptable theory.

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3.7.3.3 Lag Length Selection

To undertake the TY causality investigation, it is vital to define the optimal lag length of the VAR. Lag length selection is imperative for VAR order because selecting too few lags results in wrong specification and choosing lots of lags result in unnecessary loss of degrees of freedom. To evade this, lag lengths are carefully chosen using statistical tests which includes; Akaike information criteria (AIC), Schwarz information criteria (SIC), Hannan-Quinn information criteria (HIC), modified likelihood ratio (LR) test.

3.8 Chapter Summary

This chapter discusses the theoretical framework for the study and econometric methods and models employed. The chapter further discuss the method for the creation of Divisia index monetary aggregates for the selected SSA economies. It explained the stationary analysis, model specifications and methods of analysis used in realizing the set objectives of the study. Barnett (1978, 1980) Divisia index was used in construction of Divisia money aggregates. Other methods employed in the analysis includes; GARCH, ARDL, and TY causality tests and are explained in detail in the chapter. The data source and interpolation technique used in interpolating annual data to quarterly data was also explained.

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CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter reported the Divisia monetary aggregates and analyse the relationship between Divisia monetary aggregates and key macroeconomic variables as provided in the money demand theory. These are; income (GDP), interest rate (ITR), exchange rate (EXR), inflation (INF), monetary uncertainty (MOU) and output uncertainty (OUU) in selected SSA countries. Utilizing a standard money demand specification as contained in equation (3.28), the study investigates money demand stability for Kenya, Malawi, Nigeria, and South Africa employing Divisia index measures of money. The study employed a quarterly data for the time period 2000Q1 to 2015Q3. In addition, two new variables were incorporated to the demand for money models of the selected SSA countries. The new variables added are the monetary uncertainty (MOU) and the output uncertainty (OUU). The study further investigates the causal relationship between money and income (GDP), and between money and prices employing both the Divisia monetary aggregates and the simple sum monetary aggregates.

Following section 4.2 discusses a comparative analysis between the Divisia monetary aggregates and the simple sum aggregates for the selected countries. An analysis for the preliminary descriptive statistics and the model's estimation results analysis were carried out in the subsequents sections.

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4.2 Divisia versus simple sum Monetary aggregates

Divisia monetary aggregates corresponding to the simple sum aggregates were constructed for Kenya, Malawi, Nigeria, and South Africa using equation (3.4). The aggregates comprise of narrow and broad as defined by the countries respective monetary authorities. Data used for the construction are highlighted in sub-section 3.6.1. The constructed Divisia aggregates together with their simple sum counterparts are reported in the appendix tables 4.2a to 4.2d for Kenya, Malawi, Nigeria, and South Africa respectively. For ease of comparisons, the two aggregates are normalized at base 100 beginning from 2000Q1 base period. We carry out a preliminary analysis using graphs to provide a pictorial illustration of the relationship between the Divisia monetary aggregates and the simple sum aggregates. Figure 4.2.1 shows the graphical analysis of the movements in the two aggregates for the selected SSA countries. Both aggregates show a reasonable steady upward trend. Due to the weighing approach of the Divisia index, the constructed Divisia aggregates are lower than the simple sum aggregates. In all the countries, the observed higher figures of the simple sum aggregates as compared to the Divisia aggregates are in line with the studies of Habibullah (1999); Dahalan et al.(2005), for Malaysia and Ishida (1984) for Japan. From the above analysis it shows that the two monetary aggregates move along the same direction and are closely related for all the countries.

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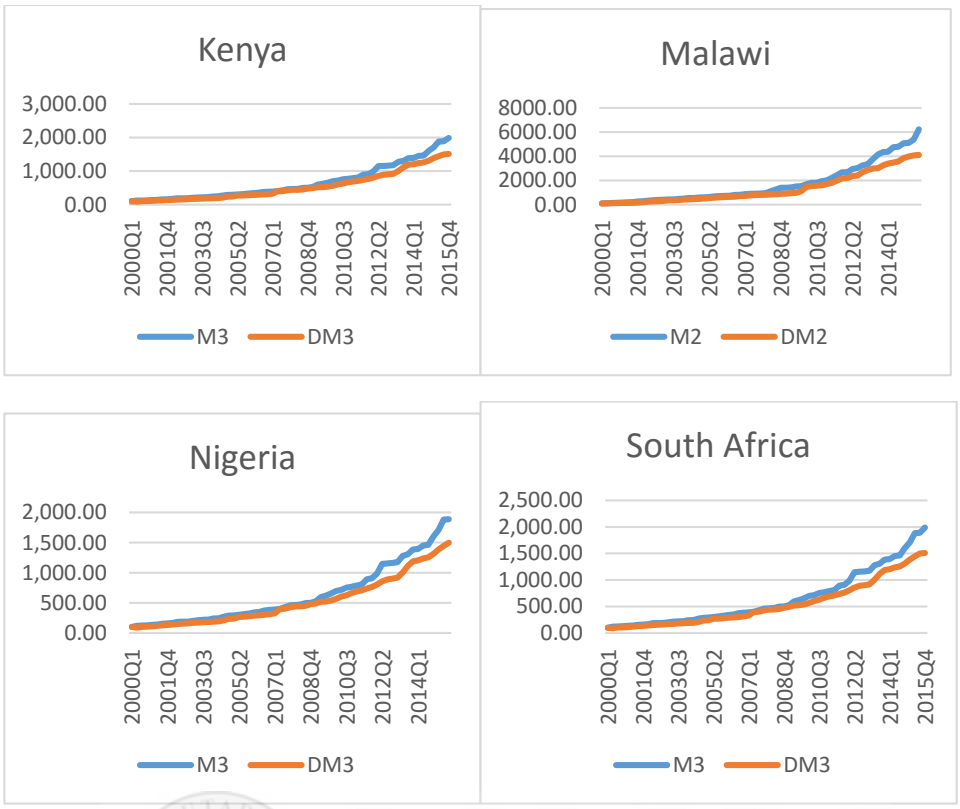

Figure 4.2.1 Simple sum and Divisia aggregates for broad money 2000Q1-2015Q3

From the figure both simple sum and Divisia monetary aggregates shows a similar trend in their movements. For instance in the case of Kenya, the trend continue until 2012Q2 when they diverge. Similar trend can be observed for Malawi where they diverge in 2008Q4. Similar movements were also recorded in Nigeria and South Africa. The divergent in the two monetary measures could be linked to the faster rate of growth of the simple sum aggregates as compared to the Divisia aggregates. It is worthy of mention to note that the broad monetary aggregates comprises of more financial assets and instruments compared to the narrow aggregates. Hence the simple sum shows a greater liquidity level in comparison to the broad Divisia DM3. This could be explained from the procedure of the aggregation of the simple sum aggregates that assign equal weights to all the monetary of financial components (Barnett et al. 2013).

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4.3 Descriptive Statistics and Correlation Analysis

To explore the features of the variables under study and lay foundation for the econometric analysis the descriptive statistics is undertaken. Descriptive analysis comprises of the descriptive statistics and correlation analysis. These are discussed in the subsequent sub-sections.

4.3.1 Descriptive Statistics

Tables 4.3.1a to 4.3.1d presents a summary of descriptive statistics for the variables for Kenya, Malawi, Nigeria and South Africa respectively. It presents the descriptive statistics for the major variables used in the study. The variables are Divisia monetary aggregates, the income (GDP), interest rate, inflation, exchange rate, monetary uncertainty and output uncertainty. The descriptive statistics comprises of the sample mean, standard deviation, skewness and Kurtosis, Jarque-Bera statistics and probability value (p – value).

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Table 4.3.1a
Kenyans' Summary of Descriptive Statistics: 2000Q1-2015Q3

Serie	Mean	Std. dev	Min	Max	Skewness	Kurtosis	J. B stat	PValue
DM3	819.352	807.788	85.649	2794.298	1.000	2.759	10.662	0.004
GDP	6.903	4.186	2.406	1.753	0.736	2.506	6.328	0.042
ITR	1.575	0.570	0.559	3.009	0.705	3.111	5.248	0.072
INF	21.276	9.578	9.444	42.907	0.375	1.888	4.717	0.094
EXR	19.940	2.107	16.732	27.818	1.289	5.987	40.884	0.000
MOU	-0.001	0.026	-0.080	0.087	0.254	5.242	13.870	0.000
OUU	0.008	0.023	-0.054	0.146	3.331	21.245	90.359	0.000

Note: DM3, GDP, ITR, CPI, EXR, MOU, and OUU represents Divisia monetary aggregates, gross domestic product, interest rate, consumer price index, exchange rate, monetary uncertainty and output uncertainty respectively. Std dev is standard deviation; min is minimum; max is maximum; JB stat is the Jarque-Bera statistic. The p-value is the probability value of the Jarque-Bera statistic.

Table 4.3.1b
Malawi's Summary of Descriptive Statistics: 2000Q1-2015Q3

Serie	Mean	Std. dev	Min	Max	Skewness	Kurtosis	J-B sta	P-valu
DM2	918.014	1278.173	62.299	4751.955	1.474	3.623	23.460	0.000
GDP	26.117	0.251	25.771	26.631	0.147	1.669	4.799	0.090
ITR	23.087	12.676	6.180	49.073	0.373	1.989	4.076	0.130
INF	1.234	0.489	0.308	2.038	0.052	1.624	4.920	0.085
EXR	45.513	32.073	14.468	140.331	1.529	4.222	28.041	0.000
MOU	-0.284	1.142	-2.457	1.606	-0.088	1.894	3.242	0.197
OUU	0.025	0.057	-0.194	0.229	0.250	7.917	63.125	0.000

Note: DM3, GDP, ITR, CPI, EXR, MOU, and OUU represents Divisia monetary aggregates, gross domestic product, interest rate, consumer price index, exchange rate, monetary uncertainty and output uncertainty respectively. Std dev is standard deviation; min is minimum; max is maximum; JB stat is the Jarque-Bera statistic. The p-value is the probability value of the Jarque-Bera statistic.
Source: Researcher`s computation.

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Table 4.3.1c
Nigeria's Summary of Descriptive Statistics: 2000Q1-2015Q3

Serie	Mean	Std. dev	Min	Max	Skewness	Kurtosis	J-B Stat	P-value
DM2	2972.616	3106.293	98.237	9698.625	0.8606	2.318	8.853	0.011
GDP	9.356	8.064	1.137	2.714	0.692	1.960	7.751	0.020
ITR	10.947	4.801	1.706	22.700	0.136	2.596	0.612	0.736
INF	2.928	0.936	1.222	4.951	0.249	2.556	1.152	0.562
EXR	34.763	5.688	25.128	53.774	0.997	4.717	17.891	0.000
MOU	0.022	0.035	-0.065	0.106	0.464	3.053	2.228	0.328
OUU	2.092	0.976	0.449	3.383	-0.141	1.692	4.626	0.098

Note: DM3, GDP, ITR, CPI, EXR, MOU, and OUU represents Divisia monetary aggregates, gross domestic product, interest rate, consumer price index, exchange rate, monetary uncertainty and output uncertainty respectively. Std dev is standard deviation; min is minimum; max is maximum; JB stat is the Jarque-Bera statistic. The p-value is the probability value of the Jarque-Bera statistic.
Source: Researcher`s computation.

Table 4.3.1d
South Africa's Summary of Descriptive Statistics: 2000Q1-2015Q3

Serie	Mean	Std. dev	Min	Max	Skewness	Kurtosis	J-B stat	P-value
DM3	455.416	329.578	78.188	1185.479	0.636	2.161	6.099	0.041
GDP	5.321	2.342	2.063	9.746	0.319	1.837	4.616	0.910
ITR	7.797	2.192	4.953	12.567	0.516	2.053	5.143	0.076
INF	21.067	5.523	13.188	31.699	0.341	1.838	4.769	0.092
EXR	1.983	0.357	1.503	2.864	0.792	2.621	6.965	0.030
MOU	0.003	0.016	0.056	0.039	0.494	4.359	7.416	0.024
OUU	0.007	0.007	0.028	0.022	0.383	6.441	32.631	0.000

Note: DM3, GDP, ITR, CPI, EXR, MOU, and OUU represents Divisia monetary aggregates, gross domestic product, interest rate, consumer price index, exchange rate, monetary uncertainty and output uncertainty respectively. Std dev is standard deviation; min is minimum; max is maximum; JB stat is the Jarque-Bera statistic. The p-value is the probability value of the Jarque-Bera statistic.
Source: Researcher`s computation.

Tables 4.3.1a to d show that the average broad Divisia money for the period of first quarter of year 2000 to the third quarter of year 2015 is 819.352 for Kenya with a minimum value of 85.649 and a maximum of 2794. 298. The minimum value for Malawi is 62.299 with a maximum of 4751.955 with an average of 918.014 under the same period.

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For Nigeria, the minimum recorded is 98.237 and a maximum of 9698.625 with a corresponding average of 2972. 616. South Africa posted an average of 455.416 and a corresponding maximum and minimum of 78.188 and 1185.479 respectively over the review period. The above statistics indicate that the Divisia monetary aggregates in the whole countries has experienced a rapid and inconsistent growth trend over time. Also from the statistics, the most unstable Divisia monetary aggregates in the sample countries is that of Nigeria with a standard deviation of 3,106.293.

Values for the other countries also present a similar movement showing an instability over the period presenting a figure of 1278.173, 807.788, and 329.572 for Malawi, Kenya and South Africa respectively. The Divisia monetary aggregates prove to have the least deviation from the mean. The trend indicates how the Divisia money variable deviates from its actual mean value over the study period. Nonetheless, this only exposes the description of the variable in its row form and it cannot be used for any inferential conclusion on the actual behaviour of the variables.

From the statistics it show that inflation, income and exchange rate are relatively more volatile as compared to interest rate, monetary and output uncertainties in the class of money determinants. The variables of monetary uncertainty and output uncertainty has a low standard deviation for all countries in the sample mostly below one except for monetary uncertainty in Malawi that has a figure of 1.142. One of the probable cause for instability in the most macroeconomic variables including the demand for money determinants in SSA countries might not be unconnected to the inconsistencies of policies.

The study utilizes three approaches to testing for normality of the sample data. These are the skewness, kurtosis and Jarque-Bera test statistic. Firstly, the skewness test indicate that all the variables are positively skewed except for monetary uncertainty for Malawi and Output uncertainty for Nigeria. The most highly skewed series are Divisia monetary aggregates and exchange rate in the whole countries. However for Kenya output uncertainty variable bears the most highly skewed among all variables in the sample. The least skewed variables are the monetary uncertainty and the output uncertainty in all the countries under study. Even though the statistic is not far from the ± 1.96 bounds (Hanif & Hudaib, 2006), nevertheless, the test statistic differ from the zero threshold value.

Secondly, from the kurtosis statistic, it is observed that with the exception of exchange rate, monetary uncertainty, output uncertainty for Kenya, exchange rate and output uncertainty for Malawi, exchange rate for Nigeria and output uncertainty for South Africa, all the rest variables are leptokurtic relative to the normal distribution while the variable inflation exhibits platykurtic relative to the normal distribution.

Thirdly, from the probability values of the Jarque-Bera statistic it shows that the data observations in the sample are not normally distributed for all the countries except interest rate and monetary uncertainty for Malawi, interest rate, inflation and monetary uncertainty for Nigeria and income for South Africa. Our findings show that most of the variables under study exhibit the features of time series data and is in line with previous studies which established that most of the variables affecting the demand for money are usually not normally distributed (Sriram, 2001). Furthermore, studies such as Diamandis (2009) and Swift and Jamacek (1991) argue that raw time series data is hardly normally distributed.

4.3.2 Correlation Analysis

Tables 4.2.2a to 4.2.2d presents the correlation analysis for Kenya, Malawi, Nigeria and South Africa. Correlation analysis show the magnitude and direction of relationship between the independent and dependent variables. The correlation values are reported with their respective probability figures for each pair wise relationship among variables for the respective countries. The results show that except for interest rate for Malawi, all other variables are positively related with money and are statistically significant at 1 percent level. Noticeable from the result is that the Divisia monetary aggregates displays high correlation with its other determinants.

Table 4.3.2a
Kenyans' Summary of correlation analysis: 2000Q1-2015Q3

Serie	**DM3**	**GDP**	**ITR**	**INF**	**EXR**	**MOU**	**OUU**
DM3	1.0000						
	-						
GDP	0.9778	1.0000					
	(0.0000)	-					
ITR	0.6634	0.6648	1.0000				
	(0.0000)	(0.0000)	-				
INF	0.9438	0.9869	0.6362	1.0000			
	(0.0000)	(0.0000)	(0.0000)	-			
EXR	0.7469	0.7421	0.5603	0.6927	1.0000		
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	-		
MOU	0.4398	0.4509	0.2567	0.4848	0.4278	1.0000	
	(0.0003)	(0.0002)	(0.0422)	(0.0001)	(0.0005)	-	
OUU	0.5354	0.5821	0.4715	0.5477	0.6689	0.2754	1.0000
	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)	(0.0288)	-

Note: DM3, GDP, ITR, CPI, EXR, MOU and OUU represents Divisia monetary aggregates, gross domestic product, consumer price index, exchange rate, monetary uncertainty and output uncertainty respectively.
Source: Researcher`s computation

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Table 4.3.2b
Malawi Summary of correlation analysis: 2000Q1-2015Q3

Serie	DM2	GDP	ITR	INF	EXR	MOU	OUU
DM2	1.0000						
	-						
GDP	0.7690	1.0000					
	(0.0000)	-					
ITR	-0.0765	-0.6153	1.0000				
	(0.5546)	(0.0000)	-				
INF	0.5724	0.0840	0.5401	1.0000			
	(0.0000)	(0.5162)	(0.0000)	-			
EXR	0.9389	0.8364	-0.1807	0.4629	1.0000		
	(0.0000)	(0.0000)	(0.1599)	(0.0002)	-		
MOU	0.7784	0.9781	-0.6292	0.0445	0.8322	1.0000	
	(0.0000)	(0.0000)	(0.0000)	(0.7313)	(0.0000)	-	
OUU	0.4396	0.4053	0.1201	0.3059	0.5460	0.4137	1.0000
	(0.0003)	(0.0011)	(0.3524)	(0.0156)	(0.0000)	(0.0008)	-

Note: DM3, GDP, ITR, CPI, EXR, MOU and OUU represents Divisia monetary aggregates, gross domestic product, consumer price index, exchange rate, monetary uncertainty and output uncertainty respectively.

Source: Researcher`s computation

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Table 4.3.2c
Nigeria's Summary of correlation analysis: 2000Q1-2015Q3

Serie	DM2	GDP	ITR	INF	EXR	MOU	OUU
DM2	1.0000						
	-						
GDP	0.9883	1.0000					
	(0.0000)	-					
ITR	-0.2200	-0.2472	1.0000				
	(0.0857)	(0.0527)	-				
INF	0.3836	-0.3737	0.2708	1.0000			
	(0.0021)	(0.0028)	(0.0333)	-			
EXR	0.8727	0.8797	-0.3052	-0.2152	1.0000		
	(0.0000)	(0.0000)	(0.0159)	(0.0930)	-		
MOU	0.2664	0.3353	0.3684	-0.2252	0.2900	1.0000	
	(0.0363)	(0.0077)	(0.0032)	(0.0785)	(0.0222)	-	
OUU	0.8894	0.9240	-0.4867	-0.4017	0.8255	0.4963	1.0000
	(0.0000)	(0.0000)	(0.0001)	(0.0012)	(0.0000)	(0.0000)	-

Note: DM3, GDP, ITR, CPI, EXR, MOU and OUU represents Divisia monetary aggregates, gross domestic product, consumer price index, exchange rate, monetary uncertainty and output uncertainty respectively.
Source: Researcher`s computation

Table 4.3.2d
South Africa's Summary of correlation analysis: 2000Q1-2015Q3

Serie	DM3	GDP	ITR	INF	EXR	MOU	OUU
DM3	1.0000						
	-						
GDP	0.99909	1.0000					
	(0.0000)	-					
ITR	-0.7220	-0.7304	1.0000				
	(0.0000)	(0.0000)	-				
INF	0.9903	0.9970	0.7528	1.0000			
	(0.0000)	(0.0000)	(0.0000)	-			
EXR	0.4824	0.4438	0.0675	0.4729	1.0000		
	(0.0001)	(0.0003)	(0.5987)	(0.0001)	-		
MOU	-0.2497	-0.2603	0.3836	-0.2845	-0.0015	1.0000	
	(0.0484)	(0.0393)	(0.0019)	(0.0238)	(0.9906)	-	
OUU	0.2317	0.2126	0.0909	0.1885	0.2359	0.5233	1.0000
	(0.0676)	(0.0944)	(0.4785)	(0.1389)	(0.0627)	(0.0000)	-

Note: DM3, GDP, ITR, CPI, EXR, MOU and OUU represents Divisia monetary aggregates, gross domestic product, consumer price index, exchange rate, monetary uncertainty and output uncertainty respectively.
Source: Researcher`s computation

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However, except the interest rate for Malawi, Nigeria and South Africa; inflation for Nigeria and monetary uncertainty for South Africa all other variables show a positive relationship with the Divisia monetary aggregates and are statistically significant at 1 percent level. The only variable found not significant is the interest rate for Malawi showing a negative sign as well. Nevertheless, this is just a preliminary indication that there would be a possibility of having a relationship between the dependent and the independent variables.

Generally, the study observe that all other variables are highly correlated with the Divisia money, therefore, we reject the null hypothesis of no correlation between the Divisia money and its determinant variables. This further implies that Divisia monetary aggregate is positively related with income (GDP), exchange rate (EXR), monetary uncertainty (MOU), and output uncertainty (OUU) and negatively related with interest rate and inflation. This is in line with studies such as, Bahmani-Oskoee *et al*. (2014).

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4.4 Unit Root Test

The time series econometrics literature established that a regression analysis may be spurious if the regressed variables happens to be non-stationary (Enders, 2004). Therefore it becomes necessary to examine the order of integration for each variable in a model in order to avoid the problem of spurious regression. In addition to that, one of the requirements for the ARDL analysis is that the variables under study should be of zero order integration I (0) or an I(1) order, or a combination of both I(0) and I(1), (Pesaran *et al.* 2001). The ARDL procedure is invalid with the presence of I(2) variables (Pesaran *et al.* 2001).

In addition, the unit root test results can be utilized to establish the order of *dmax* in the augmented VAR system for the Toda and Yamamoto non-Granger causality test. We establish the integrated properties of each variable using the familiar Augmented Dickey Fuller (ADF) (Dickey and Fuller, 1981) and Phillips Perron (PP) (Phillips and Perron, 1988) unit root tests. Tables, 4.3a-d presents the results for the ADF and tables 4.3 e-h depicts the results of the PP unit root tests. The result show that the series comprises of a mix order of *I (0)* and *I (1*).

Table 4.4.a
Kenya's Augmented Dickey-fuller Unit root test

Variable	**Level**		**First Difference**	
	Intercept	With Trend	Intercept	With Trend
LDM3	0.836	-4.330***	-8.678***	-8.496***
LGDP	0.612	-2.839	-5.402***	-5.194***
LITR	-3.282**	-3.323*	-5.289***	-5.282***
INF	-2.876*	-2.824	-3.199**	-3.873**
LEXR	0.781	-1.514	-5.877***	-5.643***
MOU	-1.889	-2.959	-7.302***	-7.228***
OUU	1.266	-1.347	-6.308***	-6.155***
SM3	2.193	-3.792**	-3.236***	-4.068***

Note: ***, **, and * imply significance at 1%, 5% and 10% levels respectively. The figures show the t-statistic value for testing the null hypothesis that the variable possess a unit root. The Scwarz Information Criterion (Schwert, 1987) is used in the lag length selection. The critical values for constant without trend are -3.479, -2.883 and -2.578 while that of constant with trend are -4.028, -3.443 and -3.146 for 1%, 5% and 10% respectively. The figures are based on Mackinnon (1991).

Source: Authors` computation

Table 4.4.b
Malawi's Augmented Dickey-fuller Unit root test

Variable	**Level**		**First Difference**	
	Intercept	With Trend	Intercept	With Trend
LDM2	0.395	-2.107	-7.754***	-7.748***
LGDP	-1.492	-2.122	-4.126***	-4.182***
LITR	-1.656	-1.326	-6.335***	-6.403***
INF	-2.269	-2.291	-3.764***	-3.800***
LEXR	-0.246	-1.689	-4.246***	-4.195***
MOU	-1.582	-3.539**	-3.458**	-3.752***
OUU	-2.128	-2.813	-6.889***	-6.822***
SM2	-1.647	-2.969	-6.127***	-6.160***

Note: ***, **,and * imply significance at 1%, 5% and 10% levels respectively. The figures show the t-statistic value for testing the null hypothesis that the variable possess a unit root. The Scwarz Information Criterion (Schwert, 1987) is used in the lag length selection. The critical values for constant

without trend are -3.479, -2.883 and -2.578 while that of constant with trend are -4.028, -3.443 and -3.146 for 1%, 5% and 10% respectively. The figures are based on Mackinnon (1991).

Source: Authors` computation

Table 4.4.c
Nigeria's Augmented Dickey-fuller Unit root test

Variable	**Level**		**First Difference**	
	Intercept	With Trend	Intercept	With Trend
LDM2	-2.632	-0.338	-11.292***	-12.108***
LGDP	-1.430	-1.060	-4.905***	-4.984***
LITR	-1.860	-1.763	-8.296***	-8.266***
INF	-3.636***	-4.171***	-7.423***	-7.248***
LEXR	-1.073	-3.192*	-5.229***	-5.173***
MOU	-2.615*	-2.631	-10.047***	-10.023***
OUU	-4.097***	-4.113**	-4.416***	-4.396***
SM2	-2.430	-1.286	-6.635***	-6.824***

Note: ***, **,and * imply significance at 1%, 5% and 10% levels respectively. The figures show the t-statistic value for testing the null hypothesis that the variable possess a unit root. The Scwarz Information Criterion (Schwert, 1987) is used in the lag length selection. The critical values for constant without trend are -3.479, -2.883 and -2.578 while that of constant with trend are -4.028, -3.443 and -3.146 for 1%, 5% and 10% respectively. The figures are based on Mackinnon (1991).

Source: Authors` computation

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Table 4.4.d
South Africa's Augmented Dickey-fuller Unit root test

Variable	**Level**		**First Difference**	
	Intercept	With Trend	Intercept	With Trend
LDM3	-2.038	-0.770	-6.197***	-5.818***
LGDP	-1.628	-1.226	-3.336**	-3.647**
LITR	-2.071	-2.965	-4.076***	-4.045**
INF	-3.103**	-3.102	-4.282***	-4.245***
LEXR	-2.189	-2.473	-3.285**	-3.272***
MOU	-3.422**	-3.507**	-4.765***	-4.707***
OUU	-2.631*	-1.751	-5.606***	-5.546***
SM3	-1.734	-1.232	-2.992**	-7.027***

Note: ***, **,and * imply significance at 1%, 5% and 10% levels respectively. The figures show the t-statistic value for testing the null hypothesis that the variable possess a unit root. The Scwarz Information Criterion (Schwert, 1987) is used in the lag length selection. The critical values for constant without trend are -3.479, -2.883 and -2.578 while that of constant with trend are -4.028, -3.443 and -3.146 for 1%, 5% and 10% respectively. The figures are based on Mackinnon (1991).

Source: Authors` computation

Table 4.4.e
Kenya's Phillip-Perron Unit root test

Variable	Level		First Difference	
	Intercept	With Trend	Intercept	With Trend
LDM3	0.836	-4.330***	-8.678***	-8.496***
LGDP	0.612	-2.839	-5.402***	-5.194***
LITR	-3.282**	-3.323*	-5.289***	-5.282***
INF	-2.876*	-2.824	-3.199**	-3.873**
LEXR	0.781	-1.514	-5.877***	-5.643***
MOU	-1.889	-2.959	-7.302***	-7.228***
OUU	1.266	-1.347	-6.308***	-6.155***
SM3	2.789	-3.148	-5.576***	-6.588***

Note: ***, ** and * imply statistical significance at 1%, 5%, and 10% respectively. The values are for the t-statistic used in testing the null hypothesis that the variable has a unit root. The bandwidths are determined based on the Newey-West using Bartlett Kernel.. The critical values for constant without trend are -3.479, -2.883 and -2.578 while that of constant with trend are -4.028, -3.443 and -3.146 for 1%, 5% and 10% respectively. The figures are based on Mackinnon (1991).

Source: Researcher`s computation

Table 4.4.f
Malawi's Phillip-Perron Unit root test

Variable	Level		First Difference	
	Intercept	With Trend	Intercept	With Trend
LDM2	0.408	-2.179	-7.749***	-7.744***
LGDP	0.215	-1.266	-5.527***	-5.155***
LITR	-1.512	-1.215	-6.309***	-6.375***
INF	-2.048	-1.948	-3.849**	-3.921**
LEXR	0.186	-1.171	-4.197***	-4.139***
MOU	-2.156	-3.718**	-8.332***	-9.092***
OUU	-4.172***	-4.816***	-10.593***	-10.498***
SM2	-2.201	-4.337***	-8.698***	-8.789***

Note: ***, ** and * imply statistical significance at 1%, 5%, and 10% respectively. The values are for the t-statistic used in testing the null hypothesis that the variable has a unit root. The bandwidths are determined based on the Newey-West using Bartlett Kernel.. The critical values for constant without trend are -3.479, -2.883 and -2.578 while that of constant with trend are -4.028, -3.443 and -3.146 for 1%, 5% and 10% respectively. The figures are based on Mackinnon (1991).
Source: Researcher`s computation

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Table 4.4.g
Nigeria's Phillip-Perron Unit root test

Variable	Level		First Difference	
	Intercept	With Trend	Intercept	With Trend
LDM3	-2.186	-0.749	-11.215***	-12.266***
LGDP	-0.968	-2.146	-4.874***	-4.886***
LITR	-2.418	-2.462	-9.818***	-11.565***
INF	-3.043**	-3.341*	-4.256***	-4.318***
LEXR	-1.073	-2.561	-5.793***	-5.717***
MOU	-2.540	-2.609	-10.069***	-10.042***
OUU	-4.144***	-4.174***	-10.110***	-10.031***
SM2	-2.294	-1.287	-6.603***	-6.797***

Note: ***, ** and * imply statistical significance at 1%, 5%, and 10% respectively. The values are for the t-statistic used in testing the null hypothesis that the variable has a unit root. The bandwidths are determined based on the Newey-West using Bartlett Kernel.. The critical values for constant without trend are -3.479, -2.883 and -2.578 while that of constant with trend are -4.028, -3.443 and -3.146 for 1%, 5% and 10% respectively. The figures are based on Mackinnon (1991).
Source: Researcher`s computation

Table 4.4.h
South Africa's Phillip-Perron Unit root test

Variable	Level		First Difference	
	Intercept	With Trend	Intercept	With Trend
LDM3	0.274	-4.144***	-13.798***	-32.402***
LGDP	-1.677	-0.787	-3.371**	-3.699**
LITR	-1.455	-2.164	-3.824***	-3.784**
INF	-2.335	-2.357	-4.307***	-4.271***
LEXR	-1.746	-1.947	-3.351**	-3.330*
MOU	-3.490**	-3.588**	-10.061***	-9.936***
OUU	-3.956***	-4.082**	-10.086***	-10.018***
SM3	-2.043	-0.454	-7.020***	-7.156***

Note: ***, ** and * imply statistical significance at 1%, 5%, and 10% respectively. The values are for the t-statistic used in testing the null hypothesis that the variable has a unit root. The bandwidths are determined based on the Newey-West using Bartlett Kernel.. The critical values for constant without trend are -3.479, -2.883 and -2.578 while that of constant with trend are -4.028, -3.443 and -3.146 for 1%, 5% and 10% respectively. The figures are based on Mackinnon (1991).

Source: Researcher`s computation.

The unit root tests presented in tables 4.3a-h for the respective countries by both the ADF and PP results suggest that the variables under investigation are integrated of *I (0)* and *I(1)* process.

With this findings, having the mixed order of integration, the traditional cointegration tests may not be appropriate (Pesaran *et al.* 2001), therefore our choice for an ARDL bounds testing approach to co-integration and the T-Y Granger non causality is suitable for the study.

4.5 ARDL Results and Discussion

Pesaran *et al.* (2001) proposed the ARDL methodology which is also known as bounds test approach. This technique of cointegration has a lot of advantages over the other single equation cointegration methods such as the Generla to specifiec, Johansen cointegration, and Engel and Granger. Under ARDL there is no formal test for cointegration. Secondly, unlike the other methods, ARDL minimizes the endogeneity problems, thereby assuming all the variables to be endogenous. Third, under ARDL both short and long run series are simultaneously estimated, solving the problems associated with an omitted variables and that of autocorrelation. Fourth, ARDL method does not generally require knowledge of the order of the integration of the variables, while it is necessary in other methods which requires that variables must have similar integration order. Also Pesaran and Shin (1999) argued that ARDL approach can be reliably applied in small sample sizes to estimate and test hypotheses on a long run coefficient in both cases where the concern independent variables are of I(1) or I(0) order of cointegration. Considering these advantages of ARDL over other techniques of cointegration, this study adopted the ARDL methodology to estimate the demand for money functions for the selected countries.

Following Pesaran and Pesaran (1997), the optimal lag order is selected on the basis of the highest value of AIC and SBC. This stage of choosing the lag orders of the series

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is significant because the appropriate lag order selection allow us to identify the actual dynamics of the models. In the second step, the choosen model is estimated by OLS to obtain the coefficients of the long run models. This also provides the estimates of the error correction model (ECM) that corresponds to the choosen ARDL model. The AIC and SBC give a fairly plausible output for the bound test. Considering our data that is quarterly the selected lag length for all the selected countries is a maximum of 4 lags.

This section presents and discuss the results of the bound test for cointegration, short run and long run analysis. It further presents the models stability tests results. The results depict how stable the money demand function is with Divisia monetary aggregates for the selected economies over the study period. Establishing a stable money demand function in a country imply several conclusions (Ball, 2012).

First it shows the level of relationship between price movements and the growth in monetary stock. This by implication provides a vital background for understanding, forecasting and regulating inflationary trends in an economy. Secondly, the stability in the association between the price movements and monetary stock growth ensures that the policy making body in an economy possess a means to evaluate any issue to the steadiness of price in the economy at both the medium and long term standpoints instead of narrowing their analysis to only short term economic developments. Thirdly, the money demand stable position may infer to the existence of an equilibrium position of money stock in the economy. The monetary stock equilibrium is a vital input in the construction of several processes for monetary indicators like the excess liquidness measures and the growth rate for money reference measure.

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Lastly, the presence of steady money demand function for a certain monetary aggregate made the dynamics for this particular aggregate indicator of the most current economic situation, as it hinge on some vital macroeconomic series and generally available shortly after the realization (Bahmani-Oskooee, 2013).

Also, a basic principle of monetary theory is that the monetary authority can regulate the financial aggregates and project their growth paths. Under these circumstances, monetary policy can check whether demand for money is stable and whether there is any long-run connection between demand for money and its determining factors. Without a stable money demand, a monetary targeting to control inflation and promote economic growth would lose much of its appeal and itself becomes a source of economic disturbance (Darrat & Al-Sowaidi, 2009).

From the unit root test results, the variables are of mixed order of integration. ARDL is the most appropriate method to apply under this circumstance (Pesaran *et al.* 2001). The bound test ARDL specification outlined in equations (3.28) is estimated for Kenya, Malawi, Nigeria and South Africa respectively using Eviews 9.5 software.

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4.5.1 Bound Cointegration Test Results

Following Pesarna *et al.* (2001), the ARDL bound test implies estimating the unrestricted error correction model of equation 3.28. The first step is to test for the existence of a long run relationships among the variables in the models. This is done using the F test. A null hypothesis of no cointegration among the variables in equation 3.28 is tested against an alternative hypothesis of the presence of long run relationship. The F test bears a non- standard distribution that depends on; whether the series in the models are *I(0)* or *I(1);* the number of independent series and if the ARDL model has

an intercept or a trend. Two sets of critical values are reported in the Pesaran and Shin (1997), where the first set is calculated with the assumption that all the series in the model are *I(1)* and the second one is computed on assumption that all the series are *I(0)*. If the computed F statistic falls outside the inclusive region, the empirical findings indicates that computed F value is higher than the upper bound region of the critical values, it signifies the presence of a stable long run relationship.

First we look at the bound cointegration among the series in the models. The long run analysis will be valid only if we establish a cointegration among the variables in the models. An F-test is applied for the joint significance of lagged level variables in error correction models. To examine the cointegration based on the computed F-statistics, the critical bounds from Pesaran *et al.* (2001) and Narayan (2005), are used. The ARDL bound tests results is depicted in table 4.4.1a-d for Kenya, Malawi, Nigeria and South Africa respectively.

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From the results, the F-test calculated values for Kenya, Malawi, Nigeria and South Africa are 4.487, 11.202, 21.156, and 6.679 respectively significant at 1% level of significance for all the models. The cointegration results indicates that the null hypothesis of no level relationship among the variables is rejected at the 1% significance level in all the models where income, inflation, interest rate, exchange rates, monetary uncertainty and output uncertainty are modelled as the independent variables over the Divisia money for all the selected countries. This clearly indicate that our computed F-statistic is greater than critical values for all the economies as indicated in tables, 4.4.1a-d for the respective countries. This confirms the presence of cointegration or a long run association among the Divisia money, income, inflation, interest rate, exchange rate, monetary uncertainty and output uncertainty in all the

models. This implied that the variables under investigation move together in the long run and the results corroborates with the findings of Davas (2015); Dahalan *et al.* (2005).

Table 4.5.1a
Kenya`s Bound Cointegration Test Results

Model	F_c	Sig. Level	F-crit values	
			I(0)	I(1)
LDM3, LEXR, MOU, OUU, LITR, INF, LGDP	4.487***	1%	2.88	3.99
		5%	2.27	3.28
		10%	1.99	2.94

Note: ***, **, and * imply 1%, 5%, and 10% significance level respectively. I (0) is the lower bound region, and I (1) is the upper bound region based on Pesaran et al. (2001), and Narayan (2005) critical values. The null hypothesis is no cointegration.
Source: Author`s computation

Table 4.5.1b
Malawi`s Bound Cointegration Test Results

Model	F_c	Sig. Level	F-critical values	
			I(0)	I(1)
LDM2, LEXR, LITR,MOU, OUU, LGDP, INF	11.202***	1%	2.88	3.99
		5%	2.27	3.28
		10%	1.99	2.94

Note: ***, **, and * imply 1%, 5%, and 10% significance level respectively. I (0) is the lower bound region, and I (1) is the upper bound region based on Pesaran et al. (2001), and Narayan (2005) critical values. The null hypothesis is no cointegration.
Source: Author`s computation.

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Table 4.5.1c
Nigeria`s Bound Cointegration Test Results

Model	F_c	Sig. Level	F-critical values	
			I(0)	I(1)
LDM2, LGDP LEXR, MOU, INF, OUU, LITR	21.156***	1%	2.88	3.99
		5%	2.27	3.28
		10%	1.99	2.94

Note: ***, **, and * imply 1%, 5%, and 10% significance level respectively. I (0) is the lower bound region, and I (1) is the upper bound region based on Pesaran et al. (2001), and Narayan (2005) critical values. The null hypothesis is no cointegration.
Source: Author`s computation.

Table 4.5.1d
South Africa`s Bound Cointegration Test Results

Model	F_c	Sig. Level	F-critical values	
			I(0)	I(1)
LDM3, LGDP, MOU, OUU, LEXR, INF, LITR	6.679***	1%	2.88	3.99
		5%	2.27	3.28
		10%	1.99	2.94

Note: ***, **, and * imply 1%, 5%, and 10% significance level respectively. I (0) is the lower bound region, and I (1) is the upper bound region based on Pesaran et al. (2001), and Narayan (2005) critical values. The null hypothesis is no cointegration.

4.5.2 Longrun Analysis

After establishing that series in the models move together in the long run, or are cointegrated based on the bound test results discussed above, we then move to the estimation of the longrun and shortrun from equation (3.28) using the ARDL procedure as proposed by Pesaran et al. (2001). The estimations are done based on the AIC criteria with an optimum selection of a maximum of 4 lags having; 4,2,0,0,4,0,1, and 2,3,0,3,2,2,2 for Kenya and Malawi respectively. However, for Nigeria and South Africa the optimum lag is 1,0,3,4,1,3,4 and 3,0,4,4,0,0,2 respectively.

The estimated outputs for the long run analysis are presented in tables, 4.5.2a-d for Kenya, Malawi, Nigeria and South Africa respectively.

From the results of the four countries it suggests that both monetary uncertainty and output uncertainty appears to have significant impact on the money demand function. Of significance is while the coefficient of monetary uncertainty appears to be positive in the case of Kenya, Malawi and South Africa, indicating a negative effect of monetary uncertainty on the demand for money. In the case of Nigeria, the coefficient appears to be negative showing a negative impact of monetary uncertainty on the demand for money in the country. This also implies that over the short run period, a rise in output uncertainty results to an increase in the preferred holding of cash balances (Bahmani-Oskooee & Baek, 2016).

However, for output uncertainty, it bears a negative and significant coefficient for South Africa only. By implication, over the long run period, output uncertainty have a tendency to lower the cash balance holdings of an individual economic agent. Kenya, Malawi and Nigeria`s coefficients bears a significant positive signs for the output uncertainty variable. This suggests that in the long run, increased monetary and output uncertainties results to an increase in the desire for public to hold more money. The result is in line with the principle of risk-adverse economic unit who when there is an uncertainty in the environment, substitutes those risky securities in his possession for money (Choi and Oh, 2003). The negative sign of monetary uncertainty imply that the public prefers to keep safer financial assets instead of liquid cash during the periods of monetary uncertainty.

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The sign, size and level of significance for the long run coefficients of output and monetary uncertainties are consistent with previous studies such as Choi and Oh (2003); Bahamani and Kutan (2010); Bahamaini-Oskooee and Xi (2011) and Bahmani-Oskooee et al. (2015).

Overall, the results suggest that when an economy is faced with an output uncertainty, an individual economic agent will substitute their risky assets holdings for money over the short run period. Nevertheless, as time progress, real assets becomes more attractive and as such an economic agent will adjust its portfolios holdings, leading to a subsequent reduction in the money holdings.

Looking at the long run effects of other variables in the models, the level of economic activities (GDP), bears the expected positive and significant coefficient values for all the countries under study supporting the transaction role of money in an economy (Omotor, 2011). A test for whether the long run income elasticity for money demand of real cash balances unity is show that the hypothesis was rejected in three out of the four economies covered in the study. The findings correspond with the works of Hossain (2012), Singh and Kumar (2012). It is widely acknowledged that income elasticity for money demand in emerging nations is greater than unity (Fry, 1978; Friedman & Schwartz, 1969).

In most cases the estimated coefficients are greater than unity, indicating that a one perectage growth in the economic output requires more than one perecent rise in the supply for money, to keep in line with rise in the demand for money. More specifically, the income elasticity is significantly positive and exceed one in all the countries.

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This imply that over the long run period, a one percent growth in the economy requires a rise in the money supply that is higher than one percent. This might be because of some rigidities that are peculiar to the SSA region economies. This further suggests a fairly large response of real cash balances to variations in real income.

The exchange rate variable has a significant coefficient for all the countries under study indicating a significant long run effect of exchange rate on the demand for money in the selected SSA economies. The estimated coefficients are positive for all the countries indicating that a depreciation of the local currency leads to a decrease in demand for domestic currency in the countries. This cannot be unconnected to expectations of further depreciation by the individual economic agents. An interesting part of our finding is that the exchange rate coefficients are highly significant and in line with the a priori expectation for all the countries under study. This is in line with the findings of Akinlo (2006), Arango and Nadiri (1981) and Kumar *et al.* (2013).

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The rate of inflation carries the a priori expected significant coefficient in the results of Kenya, Malawi, Nigeria and South Africa. It bears a significantly negative coefficient indicating an opportunity cost property for the rate. The negative and significant interest and inflation rates elasticity in all economies imply that both monetary assets and the real assets are substitutes to holding cash balances (Nautz & Rondorf, 2011), Bahmani-Oskooee and Gelan (2009).

Table 4.5.2a
Kenya`s Long Run ARDL Results

Variable	Long Run Estimates
Constant	-29.248***
	(5.121)
LGDP	1.048***
	(0.201)
ITR	-0.077***
	(0.016)
CPI	-1.980 ***
	(0.088)
LEXR	0.387***
	(0.095)
MOU	0.874***
	(0.235)
OUU	1.310*
	(0.656)

Note: ***, **, and * imply significance levels at 1%, 5%, and 10% respectively. Figures in parenthesis are the standard errors. The estimation period is 2000Q1-2015Q3.

Source: Researcher`s computation

Table 4.5.2b
Malawi`s Long Run ARDL Results

Variable	Long Run Estimates
Constant	59.609***
	(11.831)
LGDP	2.057***
	(0.483)
ITR	-0.011
	(0.125)
CPI	-2.154**
	(1.007)
LEXR	1.692***
	(0.599)
MOU	2.805***
	(0.404)
OUU	3.249**
	(1.424)

Note: ***, **, and * imply significance levels at 1%, 5%, and 10% respectively. Figures in parenthesis are the standard errors. The estimation period is 2000Q1-2015Q3.

Source: Researcher`s computation

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Table 4.5.2c
Nigeria`s Long Run ARDL Results

Variable	Long Run Estimates
Constant	84.407***
	(25.916)
LGDP	3.239***
	(1.004)
ITR	-0.752***
	(0.143)
CPI	-2.322 **
	(0.887)
LEXR	2.403***
	(0.891)
MOU	23.403***
	(6.748)
OUU	2.887***
	(0.805)

Note: ***, **, and * imply significance levels at 1%, 5%, and 10% respectively. Figures in parenthesis are the standard errors. The estimation period is 2000Q1-2015Q3.

Source: Researcher`s computation

Table 4.5.2d
South Africa`s Long Run ARDL Results

Variable	Long Run Estimates
Constant	-38.167***
	(1.949)
LGDP	1.531***
	(0.096)
ITR	-0.004
	(0.016)
CPI	-0.549***
	(0.177)
LEXR	0.339***
	(0.048)
MOU	3.768***
	(0.096)
OUU	-7.194***
	(2.054)

Note: ***, **, and * imply significance levels at 1%, 5%, and 10% respectively. Figures in parenthesis are the standard errors. The estimation period is 2000Q1-2015Q3.

Source: Researcher`s computation

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4.5.3 Short run analysis

From the long run analysis, it is apparent that the main determinants for money demand in the selected SSA economies appears to be the level of economic activities, interest rate, inflation rate and exchange rate as postulated in the money demand hypothesis. In addition, the monetary uncertainty and output uncertainty also do influence the money demand function of the respective economies since the two series bear their anticipated coefficients that are very significant. These are established using the new Divisia monetary aggregates.

Meanwhile, looking at the short run results in table 4.5.3a-d for Kenya, Malawi, Nigeria and South Africa respectively, a significantly negative coefficient of the ECT term will support adjustments towards long run equilibrium or presence of cointegration (Pesaran et al. 2001). This offers information on the speed of adjustment to the equilibrium and also ascertains how fast demand for money react to changes in its determining factors. The computed error correction term value represents the speed of adjustment. It can be inferred as the change in Divisia money per quarter that is ascribed to the disequilibrium between actual and the equilibrium levels.

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Table 4.5.3a
Kenya`s Short Run ARDL Results

Variable	Short Run Estimates
Δ(LDM3-1)	0.301***
	(0.096)
Δ(LDM3-2)	-0.158
	(0.102)
Δ(LDM3-3)	0.237***
	(0.071)
Δ(LGDP)	-0.542**
	(0.211)
Δ(ITR)	-0.025***
	(0.006)
Δ(ITR-1)	0.001
	(0.006)
Δ(ITR-2)	-0.013**
	(0.006)
Δ(ITR-3)	-0.027***
	(0.006)
Δ(CPI)	-0.846***
	(0.111)
Δ(LEXR)	-0.491***
	(0.092)
Δ(LEXR-1)	-0.631***
	(0.112)
Δ(MOU)	0.292***
	(0.081)
Δ(OUU)	0.048
	(0.078)
Δ(OUU-1)	-0.285***
	(0.086)
ECT(-1)	-0.416***
	(0.047)

Note: ***, **, and * imply 1%, 5%, and 10% significance level respectively. Figures in parenthesis are the standard errors. The estimation period is 2000Q1-2015Q3.

Source: Researcher`s computation

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Table 4.5.3b
Malawi`s Short Run ARDL Results

Variable	Short Run Estimates
Δ(LDM2-1)	0.151*
	(0.089)
Δ(LGDP)	4.467***
	(0.555)
Δ(LGDP-1)	-3.741***
	(0.574)
Δ(ITR)	0.113
	(0.090)
Δ(CPI)	2.141
	(2.599)
Δ(CPI-1)	7.396***
	(2.700)
Δ(LEXR)	0.823
	(0.543)
Δ(LEXR-1)	-0.191
	(0.417)
Δ(LEXR-2)	-0.982**
	(0.446)
Δ(MOU)	3.002***
	(0.312)
Δ(MOU-1)	-0.397
	(0.393)
Δ(MOU-2)	-0.240
	(0.283)
Δ(OUU)	0.0116
	(0.490)
Δ(OUU-1)	-2.279***
	(0.539)
ECT (-1)	0.736***
	(0.073)

Note: ***, **, and * imply 1%, 5%, and 10% significance level respectively. Figures in parenthesis are the standard errors. The estimation period is 2000Q1-2015Q3.
Source: Researcher`s computation

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Table 4.5.3c
Nigeria`s Short Run ARDL Results

Variable	Short Run Estimates
Δ(LGDP)	0.253**
	(0.095)
Δ(ITR)	-0.019**
	(0.008)
Δ(ITR-1)	0.051***
	(0.009)
Δ(ITR-2)	-0.052***
	(0.009)
Δ(ITR-3)	0.030***
	(0.008)
Δ(CPI)	0.904***
	(0.163)
Δ(LEXR)	-0.054
	(0.137)
Δ(LEXR-1)	-0.104
	(0.109)
Δ(LEXR-2)	-0.561***
	(0.172)
Δ(MOU)	-0.029
	(0.166)
Δ(MOU-1)	2.292***
	(0.271)
Δ(MOU-2)	1.291***
	(0.215)
Δ(MOU-3)	0.329*
	(0.169)
Δ(OUU)	0.138***
	(0.051)
Δ(OUU-1)	-0.109***
	(0.028)
Δ(OUU-2)	-0.067**
	(0.027)
ECT (-1)	-0.094***
	(0.006)

Note: ***, **, and * imply 1%, 5%, and 10% significance level respectively. Figures in parenthesis are the standard errors. The estimation period is 2000Q1-2015Q3.

Source: Researcher`s computation

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Table 4.5.3d
South Africa`s Short Run ARDL Results

Variable	Short Run Estimates
Δ(LDM3-1)	0.365***
	(0.103)
Δ(LDM3-2)	0.216**
	(0.096)
Δ(LGDP)	1.095***
	(0.225)
Δ(ITR)	0.014
	(0.009)
Δ(ITR-1)	0.018**
	(0.008)
Δ(CPI)	-0.257
	(0.308)
Δ(LEXR)	-0.252***
	(0.079)
Δ(MOU)	1.321***
	(0.292)
Δ(MOU-1)	-1.212***
	(0.320)
Δ(MOU-2)	-0.855***
	(0.291)
Δ(MOU-3)	-0.486*
	(0.275)
Δ(OUU)	-1.078
	(0.766)
Δ(OUU-1)	4.531***
	(0.876)
Δ(OUU-2)	3.113***
	(0.769)
Δ(OUU-3)	3.167***
	(0.733)
ECT(-1)	-0.654***
	(0.087)

Note: ***, **, and * imply 1%, 5%, and 10% significance level respectively. Figures in parenthesis are the standard errors. The estimation period is 2000Q1-2015Q3.
Source: Researcher`s computation

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The size of the coefficient reflects the adjustment speed among the variables (Bahmani-Oskooee *et al.* 2015). The ECT term of -0.416 for Kenya for instance suggest that the demand for Divisia money in Kenya converge to their long run equilibrium level by 41.6 percent speed of adjustment every quarter due to the contribution of income, interest rate, exchange rate, monetary uncertainty and output uncertainty. Similarly, the speed of adjustment for Malawi, Nigeria and South Africa are -0.736, -0.094, and -0.654 respectively. The speed of adjustment appears to be relatively high in the models for Malawi, South Africa and Kenya. This suggest that all the independent variables in the respective models have a statistically significant short term impact on the Divisia money. This corroborates the findings of Dahalan *et al.* (2005), Habibullah (1999) that Divisia monetary aggregates maintain a relatively high speed of adjustment when modelled in the money demand function. On the variance in the countries speed of adjustment process, Sriram (2000) argued that speed of adjustment in the money demand function varies from one country to another. However studies such as Omotor and Omotor (2011) also reported a low speed adjustment for Nigeria.

The error correction value further indicates the existence of market forces in monetary sectors of the SSA countries that operates to reinstate long-run equilibrium when there is a short disturbance. Our relatively large speed of adjustments for Malawi, South Africa and Kenya indicate that the projecting content of the connection of the Divisia money and its determinant factors have not worsened over time. It is worth stating that our findings are similar with those of Dahalan et al. (2005) for Malaysia, Alkhareif and Barnett (2015) for GCC countries.

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Overall, the results show that there exist a long run stable money demand function for the countries. The implication of the stable demand for money function in Kenya, Malawi, Nigeria and South Africa is that monetary policy aimed at smoothing the growth rates of monetary aggregates could enhance the stability of the economies by ruling out monetary policy as a source of uncertainty. Added to that, because demand for money function stability implies the demand for money changes in a predictable fashion, the central banks may be able to achieve the overall objective of monetary policy frameworks. Studies such as Akinlo (2006), Bahmani-Oskooee and Kutan (2010); Kumar (2011); Nautz and Rondorf (2011), Singh and Kumar (2012) also found a similar result confirming the stability of money demand function in the long run.

A stable demand for money function indicates that the instability of the functions could be explained by the omitted variables of monetary uncertainty and output uncertainty as pointed out by Choi and Oh (2003). Alternatively, it may be due to the use of simple sum monetary aggregates as reported in Dahalan et al. (2005); and Barnett and Alkhaireif (2015). The results are also in line with Barnett (2013) interpretation of the role of money in an economy. Bahamani-Oskooee (2013) established similar conclusions. Also Akinlo (2006) found similar results for Nigeria and Arize (1994) also had similar findings.

4.5.4 Diagnostic Tests Results

To proceed with the post estimation analysis we check the diagnostic tests for all the models. The first step is to observe the diagnostic test statistic from lag-estimates that preceded our long run results and that of the model`s short run dynamics. Under the diagnostic tests analysis, we observe the Langrange multiplier (LM) test for the

residual serial correlation, next is the Ramsey`s RESET test employing the square for the fitted estimates of a right functional form. The normality test for a normally distributed residuals, is based on the test of skewness and the kurtosis for the generated residuals of the estimates. The test for heteroskedasticity is built on the squared residuals of the regression over the fitted squared values. In situations when the corresponding diagnostic tests proof to be significant statistically, this suggests the existence of respective biasedness in the specified model. The results further confirm the power of the ARDL models in the study. Tables, 4.4.4a-d reported the diagnostic tests results for the respective models.

Table 4.5.4a
Kenya`s Diagnostic Tests Results

Test statistic	**LM test**	**F-test**
Serial correlation	7.011(0.1353)	1.179(0.3365)
Functional form	0.247(0.8059)	0.061(0.8059)
Normality	1.238(0.5385)	N/A
Heteroskedasticity	23.991(0.1965)	1.407(0.1800)

Note: The Langrange multiplier tests are distributed as Chi-squared variables with degrees of freedom in parenthesis. The null hypothesis of the two tests is no serial correlation, normality, correct functional form and homoskedasticity respectively. Figures in parenthesis are the p-values.

Table 4.5.4b
Malawi`s Diagnostic Tests Results

Test statistic	**LM test**	**F-test**
Serial correlation	1.251(0.5349)	0.390(0.6798)
Functional form	0.742(0.4629)	0.550(0.4629)
Normality	0.431(0.8062)	N/A
Heteroskedasticity	14.563(0.8008)	0.623(0.8703)

Note: The Langrange multiplier tests are distributed as Chi-squared variables with degrees of freedom in parenthesis. The null hypothesis of the two tests is no serial correlation, normality, correct functional form and homoskedasticity respectively. Figures in parenthesis are the p-values.

Table 4.5.4c
Nigeria`s Diagnostic Tests Results

Test statistic	LM test	F-test
Serial correlation	1.298(0.5227)	0.373(0.6918)
Functional form	0.945(0.3516)	0.893(0.3516)
Normality	1.829(0.4008)	N/A
Heteroskedasticity	13.952(0.9032)	0.501(0.9540)

Note: The Langrange multiplier tests are distributed as Chi-squared variables with degrees of freedom in parenthesis. The null hypothesis of the two tests is no serial correlation, normality, correct functional form and homoskedasticity respectively. Figures in parenthesis are the p-values.

Table 4.5.4d
South Africa`s Diagnostic Tests Results

Test statistic	LM test	F-test
Serial correlation	1.998(0.1575)	1.320(0.2579)
Functional form	1.206(0.2355)	1.454(0.2355)
Normality	2.126(0.345)	N/A
Heteroskedasticity	15.485(0.6913)	0.728(0.7675)

Note: The Langrange multiplier tests are distributed as Chi-squared variables with degrees of freedom in parenthesis. The null hypothesis of the two tests is no serial correlation, normality, correct functional form and homoskedasticity respectively. Figures in parenthesis are the p-values.

Overall, we note from tables, 4.4.4a-d that the results are encouraging in the sense that we fail to accept the existence of any statistical biasedness in our models at least at the five percent levels of significance for all the countries and hence our models are dynamically stable. It further demonstrated that none of the estimated models has a serial correlation, heteroskedasticity, non-normality or problem of functional from.

4.5.5 Models Stability Test

After passing through the diagnostic test, the stability of the ARDL models are tested using the famous CUSUM and CUSUMSQ stability test proposed by Brown et al. (1975).

The CUSUM and CUSUMSQ tests are applied to the residuals of the optimum error correction model (Pesaran *et al.* 2001). An important requirement for the Brown et al stability tests is that the sample be fragmented with adequate observations prior to and after the break point. Thus, the two stability statistics; CUSUM and CUSUMSQ are subsequently updated through the movement of one observation from one particular period to the other. The stability statistics are therefore plotted against the break points or the break dates.

For the overall coefficients to be stable, the plots for these statistics must stay within a five percent level for significance (indicated by a dual straight line having an equations provided in Bown *et al.* 1975). An unstable parameter may potentially make the results to be biased (Dritsakis, 2011). Figures 4.4.5A-D depicts the plots for the CUSUM and CUSUMSQ for Kenya, Malawi, Nigeria and South Africa respectively. From the plots, it is clear that all the models are stable by all criteria. The statistical tests suggest that there is no substantial instability in broad Divisia money relationships in spite of the financial deregulations and innovations carried out in Kenya, Malawi, Nigeria and South Africa.

It further shows that our estimates are stable since the plots of both statistics remain within the critical values. This therefore implies that including the two variables of monetary uncertainty and output uncertainty produce a stable demand for money in

Kenya, Malawi, Nigeria and South Africa using Divisia money which was missing from the previous studies.

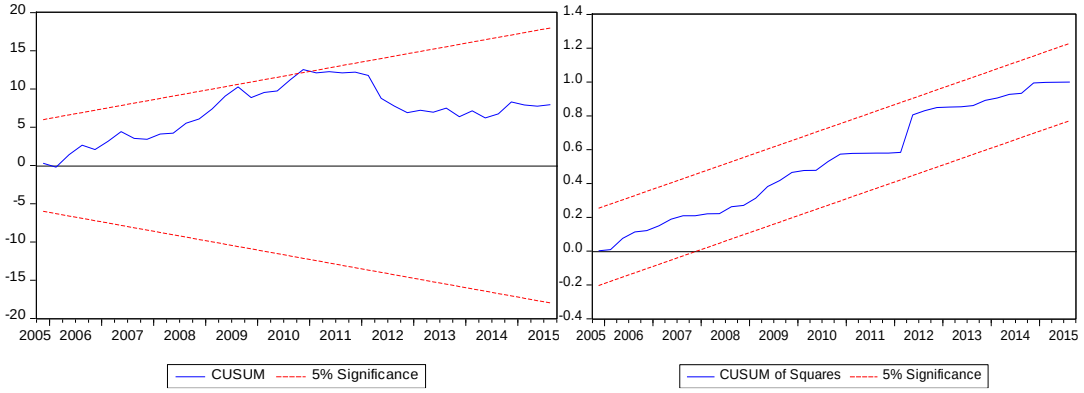

Figure 4.5.5a
Kenya CUSUM and CUSUMSQ 2000Q1-2015Q3

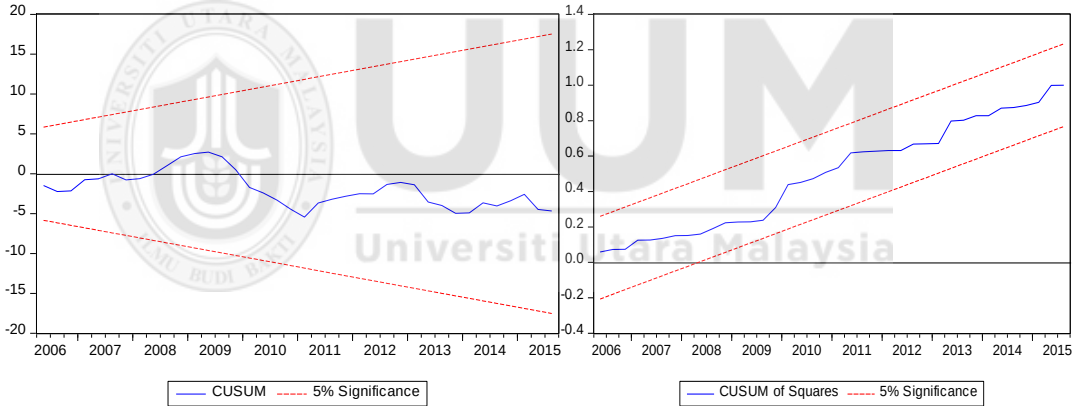

Figure 4.5.5b
Malawi CUSUM and CUSUMSQ 2000Q1-2015Q3

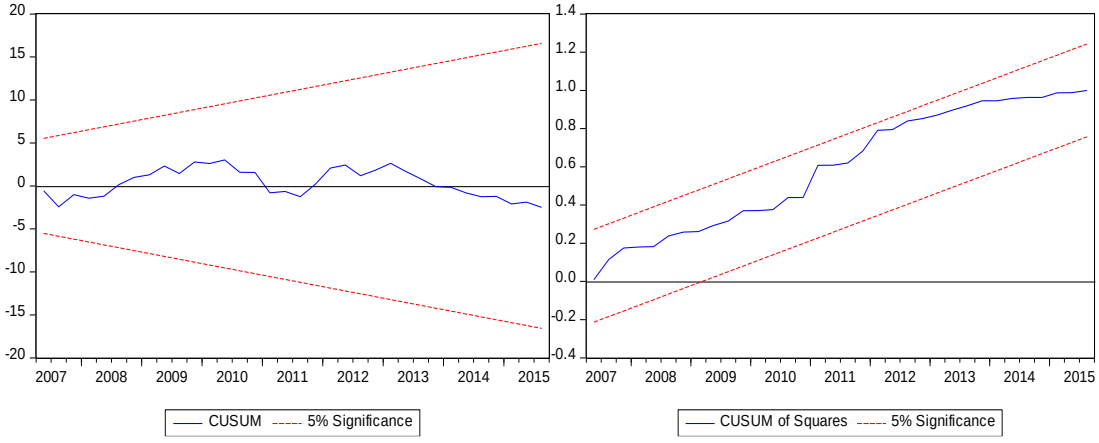

Figure 4.5.5c
Nigeria CUSUM and CUSUMSQ 2000Q1-2015Q3

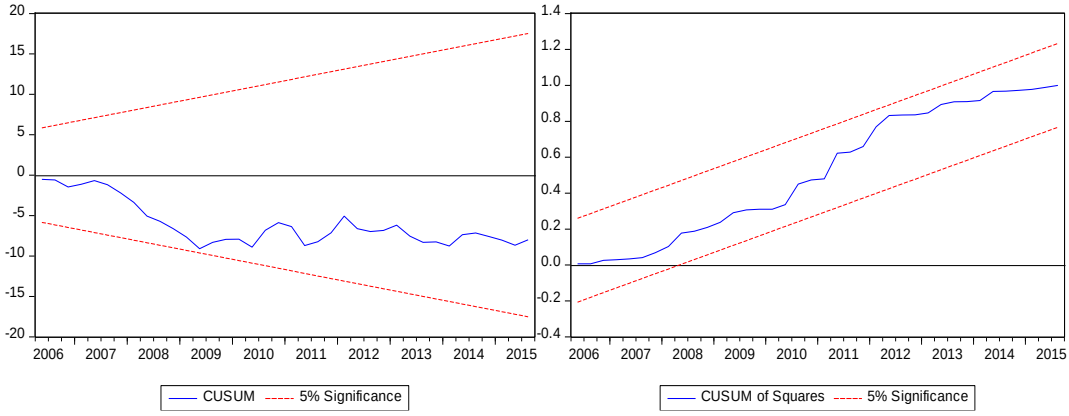

Figure 4.5.5d
South Africa CUSUM and CUSUMSQ 2000Q1-2015Q3

The plots for both the statistics for CUSUM with that of CUSUMSQ show that all the ARDL models specified in the study are steady at both long and short run levels. The results suggest that the estimated parameters of the respective models specified are generally steady over the study period.

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On the whoe, the estimates from the ARDL models that employ Divisia index aggregates are quite significant. The presented statistical evidence from the precedings indicates that money demand stability is largely an empirical realism if the Divisia index based aggregates are employed in modelling the relationships. In every country's model, there is presence of a cointegration relation amongst the Divisia money and the independent series in the model, with a realistic and steady parameter estimates of the money demand model.

4.6 Toda Yamamoto Causality Results and Discussions

One basic role of money within the empirical research is the investigation into the ability of monetary or financial aggregates to forecast the nation`s income and its price levels (Estrella & Mishkin, 1997). Also, the fundamental concern of every quantity-theoretic structure is that movements in supply for money should help to forecast the succeeding changes in the income and the price levels.

Presence of cointegration among variables does not imply causation because the Granger Representation Theorem has only provided that there must be causation if variables are cointegrated (Thoma, 1994). Therefore, Toda Yamamoto (1995) Granger causality is conducted to examine the direction of causality between money (Divisia and simple sum), income and prices. By employing the Toda Yamamoto approach to causality, the ensuing directions for a causality turn out to be independent of a presence of cointegration. A causality can be potentially obtained in any direction amongst two variables regardless of the existence of a cointegration (Thornton & Batten, 1985).

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Under this section, the study presents a detail causality analysis among the variables of money, income and inflation. Two different aggregates of money; Divisia index and the simple sum type aggregates were employed in the analysis for Kenya, Malawi, Nigeria and South Africa. The obvious reason for the use of the two aggregates in the causality analysis is to compare the two aggregates in terms of money neutrality or otherwise.

Following Wolde-Rufael (2005), the section estimates models of Toda Yamamoto (1995) Granger non causality using the Divisia aggregates and simple sum aggregates as described in section 3.6.3. The tests are carried out to investigate whether the

monetary growth rates can be used to forecast the growth in income and the price fluctuations. A comparison is made amongst the results obtained by the Divisia index-based models and the Simple sum models estimates

Employing the Toda and Yamamoto Granger non-causality test requires an information on the lag length (k) and the maximum order of integration (d) of the variables in the models. In order to establish the maximum integration order, the conventional ADF and PP unit root tests are utilized to explore the order of integration of each variable in the models for the respective countries. We utilize Schwarz Information Criteria (SIC) to establish the maximum lag order for P. Bearing in mind the statistical features of the Granger causality analysis, the SIC is an ideal option for specifying the lag order for the VAR system, particularly for smaller samples lower than 100 observations (Clarke & Mirza, 2006). Nonetheless, when the exact lag order is relatively large, the SIC might underestimate it, loosing the causal link (Clarke & Mirza, 2006). A further check is equally conducted to ascertain whether the chosen VAR (P) model specification is dynamically not stable and contain a residual serial correlation. When it is so, we have to rise the maximum lag order consecutively to adress the problem.

From the ADF and PP tests results in tables 4.3a-h, Divisia money, GDP and inflation (CPI) are integrated of order one for all the countries under consideration with an intercept as well as intercept and trend. Simple sum monetary aggregates are integrated of order one based on the tests with constants and constants with trends. Overall, the maximum order of integration appears to be one (dmax=1). Following sub sections discusses the Toda Yamamoto results for Divisia and simple sum aggregates.

4.6.1 Divisia Monetary Aggregates, Income and Prices

The unit root test result designate that dmax=1, therefore we could augment the well specified VAR(P) model by a single additional lag and carry out a standard Wald test. Tables, 4.5.1a-d presents the Toda Yamamoto Granger non causality test result between Divisia money and income (GDP) and inflation for Kenya, Malawi, Nigeria and South Africa respectively. A monetarist proposition is supported if there is a uni-directional Granger causality from money to income (GDP). On the other side, the money neutrality is supported if there is a unidirectional causality from income to money (Dyreyes et al. 1980). The respective p-values are also presented in the tables.

From the point of view of the significance of p-values for the Modified Wald (MWALD) statistic, it clearly suggests that Divisia money and income are bi-directional in all the countries except that of South Africa. The results show that the null hypothesis of Granger causality from money to income is rejected at the 1 percent significance level for Kenya, Malawi, and Nigeria. The bi-directional causality between money and income supports the the endogeneity proposition. While the unidirectional causality from Divisia money to income in the case of South Africa suggests that income seems to take precedence over the Divisia money and that increase in income leads to an increase in the demand for Divisia money in the case of South Africa. This outcome is consistent with the monetarist views that money Granger cause income in the long run. This corroborates the findings of Lee and Yang (2012). Thus this implies that Divisia money can be used to predict income in line with the monetarist postulations only in South Africa where money measured through Divisia index indicates non neutrality of money in the longrun.

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Regarding Divisia money-price causal relationship, the results suggest a bi-directional causality exist from money to CPI for all the selected countries. This results further supports the endogeneity of money in the case of Kenya, Malawi, and Nigeria.This suggests that money measured by Divisia index do influence movements in the overall prices of goods and services in the countries. However, for South Africa money proofs to be exogenous supporting the monetarist theory of non-neutrality of money in the long run. This implies that monetary expansion increase inflation in the countries in line with the monetarist view. It further indicates that an increase in money supply raises the general price level. Therefore, it is money that takes leads in raising inflation in the respective countries. The presence of bi-directional causality between money and prices show that money supply can be considered as endogenous which can be taken as effective control variable (Hossain, 2017). Similar results were obtained by Asongu (2014), Serletis and King (1993) and Lee and Yang (2012).

The results show that in the case of South Africa, an increase in money supply will lead to an increase in inflation rate using the Divisia index aggregates in both short and long run. It suggests that monetary growth has remained as the key causative factor in the persistence upsurge in price level in South Africa. The debate on whether inflation in emerging nations like the SSA could be explained from the monetarist point of view considering the huge bottlenecks in the supply chain in food and material resources flow in the SSA countries. The huge monetary expansion in the SSA countries where widespread corruption and reckless spending is a general feature of the governments makes the monetary proposition more potent than the supply side argument where inflation is seemed to be caused by supply rigidity.

Table 4.6.1a
Kenya`s Divisia Toda-Yamamoto Causality Test Results

Null hypothesis	**Chi-sq.**	**Prob.**	**Granger Causality**
DM3 does not Granger cause GDP	8.613	0.013	
GDP does not Granger cause DM3	33.033	0.000	bi-directional
DM3 does not Granger cause CPI	9.239	0.009	
CPI does not Granger cause DM3	28.731	0.000	bi-directional

Source: Author`s computation

Table 4.6.1b
Malawi`s Divisia Toda-Yamamoto Causality Test Results

Null hypothesis	**Chi-sq.**	**Prob.**	**Granger Causality**
DM2 does not Granger cause GDP	8.069	0.006	
GDP does not Granger cause DM2	16.438	0.002	bi-directional
DM2 does not Granger cause CPI	13.862	0.001	
CPI does not Granger cause DM2	41.388	0.000	bi-directional

Source: Author`s computation

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Table 4.6.1c
Nigeria`s Divisia Toda-Yamamoto Causality Test Results

Null hypothesis	**Chi-sq.**	**Prob.**	**Granger Causality**
DM2 does not Granger cause GDP	20.923	0.000	
GDP does not Granger cause DM2	15.840	0.007	bi-directional
DM2 does not Granger cause CPI	20.906	0.000	
CPI does not Granger cause DM2	10.827	0.054	bi-directional

Source: Author`s computation

Table 4.6.1d
South Africa`s Divisia Toda-Yamamoto Causality Test Results

Null hypothesis	Chi-sq.	Prob.	Granger Causality
DM3 does not Granger cause GDP	7.846	0.019	
GDP does not Granger cause DM3	1.352	0.508	Uni-directional
DM3 does not Granger cause CPI	1.315	0.009	
CPI does not Granger cause DM3	2.643	0.049	bi-directional

Source: Author`s computation

4.6.2 Simple Sum Aggregates, Income and Prices

Tables 4.5.2a-d presents reults for the T-Y Granger causality for Kenya, Malawi, Nigeria and South Africa respectively using the simple sum aggregates.Employing the simple sum aggregates to test the hypothesis for money-income causality for Kenya, Malawi, Nigeria and South Africa reveals a unidirectional causality from simple sum money to income in the case of Kenya, Nigeria and South Africa. This indicates an exodogeneity of money in the money-income relationship in Kenya, Nigeria and South Africa. This further supports the non neutrality of money. This tends to support the money non neutrality that in the long run money has no effect on the economic activities (Friedman & Kuntner, 1992). Similar results were obtained by Hurn (1991); Asongu (2014) for a selected developing countries.

However, in the case of Malawi, the direction of the causality is two ways supporting the endogeneity of money. This suggests that prices can have influence on money demand in Malawi.

In a similar way the results for Granger causality between Simple sum money and inflation presents a two way directional causality for Kenya, Malawi, and Nigeria.

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This imply that simple sum money influence the inflationary movements in the economies in line with the monetarist hypothesis. For South Africa the result is unidirectional.

Table 4.6.2a
Kenya`s Simple Sum Toda-Yamamoto Causality Test Results

Null hypothesis	**Chi-sq.**	**Prob.**	**Granger Causality**
SM3 does not Granger cause GDP	15.721	0.007	
GDP does not Granger cause SM3	6.076	0.298	uni-directional
SM3 does not Granger cause CPI	7.938	0.093	
CPI does not Granger cause SM3	21.488	0.000	bi-directional

Source: Author`s computation

Table 4.6.2b
Malawi`s Simple Sum Toda-Yamamoto Causality Test Results

Null hypothesis	**Chi-sq.**	**Prob.**	**Granger Causality**
SM2 does not Granger cause GDP	34.388	0.000	
GDP does not Granger cause SM3	12.578	0.013	bi-directional
SM3 does not Granger cause CPI	45.833	0.000	
CPI does not Granger cause SM3	17.620	0.003	bi-directional

Source: Author`s computation

Table 4.6.2c
Nigeria`s Simple Sum Toda-Yamamoto Causality Test Results

Null hypothesis	**Chi-sq**.	**Prob.**	**Granger Causality**
SM3 does not Granger cause GDP	20.825	0.002	
GDP does not Granger cause SM3	4.287	0.637	uni-directional
SM3 does not Granger cause CPI	7.088	0.069	
CPI does not Granger cause SM3	7.671	0.053	bi-directional

Source: Author`s computation

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Table 4.6.2d
South Africa`s Simple Sum Toda-Yamamoto Causality Test Results

Null hypothesis	**Chi-sq.**	**Prob.**	**Granger Causality**
SM3 does not Granger cause GDP	19.906	0.001	
GDP does not Granger cause SM3	4.414	0.352	uni-directional
SM3 does not Granger cause CPI	4.589	0.332	
CPI does not Granger cause SM3	13.434	0.009	uni-directional

Source: Author`s computation

The Toda Yamamoto Granger causality analysis results imply that under the period of study, monetary aggregates are essential in forecasting the income and the rate of inflation in Kenya, Malawi, Nigeria and South Africa. This further implies that monetary aggregates contains an essential information regarding their determinants factors of income and price. On the whole, the Divisia index based money aggregates perform slightly better than their simple sum money equivalents in all the countries particularly in the case of South Africa. Similar results were obtained by Dahalan et al. (2005); Hendrickson, (2014).The result is not consistent with the studies of Agenor et.al. (2000), which found no evidence of Granger causality flowing from money to income, irrespective of the measurement of money used.

The results from the Divisia index aggregates show that money at all times has played an important role as the intermediate target or as an indicator serie, and that any seemingly decline in its information content can be associated to the measurement errors inherent in the use of the simple sum method of aggregation (Belongia & Ireland, 2014b).Generally, the findings show that monetary aggregates are useful in predicting nominal income growth and inflation. This corroborates the findings of Estrella and Mishkin (1997), Darrat et al. (2005) and Belongia and Ireland (2014b).

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4.7 Chapter Summary

The chapter presents and discusses results of the three objectives of the study. First, the stability of money demand functions under Divisia money with monetary uncertainty and output uncertainty variables using the ARDL approach to cointegration. From the bound test it indicate a presence of a cointegration amongst the variables of money, income, interest rate, inflation, exchange rate, monetary uncertainty and output uncertainty in Kenya, Malawi, Nigeria and South Africa. The result further show that the money demands for the respective economies are stable over the study period using the Divisia money.

The two uncertainty variables included in the money demand models are statistically significant and key in the money demand stability for the selected SSA economies. It imply that both monetary uncertainty and output uncertainty impact on the money demand function.

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Second, the Toda Yamamoto (1995) Granger causality analysis models reveals that monetary aggregates (Divisia and simple sum) matters in the Money-income and money-price causality. The two way directional causality for Divisia money and income in Kenya, Malawi and Nigeria tends to support the endogeneity postulations for money, and that money matters in the long run output and prices fluctuations.Third, Divisia monetary aggregates explains the money-price causal relationship better than the simple sum aggregates.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the conclusions and main recommendations for the study. It is divided into five sections. Following the introduction is section 5.2 which contain the summary of the whole work. Sections 5.3 and 5.4 discuss the policy implications and recommendations for future research respectively. Section 5.5 presents the limitations of the study.

5.2 Summary

The main purpose of this study is to assess the role of monetary aggregates in monetary policy formulation in four selected SSA countries; Kenya, Malawi, Nigeria, and South Africa. The Divisia index method for the creation of monetary aggregates was presented by the Barnett (1978, 1980) seminal work to solve the problem of theoretical and empirical shortcomigs identified with the simple sum method of aggregation. Several studies have constructed Divisia index money aggregates for different countries and compared them with the simple sum type aggregates in terms of performance and information content. A vast number of the studies targeted the advanced countries and there is an almost absence of studies as regards African nations (Njokou, 2013). More so, most of the studies employed the traditional cointegration techniques like the Johansen (1995) cointegration tests. This study adopted the ARDL approach to cointegration for Pesaran *et al*. (2001) and T-Y Granger causality tests.

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The first objective of this study is to create the Divisia index money aggregates for the selected countries. Divisia aggragets are the most appropriate measure of money in an economy (Barnett, 1980; Belongia & Ireland 2014b). Using the new aggregation technique that is designed based on economic and index number theories proposed by Barnett (1980) and Barnett *et al*. (2013), the study constructs the Divisia money indexes for Kenya, Malawi, Nigeria, and South Africa. The indexes are appropriately weighted monetary aggregates that provide critical information concerning the role of money in an economy (Barnett & Alkhareif, 2015). These countries were selected based on the fact that; first the countries recorded an unprecedented economic growth in the past few decades compared to other nations in the region. Second, they experienced a rapid financial sector development which affects the composition and definition of money thereby questioning the appropriateness of the simple sum aggregates measures of money (Dube, 2013). Third, the selected economies are among the frontier and emerging economies and are faced with the challenges of money demand instability resulting from financial developmenst and innovations leading to the shift from monetary targeting to short term interest rates targeting. And finally, they are selected based on the data availability.

The second objective is to investigate the empirical association between Divisia money aggregates and income, interest rate, exchange rate, inflation, monetary uncertainty, and output uncertainty. An investigation of Divisia index monetary aggregates and their determining factor show that they have an I(0) and I(1) integration order, suggesting a mix order. To that effect, ARDL technique deemed to be the most appropriate econometric methodology in such situation, has been utilized on Divisia index monetary aggregates with their respective identified determinants, to confirm whether an economically significant stable money demand relationship exists for the

Kenya, Malawi, Nigeria, and South Africa. An ARDL method of cointegration based on Pesaran *et al*. (2001) is applied to tests stability of money demand function in the respective countries. Added to the conventional factors in money demand relationships, the monetary uncertainty and output uncertainty variables were incorporated into the models based on Choi & Oh, (2003), and Bahmani-Oskooee *et al*. (2013), studies.

The study found that the demand for money functions for Kenya, Malawi, Nigeria, and South Africa are well specified and stable over the study period. Both monetary uncertainty and output uncertainty exerts influence on the amount of money demanded. The statistical results suggest the presence of a long run equilibrium relationship between broad Divisia money balances, income, interest rate, exchange rate, inflation, monetary uncertainty, and output uncertainty. The coefficients of both variables in the models bear their a priori expected signs which are highly significant. The coefficients of MOU and OUU variables are statistically significant and carries the expected signs in all the countries.

The estimates of the long and the short run analysis further reveals that MOU and OUU play a significant role in the money demand analysis. Empirical findings imply that demand for money models with Divisia money can yield credible results. The obtained coefficients in the models presents a statistically significant value that are in accordance with the a priori theoretical postulations. These findings are similar with those obatained by Bahmani-Oskooee and Gelan (2009). Hence, beside the simple sum aggregates, Divisia money aggregates can also be adopted as a complementary or an alternative money measures in monetary policy frameworks for Kenya, Malawi, Nigeria, and South Africa.

In this study we uncover the possibility of having a stable money demand relation by incorporating monetary uncertainty and output uncertainty series in the model using the Divisia monetary aggregates for Kenya, Malawi, Nigeria, and South Africa.

The short and long run relations are examined in the empirical analysis. An array of procedures were undertaken to further check for the robustness of the empirical findings for the respective money demand models. The test for the models stability confirms the existence of a stable money demand function for all the sample countries in the short and long run. Overall, the empirical analysis proves to be robust to a number of diagnostic checks. The residuals from the diagnostic tests for the Divisia index models highlighted that there is no remarkable support for the existence of non normality, serial correlation, or heteroskedasticity.

The third objective of the study explores the causal relationship between money and income employing both Divisia index aggregates and simple sum money aggregates. The money- income causality relationship was investigated for Divisia money and simple sum using a more advanced econometric technique, the T-Y Granger causality test. The results obtained are promising and in accordance with the existing monetary theory. In the money, income, and price causality, the Divisia monetary aggregates generally performed well in the respective models especially for Kenya, Malawi, and Nigeria.

Objective four investigates the causal relationship between money and inflation testing the Divisia money index aggregates and simple sum money aggregates. In all the sample countries results, Divisia money seem to perform better in explaining the long run association between money and price fluctuations in South Africa. However, our

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results on the empirical validity of the long run relationship between money, income and prices provide an idea that Divisia index monetary aggregates can and should play a vital role in the demand for money and monetary growth theories. We believe that Divisia monetary aggregates will improve our knowledge and understanding of how money influence the economy as pointed out by Barnett (1982) and Serletis and Gogas (2014).

The study has many contributions and significance for both theoretical, empirical and policy purposes. For instance, it adds to the empirical literature on the construction of an alternative monetary aggregates for the selected SSA countries and the role of the Divisia aggregates in money demand function stability. Therefore, this study may serve as a guide to policy makers on the appropriate monetary policy framework to adopt and the key macroeconomic variables to target for money demand stability. The result may equally be useful for the other countries in the SSA region to serve as a guide to produce their own aggregates. By extension, future studies can build upon this study to consider other countries in the region.

Unlike previous studies, this work principally adapt ARDL and Toda Yamamoto (1995) causality approach which has been argued to be more robust for a mixture of I(0) and I(1) variables (Pesaran et al. 2001). Methodologically, the study employs time series analysis on the ARDL and T-Y estimates. The study revealed that the Divisia index based monetary aggregates have more elaborate results as compared to their simple sum counterparts. The variables of monetary uncertainty and output uncertainty are significant. The cointegration analysis indicate the existence of a long run relationship amongst the Divisia aggregates and other determinants. Furthermore, outcomes of Toda Yamamoto (1995) Granger causality tests presented an evidence

that the Divisia monetary aggregates performs relatively better as compared to the simple ssum aggregates. Using Divisia index as a measure for monetary stock growth in an economy provides a result that concur with the theoretical postulations and also proof to be statistically robust.

Summarily, Divisia monetary aggregates is confirmed not only theoretically better but also empirically valid as a useful measurement for money stock as compared to the simple sum measures atleast in the case of Kenya, Malawi, Nigeria, and South Africa. Not only that, the growth of the Divisia measures for money allows additional reliable and appropriate information to be acquired by the policy makers bearing in mind that these weighted monetary aggregates can better cope with the fast changing financial deregulations and innovation atmosphere as currently taking place in the developing countries particularly the SSA countries. Hence the Central Banks of the respective countries might think about employing monetary stock targeting by adopting the Divisia money as a policy variable in place of the conventional simple sum type aggregates. This study first identify stability in the money demand relations for Kenya, Malawi, Nigeria, and South Africa with Divisia monetary aggregates. Second, evidence from Toda Yamamoto (1995) test suggests that stock of money is very important in explaining the income and price fluctuations when a Divisia index aggregates are utilized.

In conclusion, the analysis, and investigations into the short and the long run money demand relations in the considered SSA economies allow us to draw a conclusion that the Divisia index type aggregates could serve as a possible target variable in monetary policy frameworks for Kenya, Malawi, Nigeria, and South Africa. This can be elucidated from the factual point that the Divisia index money offers a testable

framework to handle the effects for innovations in the financial system and equally perform well at high aggregation level.

5.3 Policy Recommendation

A number of significant policy implications can be obtained from the conclusions of the study. First on the basis of the established stability in money demand relations for Kenya, Malawi, Nigeria and South Africa, monetary targeting policy framework can be utilized as it proofs to be ideal. As stressed by Thornton, (2014), the supply for money should be targeted when money demand stability is assured. Under the circumstances of a stable money demand function, monetary targeting is the feasible policy stance for the countries. This may offer a justification for the monetary authorities to target the broad monetary aggregates and stability in money demand in monetary policy for all policy decisions. Nonetheless, the identifed low adjustment coefficient for Nigeria suggests that monetary targeting can maximally be applied during a long term period instead of a short term period. The small speed of adjustment might signify lack of asset sophistication in Nigeria. Accordingly, this may also indicate that Nigeria is endowed with a low level of financial deepening having a more or less repressed financial system (Doguwa et al, 2013).

It seems that monetary targeting still signifies a proper long run policy strategy in the four selected SSA countries. In total, the evidence from our results suggest that monetary targeting is alive and well at least in the four SSA economies investigated in this study and that their respective monetary authorities should keep a close watch on money growth.

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Second, our conclusion consistently suggest that Divisia monetary aggregates share a robust and stable long run relationship with income, interest rate, exchange rate, inflation, monetary uncertainty, and output uncertainty. This finding appears so despite a major financial market innovations and a vital regulatory changes that took place during the middle and late 1980`s in all the countries. This result provides further support for the studies of Belongia (1996) and Schunk (2001) and suggest that statistical inferences concerning the thrust for monetary policy are in fact sensitive to the measurement of the money (Darrat & Al- Sowaidi 2009).

A fascinating aspect of the findings is that although the economies of Kenya, Malawi, Nigeria, and South Africa had experienced a series of vital structural alterations during the study period like the different monetary policy frameworks under the structural adjustment programmes, the long run relations amongst the studied macroeconomic and financial variables are fairly stable and in accordance with economic theory. Monetary targeting to control inflation rest on the stability and predictability of money demand (Dekle & Pradhan, 1999). In a similar manner, Pinga and Nelson (2001) established a unidirectional causality running from money to prices without a feedback effect in the case of japan showing a support for the monetarist view. Thus, monetary targeting policies to correct inflation or deflation might be an encouraging strategy in the long run.

Regarding the causal effect of money over income and prices, a number of policy implications can be derived. The Money do Granger cause income has been established and therefore the information on money growth can be utilized in implementing monetary policy. A rise in money supply leads to an upsurge in the income which eventually rises the money demand to fund the higher level of economic

activity. Conversely, this equally rises the level of price thus causing an inflation. A higher income level devoid of inflation may be realized if the money supply growth rate is constant roughly at an equal rate to that of economy`s rate of growth. Therefore, if the objective of a policy is to attain a high rate of economic growth as well as control inflation, money supply should equally be considered as the most appropriate policy target. More so, from the point of a bi-directional causality between money and income for Kenya, Malawi and Nigeria, monetary policy frameworks should be formulated by considering the reaction of output on money (Stock & Watson, 1989).

The findings that money supply effects inflation in the selected countries lends support for the countries policies of using money as an anchor to inflation control. The results clearly show that an upsurge in money supply above output growth can be inflationary, so the respective central banks should monitor the money supply growth rate as it is strongly linked to the price movements. If this is done, it can lead to a stable and low inflation and a sustainable economic growth.

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The central banks of Kenya, Malawi, Nigeria, and South Africa could benefit from this study in enhancing their monetary databases. Likewise, economic researchers and financial analysts can utilize the new money supply indexes to undertake several applications and empirical researches. In addition to that, the respective countries central banks may consider constructing Divisia monetary aggregates alongside the simple sum aggregates to provide policy makers and academic researchers with additional information on economic activities in the respective countries.

5.4 Recommendation for Future Research

The study explores several theoretical and empirical issues that surrounds the construction and application of various measures of money in policy implementation. However, the study does not fully tackle all the problems identified in the previous literatures. The first objective of the study construct Divisia monetary aggregates at the narrow and broad money levels for the selected SSA countries. Considering the different levels of financial developments across countries, more especially in SSA, the study recommends that further research may be carried out to construct similar aggregates for the rest of the countries. There is need for more studies to find the optimal levels of aggregation and the usefulness of Divisia monetary aggregates for monetary policy.

This study did not cover the forecasting ability of Divisia monetary aggregates. Future research could examine the forecasting power of the Divisia index monetary aggregates on the income and the prices. They should compare the predicting capability for the Divisia monetary and simple sum type aggregates in forecasting output and prices.

A number of studies in developed countries such as Barnett (2009), Serletis and Rehman (2012) and Serletis and Gogas (2014) have all established a strong evidence that Divisia index monetary measures are better than their simple sum equivalents in forecasting output and inflation.

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5.5 Limitations of the Study

Despite the modest effort of the study to construct the Divisia monetary aggregates and investigate its relationship with other macroeconomic variables in the money demand functions of the selected SSA countries, the study is not without some limitations. First, the study covers only four SSA countries. There are 58 countries in SSA having different levels of financial developments. Thus, results might not be universally true for all the other economies.

Some of the limitations of the study include absence of longer sample data of the various monetary components used in the construction of the Divisia monetary aggregates. The study covers only four out of the several economies of the SSA region.

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APPENDIX

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APPENDIX A

Monetary Aggregates for Kenya 2000Q1-2015Q3

End of period	SM1	DM1	SM2	DM2	SM3	DM3
2000Q1	100.00	100.00	100.00	100.00	100.00	100.00
2000Q2	102.90	82.96	105.82	84.85	119.65	89.65
2000Q3	103.72	84.38	107.70	86.19	123.44	104.23
2000Q4	105.45	88.35	112.10	103.36	128.47	105.23
2001Q1	108.27	86.24	110.82	109.23	134.68	112.32
2001Q2	109.98	93.65	112.64	110.00	141.68	119.54
2001Q3	108.72	91.49	115.31	113.25	154.08	128.36
2001Q4	115.90	101.87	122.98	120.33	159.36	136.23
2002Q1	115.55	99.85	123.20	121.02	167.33	141.00
2002Q2	122.15	112.01	129.90	126.69	186.23	149.30
2002Q3	123.47	110.12	127.86	126.37	187.23	155.77
2002Q4	131.79	125.79	139.68	134.56	189.66	159.20
2003Q1	134.08	130.80	142.68	138.98	202.47	168.69
2003Q2	138.08	139.23	151.39	143.21	212.69	172.33
2003Q3	159.09	142.33	164.98	159.36	218.99	179.68
2003Q4	172.38	152.00	182.11	168.36	222.36	182.69
2004Q1	173.95	159.32	189.34	172.31	241.88	189.33
2004Q2	175.99	164.58	190.56	187.63	243.68	194.00
2004Q3	182.59	169.33	198.87	188.65	271.64	208.36
2004Q4	189.99	178.69	201.32	199.98	288.03	236.01
2005Q1	186.76	184.33	208.64	203.00	291.27	240.00
2005Q2	193.66	189.23	215.34	212.47	302.31	268.44
2005Q3	201.94	190.00	218.66	214.42	312.22	271.88
2005Q4	208.77	201.11	224.47	220.02	324.51	279.32
2006Q1	217.27	204.12	227.11	223.45	341.28	288.32
2006Q2	235.76	214.21	241.33	236.23	349.88	294.14
2006Q3	240.94	231.32	258.97	247.74	374.66	302.11
2006Q4	259.35	240.00	274.61	260.21	384.12	312.64
2007Q1	264.80	249.65	287.32	279.97	389.64	327.68
2007Q2	290.98	256.33	310.51	281.44	401.11	398.22
2007Q3	314.70	279.11	324.01	312.36	428.72	402.00
2007Q4	327.57	284.12	338.85	324.23	458.11	426.33
2008Q1	343.43	299.71	350.33	341.00	464.69	439.77
2008Q2	369.58	317.12	384.22	364.88	471.98	443.23
2008Q3	347.53	319.45	389.12	379.88	497.11	452.33
2008Q4	357.82	325.65	394.81	388.20	502.14	477.32
2009Q1	358.69	347.87	399.21	391.23	525.57	491.64
2009Q2	355.29	349.87	406.12	403.10	597.22	518.62
2009Q3	390.97	356.65	417.50	405.65	621.74	523.70
2009Q4	401.93	379.18	428.77	419.11	654.77	538.64

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Appendix A (Continued)

End of period	SM1	DM1	SM2	DM2	SM3	DM3
2010Q1	418.76	392.57	453.27	430.01	698.88	567.00
2010Q2	446.86	412.33	489.65	444.52	715.63	604.08
2010Q3	475.41	431.21	492.98	488.98	754.12	625.99
2010Q4	511.43	456.33	538.26	526.36	768.22	663.21
2011Q1	533.20	459.36	549.97	531.21	789.10	689.90
2011Q2	549.11	477.27	560.88	542.21	807.17	709.22
2011Q3	565.46	495.65	589.12	566.65	892.33	736.50
2011Q4	579.06	521.21	591.66	574.58	907.56	764.23
2012Q1	555.11	528.65	602.45	589.63	987.12	804.04
2012Q2	564.27	534.33	612.47	603.33	1,145.22	856.23
2012Q3	589.44	566.69	625.44	605.21	1,154.23	890.07
2012Q4	634.70	575.54	649.33	632.11	1,162.98	901.67
2013Q1	646.41	592.70	678.97	649.74	1,174.65	918.44
2013Q2	682.02	612.00	702.08	677.12	1,278.33	1,004.23
2013Q3	700.03	652.78	711.22	698.32	1,304.98	1,112.38
2013Q4	744.96	689.98	769.14	744.00	1,385.44	1,189.22
2014Q1	777.04	711.20	786.47	768.32	1,392.44	1,203.55
2014Q2	814.18	726.36	829.32	799.68	1,451.33	1,236.09
2014Q3	821.84	800.25	859.78	802.07	1,463.23	1,254.87
2014Q4	843.47	826.36	870.22	855.63	1,601.33	1,309.65
2014Q1	863.03	849.65	895.37	877.26	1,709.92	1,384.23
2015Q2	903.66	878.98	934.22	883.23	1,882.32	1,444.23
2015Q3	909.65	894.23	965.47	942.32	1,887.24	1,498.00

Note: SM1, SM2 and SM3 are the simple sum monetary aggregates, DM1, DM2 and DM3 are the Divisia monetary aggregates

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APPENDIX B

Monetary Aggregates for Malawi 2000Q1-2015Q3

End of Period	SM1	DM1	SM2	DM2
2000Q1	100.00	100.00	100.00	100.00
2000Q2	105.04	89.64	107.21	99.63
2000Q3	125.47	109.17	134.26	113.53
2000Q4	138.56	118.17	145.25	126.36
2001Q1	130.58	122.32	164.36	132.78
2001Q2	161.38	120.82	189.56	138.45
2001Q3	177.35	141.03	208.36	153.26
2001Q4	186.00	165.22	256.32	169.54
2002Q1	211.23	182.54	289.77	204.36
2002Q2	228.36	198.23	322.25	245.08
2002Q3	244.98	221.64	366.81	271.58
2002Q4	268.97	234.47	389.23	289.11
2003Q1	272.45	249.84	400.36	312.47
2003Q2	284.00	266.85	423.66	356.27
2003Q3	324.21	294.01	435.26	364.25
2003Q4	336.89	319.66	469.78	380.54
2004Q1	356.47	325.20	497.00	419.65
2004Q2	402.36	355.54	544.47	435.61
2004Q3	432.01	386.23	548.97	454.26
2004Q4	448.33	409.89	588.82	475.23
2005Q1	467.23	423.25	608.51	506.55
2005Q2	478.26	455.63	623.32	536.27
2005Q3	490.12	461.00	677.41	579.36
2005Q4	533.21	492.11	711.00	597.87
2006Q1	560.44	508.04	719.55	622.35
2006Q2	569.98	524.32	732.23	638.96
2006Q3	582.44	536.98	802.36	652.36
2006Q4	608.55	587.24	818.22	711.23
2007Q1	666.36	603.25	864.55	723.54
2007Q2	689.00	613.25	898.27	764.48
2007Q3	746.36	635.24	906.33	783.25
2007Q4	799.68	655.63	913.61	800.25
2008Q1	836.65	693.23	940.35	816.35
2008Q2	903.26	704.21	1102.23	839.25
2008Q3	1124.33	735.89	1252.01	856.69
2008Q4	1137.80	801.11	1398.26	896.74
2009Q1	1143.23	827.54	1402.23	908.36
2009Q2	1194.65	855.24	1428.33	945.74
2009Q3	1280.32	904.44	1508.33	977.26
2009Q4	1318.98	944.36	1524.74	1103.00

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Appendix B (Continued)

End of Period	SM1	DM1	SM2	DM2
2010Q1	1539.25	989.00	1683.23	1465.69
2010Q2	1695.52	1125.63	1804.55	1523.68
2010Q3	1784.56	1194.52	1811.20	1569.36
2010Q4	1822.00	1211.01	1941.59	1602.36
2011Q1	1883.56	1356.21	2004.95	1700.20
2011Q2	2010.11	1498.23	2217.84	1812.00
2011Q3	2064.75	1849.22	2438.13	1994.36
2011Q4	2154.00	2084.10	2682.29	2163.54
2012Q1	2266.00	2198.66	2664.58	2205.78
2012Q2	2300.54	2345.96	2943.79	2368.44
2012Q3	2369.23	2399.51	3027.01	2401.00
2012Q4	2541.22	2431.20	3250.22	2688.57
2013Q1	2631.00	2553.26	3342.08	2874.58
2013Q2	2981.11	2569.23	3773.45	2988.00
2013Q3	3089.63	2641.02	4160.10	3012.45
2013Q4	3125.00	2811.00	4348.98	3256.32
2014Q1	3369.25	3024.26	4384.14	3398.68
2014Q2	3377.38	3124.55	4746.18	3475.81
2014Q3	4498.02	3259.88	4796.85	3566.36
2014Q4	4112.23	3569.36	5080.60	3845.21
2014Q1	4229.68	3587.42	5108.73	3978.65
2015Q2	4268.98	4032.01	5391.32	4076.00
2015Q3	4310.66	4326.95	6238.59	4118.36

Note: SM1, SM2 are the simple sum monetary aggregates, DM1 and DM2 are the Divisia monetary aggregates

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APPENDIX C

Monetary Aggregates for Nigeria 2000Q1-2015Q3

End of Period	SM1	DM1	SM2	DM2
2000Q1	100.00	100.00	100.00	100.00
2000Q2	112.26	99.68	116.00	109.35
2000Q3	124.86	109.45	131.72	117.36
2000Q4	138.30	118.36	146.32	128.69
2001Q1	166.52	146.37	189.24	167.88
2001Q2	181.39	153.23	216.33	178.69
2001Q3	174.81	158.07	224.10	197.36
2001Q4	185.39	167.98	238.00	209.47
2002Q1	190.74	172.36	239.65	226.36
2002Q2	200.43	189.65	254.02	239.00
2002Q3	209.53	190.03	287.49	259.64
2002Q4	223.86	204.31	294.68	276.30
2003Q1	252.91	222.69	304.26	279.63
2003Q2	275.61	246.68	322.00	308.66
2003Q3	278.63	254.36	339.57	317.20
2003Q4	297.94	271.02	356.65	232.36
2004Q1	326.69	306.58	372.01	348.69
2004Q2	339.97	324.69	389.00	364.58
2004Q3	365.87	349.27	394.67	372.26
2004Q4	379.68	361.23	408.37	379.09
2005Q1	403.26	378.25	436.69	408.36
2005Q2	426.68	403.32	456.03	442.36
2005Q3	438.57	418.67	477.27	451.02
2005Q4	469.75	428.69	493.61	467.00
2006Q1	498.23	465.36	511.21	477.07
2006Q2	526.96	496.36	531.26	509.47
2006Q3	530.68	516.28	563.24	518.66
2006Q4	566.74	541.33	614.55	539.58
2007Q1	601.01	574.32	658.23	557.36
2007Q2	626.10	609.32	695.88	577.03
2007Q3	673.89	654.22	754.72	606.57
2007Q4	701.03	674.00	797.33	626.69
2008Q1	721.02	698.76	824.36	652.33
2008Q2	732.01	704.36	869.34	687.24
2008Q3	842.26	737.65	945.36	711.26
2008Q4	869.87	811.23	1194.99	796.66
2009Q1	902.21	836.24	1263.60	804.57
2009Q2	938.69	889.37	1236.78	897.25
2009Q3	1023.33	924.33	1284.06	918.63
2009Q4	1107.57	997.87	1432.40	1103.42

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Apppendix C (Continued)

End of Period	SM1	DM1	SM2	DM2
2010Q1	1121.00	1008.69	1488.93	1187.36
2010Q2	1165.47	1123.04	1503.47	1202.47
2010Q3	1216.60	1165.49	1554.68	1268.68
2010Q4	1258.73	1206.97	1564.18	1321.22
2011Q1	1274.48	1254.22	1606.55	1389.67
2011Q2	1307.49	1278.49	1664.07	1407.33
2011Q3	1380.38	1297.84	1731.37	1489.77
2011Q4	1427.16	1311.25	1739.26	1508.69
2012Q1	1538.22	1369.54	1854.34	1566.58
2012Q2	1540.73	1433.00	1864.08	1602.28
2012Q3	1599.78	1489.67	1902.70	1647.57
2012Q4	1621.72	1504.47	2074.29	1700.55
2013Q1	1628.56	1566.37	2147.18	1769.89
2013Q2	1723.36	1602.57	2153.01	1812.21
2013Q3	1765.02	1639.58	2326.36	1922.01
2013Q4	1821.56	1729.58	2596.67	2114.23
2014Q1	1899.97	1768.96	2789.64	2368.58
2014Q2	1956.27	1845.67	2968.46	2410.30
2014Q3	2214.18	1908.65	3260.23	2811.31
2014Q4	2567.24	2106.98	3594.66	2947.87
2014Q1	2711.63	2398.23	3846.97	3223.26
2015Q2	3150.66	2943.21	3948.86	3367.23
2015Q3	3684.07	3328.90	4237.69	3896.37

Note: SM1, SM2 are the simple sum monetary aggregates, DM1 and DM2 are the Divisia monetary aggregates

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APPENDIX D

Monetary Aggregates for South Africa 2000Q1-2015Q3

End of period	SM0	DM0	SM1A	DM1A	SM1	DM1	SM2	DM2	SM3	DM3
2000Q1	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
2000Q2	102.53	98.36	116.08	105.32	119.63	109.24	121.37	118.36	136.23	128.67
2000Q3	103.80	99.07	119.45	116.74	121.03	120.14	126.23	124.23	139.68	131.23
2000Q4	114.60	106.23	127.66	119.68	132.02	126.34	134.26	131.26	146.28	139.97
2001Q1	120.09	112.17	136.25	123.44	139.26	131.26	146.31	139.66	153.23	145.36
2001Q2	122.38	120.83	139.65	128.32	148.27	139.87	158.96	147.37	169.32	158.97
2001Q3	134.76	122.20	146.32	134.22	153.20	144.21	164.25	153.08	174.23	165.67
2001Q4	139.67	136.23	149.25	139.68	158.69	149.68	169.44	159.21	189.23	178.68
2002Q1	146.00	140.11	153.23	144.27	167.26	153.04	174.38	168.77	192.20	181.55
2002Q2	149.67	147.95	159.67	150.23	171.23	159.68	182.03	173.22	206.31	196.57
2002Q3	154.36	151.02	161.30	158.34	182.22	168.33	197.82	189.27	211.07	201.58
2002Q4	158.77	154.00	168.45	160.00	190.07	173.66	203.36	198.14	219.90	209.36
2003Q1	162.03	158.98	173.22	167.34	193.02	179.89	219.68	200.13	234.56	216.28
2003Q2	169.22	165.66	178.27	169.87	203.24	188.70	227.21	209.12	248.69	229.32
2003Q3	174.53	168.67	184.90	171.02	208.31	190.57	242.00	218.43	271.01	243.22
2003Q4	181.07	176.31	189.23	179.79	213.34	199.37	249.61	**234.67**	283.23	256.87
2004Q1	189.36	179.04	196.00	187.64	229.20	208.46	253.23	241.07	289.10	267.44
2004Q2	193.37	184.46	218.11	189.87	238.37	211.54	261.03	253.44	309.20	298.68
2004Q3	203.12	189.38	231.54	209.36	249.11	219.97	269.45	258.97	316.37	308.31
2004Q4	219.55	206.43	239.36	224.21	261.18	234.63	272.19	266.59	328.21	311.23
2005Q1	231.67	218.21	246.36	226.34	274.00	241.27	294.28	270.37	336.61	319.87
2005Q2	238.36	229.32	258.30	238.97	283.46	257.58	308.15	286.37	348.28	328.16
2005Q3	254.33	237.48	265.51	251.33	294.56	266.69	319.67	297.83	366.04	341.02
2005Q4	277.59	243.22	287.13	263.21	306.27	278.69	344.61	322.94	374.92	348.31
2006Q1	298.36	262.30	306.23	289.33	327.08	294.50	358.64	340.06	389.30	362.57
2006Q2	308.23	279.05	329.47	307.19	339.61	316.24	374.87	357.61	396.27	377.54
2006Q3	316.25	299.61	342.51	311.69	365.46	339.61	392.06	366.23	411.03	389.53
2006Q4	325.11	316.24	358.27	342.36	381.05	344.28	406.09	378.97	432.03	394.51
2007Q1	329.63	319.21	371.01	358.98	401.08	368.92	413.22	391.04	456.01	409.31
2007Q2	347.29	326.88	382.20	369.59	416.23	395.27	432.26	409.78	473.63	425.37
2007Q3	368.67	352.48	394.11	372.02	433.21	408.31	463.11	435.64	498.01	436.66
2007Q4	384.33	363.52	403.26	388.64	448.67	423.07	478.03	459.37	507.03	463.57
2008Q1	408.29	377.65	428.61	397.48	473.23	436.98	501.31	487.21	531.03	498.64
2008Q2	439.66	422.27	452.17	433.32	492.11	468.65	519.68	492.05	546.08	511.03
2008Q3	454.21	439.31	484.70	456.37	508.37	499.27	536.22	521.22	577.00	538.72
2008Q4	476.32	455.19	492.08	482.32	521.43	504.61	548.28	533.00	592.03	558.57
2009Q1	481.02	468.37	510.04	497.36	533.21	521.06	566.00	543.23	628.01	586.97
2009Q2	489.37	471.89	519.23	503.79	557.31	538.21	589.07	562.22	656.03	590.01
2009Q3	496.32	481.02	536.67	522.13	582.67	567.61	596.77	572.22	668.09	608.93
2009Q4	508.06	490.33	549.31	537.54	590.17	583.07	609.21	587.94	683.04	623.52

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Appendix D (Continued)

End of period	SM0	DM0	SM1A	DM1A	SM1	DM1	SM2	DM2	SM3	DM3
2010Q1	513.67	508.22	565.29	548.64	608.23	593.05	623.01	608.33	723.04	657.64
2010Q2	534.66	517.24	582.34	568.00	633.23	608.33	648.07	619.57	744.03	684.05
2010Q3	558.31	531.04	597.28	577.81	648.23	619.76	659.33	633.51	749.27	697.03
2010Q4	572.33	557.46	609.37	580.64	667.83	634.58	672.12	649.88	763.02	708.11
2011Q1	579.84	562.77	632.10	593.24	698.20	649.31	679.22	655.53	788.09	712.35
2011Q2	588.07	569.33	659.33	608.65	704.60	663.44	704.23	679.28	796.00	725.68
2011Q3	601.39	576.39	674.43	618.54	716.08	687.64	732.00	693.76	824.01	746.38
2011Q4	623.54	598.63	692.31	632.56	728.36	697.08	766.42	728.62	833.04	759.67
2012Q1	638.45	613.20	703.01	641.11	754.01	711.24	789.27	745.22	852.97	781.04
2012Q2	652.30	634.52	724.23	659.63	769.08	738.55	803.66	779.38	869.33	789.62
2012Q3	679.13	663.24	744.31	718.77	793.02	751.04	816.20	798.27	878.64	803.65
2012Q4	688.27	671.01	762.37	726.38	806.31	776.38	835.43	813.24	902.00	832.04
2013Q1	692.01	679.68	789.36	724.31	813.03	792.01	848.97	826.67	923.43	855.26
2013Q2	701.23	692.17	799.21	754.26	819.23	803.24	865.43	833.56	944.31	867.34
2013Q3	716.28	705.65	807.24	784.66	834.65	816.37	884.01	849.00	973.23	881.76
2013Q4	724.36	719.86	833.60	809.33	889.76	833.29	908.87	880.69	1009.55	898.98
2014Q1	739.64	721.00	859.27	826.54	906.28	848.96	922.01	894.53	1137.44	938.66
2014Q2	744.23	734.26	873.44	839.57	925.66	870.38	934.07	908.21	1165.03	949.01
2014Q3	783.26	758.46	889.37	861.78	938.23	889.67	973.03	918.64	1198.20	992.73
2014Q4	796.23	764.58	897.20	874.02	964.51	916.55	1123.03	968.11	1236.88	1014.64
2014Q1	804.23	782.04	905.36	897.68	986.21	924.33	1203.01	1105.03	1243.22	1034.14
2015Q2	812.22	791.22	924.12	916.35	1002.06	958.36	1239.33	1118.33	1287.49	1104.57
2015Q3	823.54	806.31	933.24	921.37	1016.03	977.68	1298.31	1134.98	1321.00	1167.06

Note: SM0, SM1A, SM1, SM2 and SM3 are the simple sum aggregates, while DM0, DM1A,DM1, DM2 and DM3 are the Divisia aggregates

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APPENDIX E

Estimation results of GARCH (1,1) model for Kenya

Parameters		MOU	OUU
Mean Equation	Φ(Constant)	104.049(0.469)***	6.924(7.103)***
Variance Equation	ϾϽ(Constant)	0.398(0.426)*	5.071(7.484)*
	α(ARCH effect)	1.666(0.716)**	0.348(0.138)***
	β(GARCH effect)	0.441(0.119)***	0.548(0.162)***

Note: Numbers in parenthesis are the standard errors. ***,** and * indicate 1%, 5%, and 10% significance level respectively.

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APPENDIX F

Estimation results of GARCH (1,1) model for Malawi

Parameters		MOU	OUU
Mean Equation	Φ(Constant)	0.0189(0.001)***	7.510(5.702)***
Variance Equation	ϾϽ(Constant)	1.496(1.305)**	8.223(2.507)*
	α(ARCH effect)	1.531(0.626)**	0.436(0.242)**
	β(GARCH effect)	0.202(0.098)**	0.327(0.279)**

Note: Numbers in parenthesis are the standard errors. ***,** and * indicate 1%, 5%, and 10% significance level respectively.

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APPENDIX G

Estimation results of GARCH (1,1) model for Nigeria

Parameters		**MOU**	**OUU**
Mean Equation	Φ(Constant)	295.246(0.297)***	30.125(0.016)***
Variance Equation	ϠϽ(Constant)	15.213(5.026)**	0.001(0.006)
	α(ARCH effect)	1.900(1.030)*	1.846(1.777)**
	β(GARCH effect)	0.440(0.049)***	0.778(0.052)***

Note: Numbers in parenthesis are the standard errors. ***,** and * indicate 1%, 5%, and 10% significance level respectively.

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APPENDIX H

Estimation results of GARCH (1,1) model for South Africa

Parameters		MOU	OUU
Mean Equation	Φ(Constant)	108.147(2.481)***	27.137(0.118)***
Variance Equation	ϠϽ(Constant)	50.164(57.617)	0.000(0.002)
	α(ARCH effect)	1.656(1.023)**	1.424(1.329)*
	β(GARCH effect)	0.714(0.111)***	0.452(0.142)***

Note: Numbers in parenthesis are the standard errors. ***,** and * indicate 1%, 5%, and 10% significance level respectively.

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