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Money Demand Stability and Its Implications for the Conduct and Implementation of Monetary Policy in Rwanda

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Abstract:
From international experience, instability of the relationship between monetary aggregates and goal variables (inflation and nominal income) and the weak relationship between money and nominal income implies that hitting a monetary target will not produce the desired outcome for a goal variable such as inflation, it make monetary targeting problematic, which is the main cause of wide spread changes from monetary targeting to inflation targeting regime, this attempts the researcher to carry out an empirical analysis on stability of money demand function and its implication on monetary policy in Rwanda by assessing the stability of the relationship between monetary aggregate M3and goal variable (inflation) through real money demand function and its determinants namely real gross domestic product (Y), T-bill rate (TB), exchange rate (ER), bank average deposit rate (DR) and bank average lending rate (LR) in Rwanda covering the period using quarterly data (2004q1-2014q4) using Johansen co-integration approach and error correction model (ECM),the results reveals the co-integration between variables and therefore the diagnostic tests were conducted and confirm the stability of money demand in Rwanda ,also empirical evidence reveals that in the long run real broad money demand is positively linked to GDP growth and bank deposit Rate, while real demand for money responds inversely to exchange Rate changes, T-bills rate changes and bank average lending rate.

Keywords: *Money demand stability, Monetary policy, Johansen co-integration analysis*

1. Background ofthe Study

Money plays an important role in our daily lives as it is needed for human survival. In the simple version, money is defined as anything that is generally and instantly accepted in payment of goods and services and in settling debts. Since money is accepted in exchange for all things, it measures the value of all things, by comparing their prices. The monetary tools used to control monetary policy are interest rates, money supply or demand and other conditions affecting the availability of credit (Pearce, 1992). Monetary theory classifies money according to three main categories, M1, which refers to currency in the hands of the public, is also known as narrow money, while M2, which includes currency plus demand deposits is known as the broad money. The third category known as M3 includes M2 plus long-term deposits and is known as high-powered money. Many researchers have suggested that the stability of money supply or money demand is a desirable ingredient for the implementation of effective and appropriate monetary policy in any economy. The conduct of monetary policy is important for, amongst others, the promotion of monetary and macroeconomic stability to ensure price stability. The money demand[1] function is one of the most closely studied relationships in economics. One reason is that the question of the stability of money demand has long been central to issues of monetary theory. A stable money demand is among the indispensable preconditions for the formulation and conduct of monetary policy (Sriram,1999).

In fact, what is being sought in a stable money demand function is a set of necessary conditions for money to exert a predictable influence on the economy so that the central bank's control of the money supply can be a useful instrument of economic policy (Judd and Scadding, 1982). Because of the importance of stability, a steady stream of theoretical and empirical research has been conducted worldwide over the past several decades.

Theory portrays that money demand depends positively on real GDP and the price level due to the demand for transactions. Money demand depends negatively on interest rates due to speculative concerns. This relationship can be depicted as follows: $M^D = f(P^{(+)}, Y^{(+)}, I^{(-)})$,

[1]The demand for money is the desired holding of financial assets in the form of money: that is, cash or bank deposits. It can refer to the demand for money narrowly defined as M1 (non-interest-bearing holdings), or for money in the broader sense of M2 or M3

Where $M^D$is the aggregate, economy-wide money demand, *P* is the current price level, *Y* is the scale variable (real GDP, wealth, or expenditure in real terms) and *i*is the average interest rate. The positive sign indicates a positive relationship while the negative sign indicates negative relationship between the dependent variable and the explanatory variable.Many commentators have argued that inflation is a monetary phenomenon in the long run and the empirical relation between money and prices is usually discussed in the money demand framework. Monetary policy is arguably effective as a means of controlling inflation. If the money demand function is stable over the long run, money supply changes are closely related to prices and income, and it is possible for policy authorities to control inflation through appropriate adjustments to the money supply, If, on the other hand, the money demand function is unstable over the long run, changes in money supply are not closely related to prices and income and it becomes difficult for policy makers to appropriately control inflation through adjusting the money supply.

2.Problem Statment

The effectiveness and success of a monetaryprogram crucially depends on a stable money demand function. The stable money demand function ensures that the money supply would have predictable impacts on other economic variables such as inflation, interest rates, national income, and private investments.

As part of these developments, in 1998, the Rwandan monetary authority was advised by its economic partners - the IMF and World Bank - to consider a medium term inflation target of three *per cent* a year, the National Bank of Rwanda utilizes the M3 monetary aggregate as an intermediate objective, with the monetary base as its operational instrument. In contrast to a policy of inflation targeting, a monetary policy of monetary aggregate targeting requires first that there is a stable money demand function and, second, that changes in money determine price changes.

3. Conceptual and Theoretical Review

3.1. QUANTITY THEORY"Equation of Exchange"

Through the equation of exchange, Irving Fisher (1911) presented the notion of the classical quantity theory of money. Fisher's identity is given as: $MV = PY$ (*) , Where *M* indicates the average stock of money over a period, *V*its velocity, *P*the price level and *Y*the real income or output of that period.

Fisher (1911) believed that velocity is determined by the institution in economy that affects the way individuals conduct their transactions. Fundamentally, he assumed velocity to be reasonably constant in the short-run and that institutional and technological features of the economy would affect velocity slowly over time. His view of short-run constant velocity transforms the equation of exchange into the quantity theory of money demand.

In the perspective of classical economists, the quantity theory of money provided an explanation of movements in the price level, the evidence that the quantity theory of money is indeed a theory of money demand can be seen by dividing both sides of the equation by *V* to give. $M = 1/v\ PY$ (**)

In this equation, the money market is deemed to be in equilibrium, with quantity of Money *M* that people hold equal to the quantity of money demand M^D. Hence, *M* in the above equationcan be replaced by M^Dusing *k* to represent the quantity $1/v$ *so* that the above equation canbe rewritten as follows:$M^D = k\ PY$ (***)

Since *k*is a constant, the level of transactions generated by a fixed level of nominal income *PY* determines the quantity of money M^Dthat people demand. In this regard, Fishers quantity theory of money suggests a money demand function determined by income only, with interest rates having no effect. Fisher assumed that people hold money only to conduct transactions and have no freedom of action in terms of the amount they want to hold.

However, several criticisms have been level led against this school of thought. Bain andHowells (2003) argues that the exclusion of financial transaction from consideration undermines much of the logic of the original quantity theory and brought the theory into line with the Cambridge approach and later portfolio models of money demand.

3.2. The Cambridge Approach to Money Demand

Alfred Marshall and A.C. Pigou (1917) developed a similar model to the Fisher's identity, known as the Cambridge cash balance approach.This approach changed the focus of interest from a model where velocity is determined by the payments mechanism to one where agents have a desired demand for money (Cuthbert son, 1991:4).

Cambridge economists postulated that the levels of people wealth had a direct effect on money demand as given in the following identity.$M^D/P = KW$(****)

Where $M^D$is the demand for money, *P* is the price level, M^D/Prepresents real money holdings demanded, *k* is the fraction of income that is held in cash, hence a coefficient of proportionality representing varying relationships between money demand and levels of wealth as given by income and *W* is representing real resources and indeed a long-run concept. The Fishers identity could essentially be the same as that of the Cambridge economists as long as the assumptions of exogeneity of money supply and constant velocity were holding. However, it is quite imperative to note that factors influencing velocity in the Fishers version of money demand are a subset of those influencing ***k***in the Cambridge version. Portfolio sovereignty was an influencing factor in the Cambridge *k*, thus causing it to fluctuate in the short-run because the decisions about using money as a store of wealth largely depended on the yields and expected returns on other assets that also function as stores of wealth, probably bonds etc. In the long-run equilibrium, savings, rather than being held as money, are invested leading to an increase in the economy's resources.

The individuals demand for money, then depends on

- The convenience and feeling of security obtained from holding money.
- The expectations and total resources of the individual; and

- The opportunity costs of holding money (Bain and Howells, 2003:102)

3.3. KEYNES MONEY DEMAND THEORY "The Liquidity Preference Theory"

The very late and very great John Maynard Keynes (to distinguish him from his father, economist John Neville Keynes) developed the liquidity preference theory in response to the rather primitive pre-Friedman quantity theory of money, which was simply an assumption-laden identity called the equation of exchange:$MV=PY$equation of exchange
Where:
M = money supply
V = velocity
P = price level
Y = output
Nobody doubted the equation itself, which, as an identity (like x = x), is undeniable, but many doubted the way that classical quantity theorists used the equation of exchange as the causal statement: increases in the money supply lead to proportional increases in the price level.

The classical quantity theory also suffered by assuming that money velocity, the number of times per year a unit of currency was spent was constant.To find a better theory, Keynes took a different point of departure, asking in effect, "Why do economic agents hold money?"

He negated the classical view that velocity was constant and emphasized the importance of interest rates; in general he envisaged that there are three motives behind the demand for money:

- Transactions: Economic agents need money to make payments. As their incomes rise, so, too, do the number and value of those payments, so this part of money demand is proportional to income.
- Precautions: It happens was a catch phrase of the 1980s, recalled perhaps most famously in the hit movie Forrest Gump. Way back in the 1930s, Keynes already knew that bad stuff happens—and that one defense against it was to keep some spare cash lying around as a precaution. It, too, is directly proportional to income, Keynes believed.
- Speculations: People will hold more bonds than money when interest rates are high for two reasons. The opportunity cost of holding money (which Keynes assumed has zero return) is higher and the expectation is that interest rates will fall, raising the price of bonds.When interest rates are low, the opportunity cost of holding money is low, and the expectation is those rates will rise, decreasing the price of bonds. So people hold larger money balances when rates are low. Overall, then, money demand and interest rates[2] are inversely related.

More formally, Keynes's ideas can be stated as**:**

$$\frac{M^{d}}{P} = f\left((\mathrm{i} < ->,\ \mathrm{Y} < + >\right)$$

Where:
M^d/P = demand for real money balances
f means "function of" (this simplifies the mathematics)
i = interest rate
Y = output (income)
<+> = varies directly with
<–> = varies indirectly with

An increase in interest rates induces people to decrease real money balances for a given income level, implying that velocity must be higher.

4. Economic Theory on Money Demand Stability

In the classical theory money was held for transaction purposes or as a medium of exchange. Money supply is defined as the sum of notes and coins, and the demand deposits. The quantity theory of money is based on the assumptions that money supply is exogenous and the income velocity of money is stable. If the velocity is stable, then the demand for money is stable.

Hence, there is a tight link between the amount of money and the level of nominal income. In addition, this theory postulates that the economy moves to a long run full-employment equilibrium thus in the long run, the price level depends upon the quantity of money in the economy.
In Freidman's monetarist school of thought, money is demanded by two groups.

- Ultimate wealth holders (for whom money is simply one way in which they may hold wealth), and
- Business enterprises (for whom money is a productive resource).

The modern quantity theory states that a change in money supply will change the price level as long as the demand for money is stable; such a change also affects the real value of national and economic activity but in the short-run only. According to Friedman, the stability in the demand for money is just a behavioral fact, proven by empirical evidence (Ghatak, 1995:22).

As long as the demand for money is stable it is possible to predict the effects of changes of money supply on total expenditure and income. The monetarists are also of the idea that if the economy operates at less than full employment level, then an increase in money supply will lead to a rise in output and employment because of a rise in expenditure, but

[2]An interest rate is the rate at which interest is paid by borrowers (debtors) for the use of money that they borrow from lenders (creditors). Specifically, the interest rate is a percentage of principal paid a certain number of times per period for all periods during the total term of the loan or credit.

only in the short-run. After a time, the economy will return to a less than full employment situation which must be caused by other real factors.

Monetarist approach to the quantity theory also assumes that the money supply is exogenous and income velocity of money is stable. However, this approach differs from the conventional quantity theory in explaining the link between the money supply and the level of income. Monetarists postulate a direct transmission mechanism from monetary to real sector through the real balance effect.

Friedman's quantity theory postulates that in the long run the income elasticity of money demand is unity and velocity of money is constant; whereas Tobin's transactions demand theory postulates that the income elasticity is 0.5 and velocity is not constant.

The theories on the value of long run income elasticity of money demand are totally different as a result of their postulates about the money demand. The main argument against conventional quantity theory is that the transaction demand for money does not only have a response to the transaction needs, but also has a response to the physiological factors (such as expectations), institutional factors (such as credit facilities), and to any stochastic shock in the economy (Aysu,Insel 1997).

Keynes (1936) developed the liquidity preference theory which explicitly highlights the transaction, precautionary and speculative motives for holding money. In the Keynesian approach there is a link between the quantity of money and the level of income in an economy, but this approach does not postulate that economy moves to a long run full-employment equilibrium. It is assumed that the interest rate has an important effect on the money demand and the income velocity of money is not stable. Keynesians claim that there is an indirect transmission mechanism that works through the interest rate effect on investment, and through the multiplier effect on the real sector of the economy.

The changes in the postulates such that instable velocity, financial innovations, expectations, and preferences lead to the rejection of the quantity theory and result in the theory of endogenous money supply.That is, if there is an increase in demand for money, the central bank cannot control the money supply, but can control the interest rate. Thus the purpose of monetary policy is to target the rate of interest not the money supply.The quantity of money is determined by the demand for it. Therefore, the rate of interest has no effect on the amount of money individuals wish to hold, rather has an indirect effect on demand due to changes in the level of income (AysuInsel 1997).

Friedman (1956) opposed the Keynesian view that money does not matter and presented the quantity theory as a theory of money demand. He modelled money as abstract purchasing power (meaning that people hold it with the intention of using it for upcoming purchases of goods and services) integrated in an asset and transactions theory of money demand set within the context of neoclassical consumer and producer behaviour microeconomic theory.

Friedman argued that the velocity of money is highly predictable and that the demand for money function is highly stable and insensitive to interest rates. This implies that the quantity of money demanded can be predicted accurately by the money demand function (Webber and Fargher 2010).

5. Determinants of Money Demand

- The demand for money is the relationship between the quantity of money people want to hold and the factors that determine that quantity.
- The demand for money results from people's desire to hold money. When the money is held not spent or invested then it does not contribute to the velocity of money. Money velocity increases only when the people spend or invest it. Therefore, any factors that cause people to hold money will decrease the velocity of money, while factors that increase spending or investment will increase the velocity of money. Therefore, the demand for money is inversely related to the velocity of money. So to understand how the velocity of money changes, one must understand what causes changes in the demand for money.To understand the factors that determine people's demand for money, it helps to know the four main motives for holding money at any given time.
- Firstly, people often hold money in the form of cash or checking accounts in order to buy goods and services. Economists call this the transactions demand for money. The transactions demand for money is the demand for money to be used as a medium of exchange, or as a means of payment.
- The portfolio demand for money results from people's desire to invest money, to serve as a store of value, The primary factors affecting the transactions demand for money are the:Inflation rate,Nominal income,Nominal interest rates, andTechnology.
- Inflation: Inflation increases demand for money because higher prices requires more money for a given amount of goods and services, higher inflation also increases the holding costs of money.
- Nominal income: Because money is used as a means of payment, a higher nominal income will tend to increase the amount of money that people desire to hold, since wealthier people buy more expensive products and services and have a higher level of expenditures.
- Nominal interest rate: Higher interest rates reduce the demand for money by increasing the opportunity cost of holding money, which is the interest that could be earned if the money was invested.
- Technology: Technology that provides liquidity, such as credit cards or demand deposits that earn interest, such as interest-paying checking accounts, reduces the demand for money, since these payment substitutes provide a means of payment without the need to hold the money itself, technology can also reduce the demand for money by reducing the cost or time to convert assets into a means of payment.
- Secondly, people sometimes hold money as a safety net for unexpected expenses. Economists call that the precautionary demand for money.

Thirdly, people may hold some of their wealth in the form of investments, such as bonds, that pay them interest. Economists call this the speculative demand for money.Since cash and most checking accounts don't pay much interest, but bonds do, money demand varies negatively with interest rates. That means the demand for money goes down when interest rates rise, and it goes up when interest rates fall.

Finally, people may hold some of their wealth in the form of money to balance out their portfolio of investments and hedge the risk of losing money in the bonds or the other investments. This is referred to as the portfolio demand for holding money.

Instability of the demand for money can be explained by the instability of the velocity of circulation. More frequently, the instability of the demand for money is illustrated in terms of the factors included in the demand for money function.

Anderson (1985) identified three sources of instability of the demand for money;

- Change in the velocity of circulation in response to fluctuations in interest rates as well as to movements in other arguments of the money demand function other than real income,
- The demand for money function itself may shift. For instance, financial innovations and deregulation of interest rates may shift the demand for money at the prevailing levels of nominal interest rates, and
- Over shorter periods the money stocks actually held may not correspond to the money balances desired. If the speed of adjustment is low then such discrepancies will induce large and unexpected changes in the velocity of circulation.

5.1. TheVelocity of Money

The velocity of money is how fast money changes hands in the economy during the year. It's defined as nominal GDP divided by the money supply.

It can be thought of as the rate of turnover in the money supply: that is, the number of times that one currency unit is used to purchase final goods and services included in the GDP.

In economy, the CB is in charge of managing the money supply, which they call monetary policy. They use monetary policy in an effort to encourage steady economic growth, stable prices and low unemployment. Estimating the velocity of money is an important part of this process and guides them in their policy decisions.

Here are some of the things that determine velocity:

- The number of financial institutions in an area
- The population density of an area
- The speed of transportation

5.2. Factors Explaining Changes In Velocity Of Money

5.2.1. Money Supply

Velocity of money depends upon the supply of money in the economy. If the supply of money in the economy is less than its requirements, then the velocity of money will increase and if the money supply is less than its requirement, the velocity of money will fall.

5.2.2. Value of Money

The velocity of money is high during inflation when value of money decreases because people will like to part with money as soon as possible. Similarly, during deflation, when the value of money rises, the velocity of money is low because people like to keep money with them.

5.2.3. Credit Facilities

The velocity of money increases with the expansion of lending and borrowing facilities in the country. Therefore the growth of credit institutions has a favourable effect on the velocity of money.

5.2.4. Volume of Trade

The velocity of money increases as the volume of trade increases the number of transactions and as the volume of trade decreases, the velocity of money decreases.

5.2.5. Frequency of Transactions

With the increase in the frequency of transactions, the number of payments and receipts increases and, as a result, velocity of money increases. Similarly, with the decrease in the frequency of transactions, the velocity of money decreases.

5.2.6. Business Conditions

The velocity of money increases during the period of hectic business conditions and decreases during slump conditions.

5.2.7. Business Integration

If business is vertically integrated, the velocity of money will be less and if business is vertically disintegrated, the velocity of money will increase.

5.2.8. Payment System

The velocity of money is also determined by the frequency with which the labour force is paid (i.e., weekly or monthly) and the speed with which the bills for goods are settled.

5.2.9. Regularity of Income

If people receive income at regular intervals, they will spend their income more freely and the velocity of money will increase. But, if people receive their income at irregular intervals, they will prefer to hold more cash balances to meet the uncertain conditions in future and the velocity of money will fall.

5.2.10. Propensity to Consume

Greater the tendency of the people to consume, other things remaining the same, higher will be the velocity of money. On the contrary, lower the propensity to consume, lesser will t3 the velocity of money. Saving, or not consuming, has an adverse effect on the velocity of money.

6. Monetary Policy in Rwanda

6.1. Monetary Policy Framework

The goal of monetary policy is set out in the National Bank of Rwanda (BNR) Law which requires the BNR to conduct monetary policy in a way to deliver price stability and in low inflation environment. Law no 55/2007 of 30/11/2007 governing the Central Bank of Rwanda assigns to the BNR the responsibility of formulating and implementing monetary policy.

According to article 5 of the same law, the main missions of BNR shall be:

- To ensure and maintain price stability;
- To enhance and maintain a stable and competitive financial system without any exclusion;
- To support Government's general economic policies, without prejudice to the two missions referred to in Paragraphs 1° and 2° above.

These objectives allow the National Bank of Rwanda to focus on price stability while taking into account of the implications of monetary policy for the whole economic activity and, therefore, price stability is a crucial precondition for sustained economic growth.

The National Bank of Rwanda agrees on the importance of low inflation and low inflation expectations. These assist businesses in making sound investment decisions, underpin the creation of jobs, protect the savings of Rwandans and preserve the value of the national currency.(BNR web on 23 march 2015)

To achieve the price stability objective, the BNR currently operates in a flexible monetary targeting framework with the monetary base as operating target, broad money aggregate as an intermediate target and inflation as the ultimate goal. The BNR monitors movements in monetary base on daily basis in line with the targets as set in the annual monetary program. In that exercise, the BNR uses several policy instruments mainly open market operations, discount rate and reserve requirement, the key repo rate (policy rate) set by the monetary policy committee is used to signal the stance of monetary policy.(BNR web on 23 march 2015)

7. Stimation and Interpretation of Research Findings

7.1. Modeling Money Demand Function in Rwanda

Modelling the real money demand function in Rwanda requires careful consideration not only for the choice of the relevant variables but also for the formulation of the model. Hence, the real money demand is defined to be an increasing function of growth domestic products and a decreasing function of opportunity costs, i.e. nominal interest rates and inflation.

The nominal interest rates (T-bills rate, lending rate, deposits rate and exchange rate) and consumer price index are considered to be the opportunity cost for money. A high consumer price index reduces the real cash balances and the relative attractiveness of financial assets. Thus, economic agents move towards the speculative motive and move away from cash that buys real assets or moving to dollarization in order to find good hedge against inflation. This is the main reason why exchange rate is included in the model.

FollowingShigeyuki Hamori, Naoko Hamori(2008), the model includes money supply**,** price index**,** output andcost of opportunity cost of holding alternative assets**,** which can be written as:

$$\frac{M_t}{P_t} = L(Y_t, R_t) \qquad L_Y > 0 \qquad L_R < 0 \qquad (1)$$

Where

M_t represents nominal money supply for period t;

P_t represents the price index for period t; (the consumer price index (CPI)

$Y_t$represents gross domestic product for period t; and

R_t represents theopportunity cost ofholding moneyincluding T-bill rate, exchange rate, bank average lending and deposit rate for period t.

Increases in growth domestic product bring increases in money demand **(** $L_Y > 0$ **)** and increases on opportunity cost of holding money bring decreases in money demand **(** $L_R < 0$ **).**

Getting the log of Equation (1) we get the following function:

$$\ln(M_t) - \ln(P_t) = \beta_0 + \beta_1 \ln(Y_t) + \beta_2 \ln(R_t) + u_t \qquad \beta_1 > 0 \qquad \beta_2 < 0 \qquad (2)$$

$$\ln(M_t) - \ln(P_t) = \beta_0 + \beta_1 \ln(Y_t) + \beta_2 \ln(TBR_t) + \beta_3 \ln(DR_t) + \beta_4 \ln(LR_t) + \beta_5 \ln(EXR_t) + u_t$$

With,

$\ln M_t$: Logarithm of nominal money supply in period t,

$\ln(P_t)$: Logarithm of consumer price index in period t,

$\ln(DR_t)$: Logarithm of real deposit rate in period t,

lnYt: Logarithm of RGDP in period t,
lnEXRt: Logarithm of exchange rate in period t,
lnTBRt: logarithm of T-bill rate in period t
lnLRt: logarithm of lendingrate in period t

β_0 : Intercept

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ are coefficients and μt represent an error term which is assumed to be a white noise error. The problem confronting the estimation of the function for money demand is that money supply M3, growth domestic product, price index, and interest rates can all be characterized as non-stationary I(1) variables.

7.2. Stationarity Test

VARIABLES		**ADF TEST STATISTICS (max-lag 9)**				**CONCLUSION**
		With intercept		With trend and intercept		
		T-statistics	Lag	T-statistics	lag	
LMd	Level	-0.1161	0	-0.1245	0	stationary at firt difference
	1st diff	-7.7253	0	-7.7517	0	
LY	Level	-0.1587	0	-0.1125	0	stationary at firt difference
	1st diff	-7.0025	0	-6.9289	0	
LDR	Level	-0.2458	0	-0.2267	0	stationary at firt difference
	1st diff	-6.3563	0	-6.4226	0	
LLR	Level	-0.3215	0	-0.1256	0	stationary at firt difference
	1st diff	-5.3231	0	-5.4917	0	
LEXC	Level	-0.2672	0	-0.2458	0	stationary at firt difference
	1st diff	-6.8458	0	-6.8241	0	
LTBR	Level	-0.1267	0	-0.1167	0	stationary at firt difference
	1st diff	-6.8891	0	-7.1197	0	

Table 1: Results of the Unit Root Tests: at First Difference
Source: Elaborated by the Research from E-Views 7, June 2015

Table 1 shows the results of both the augmented Dickey-Fuller (ADF) test for the level and the difference series on constant only and constant and trend. The results indicate that the null hypothesis of non-stationarity (of unit root) at level cannot be rejected for all variables at 5 percent level of significant, which casts doubts on the validity of the (OLS) results. To determine the degree of integration, all variables were tested in their first difference. The ADF reject the null hypothesis of a unit root at 5 percent level of significant.

The results are shown in table 1. It appears that all variables are integrated of order one. To test for the existence of long relationship among the proposed variable, the Johnson multivariate unit root test is used.

7.3. Integration and Co-Integration Test

VAR Lag Order Selection Criteria						
Endogenous Variables: LMD LTBR LY LLR LEXR LDR						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	17.08270*	NA	2.41e-08	-0.515474	-0.269726	-0.42485
1	235.8397	366.2908*	4.98e-12*	-9.015801*	-7.295559*	-8.381429*
* indicates lag order selected by the criterion						

Table 2: VAR Lag Order Selection Criteria
Source: E-views 7, June 2015

Lag Length Selected is 2 as it is indicated by LR,FPE, AIC, SC and HQ information and is better for the model.

7.3.1. Johansen Co-Integration Analysis for Money Demand Stability in Rwanda

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized	**Trace**		**0.05**	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.653056	108.8961	95.75366	0.0046
At most 1	0.490809	64.43532	69.81889	0.1247
At most 2	0.335486	36.08814	47.85613	0.3919
At most 3	0.203255	18.92275	29.79707	0.4985
At most 4	0.183781	9.379482	15.49471	0.3314
At most 5	0.020045	0.850427	3.841466	0.3564

Table 3: Johansen Cointegration
Trace Test Indicates 1 Cointegrating Eqn(S) at the 0.05 Level
** Denotes Rejection of the Hypothesis at the 0.05 Level*
***Mackinnon-Haug-Michelis (1999) P-Values*
Source: E-Views 7, June 2015

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		**Max-Eigen**	**0.05**	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.653056	44.46082	40.07757	0.0151
At most 1	0.490809	28.34719	33.87687	0.1979
At most 2	0.335486	17.16539	27.58434	0.5658
At most 3	0.203255	9.543269	21.13162	0.7863
At most 4	0.183781	8.529055	14.26460	0.3274
At most 5	0.020045	0.850427	3.841466	0.3564

Table 4: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)
Max-Eigenvalue Test Indicates 1 CointegratingEqn(S) at the 0.05 Level
** Denotes Rejection of the Hypothesis at the 0.05 Level*
***Mackinnon-Haug-Michelis (1999) P-Values*
Source: E-Views 7, June 2015

Table 5 below shows the results for the cointegrating test. From the result, the Maximum Eigen value statistics show that there is one cointegrating vector at 5 percent level of significance. The null hypothesis of zero cointegrating vectors is rejected against the alternative of one cointegrating vector. Therefore, it is concluded that there is only one cointegrating vector specified in the model.

1 Cointegrating Equation(s):		**Log likelihood**	**238.5343**			
Normalized cointegrating coefficients (standard error in parentheses)						
LMD	LTBILL	LY	LLR	LEXR	LDR	
1.000000	0.330668	-1.129946	3.750232	0.454618	-0.328886	
	(0.16773)	(0.08017)	(0.95573)	(0.07795)	(0.48133)	

Table 5:Long Run Equation
Source: E-Views 7, June 2015

$M^d = 1.12\ Y - 3.75\ LR - 0.33\ TBR - 0.45\ EXR + 0.32\ DR$

With the evidence from the cointegration test, it can be interpreted that Rwanda's money demand function is influenced by Gross Domestic Product, lending rate, interest rate on other financial assets, exchange rate and deposit rate together.

The cointegrating vectors were, therefore, normalized by the dependent variable. From the longrun equation it can be concluded that money demand function in Rwanda largely depends on all the variables in the model.The money demand function is positively affected by GDP and deposit rate(DR), The coefficient of -1.12shows that one unit increase in GDP leads to1.12% increase in money demand and an increase of one percent inDR increase money demand by 0.32% in long-run, ceteris paribus.

On the other hand, the money demand function is negatively affected by LR, TBR and EXR,an decrease of one percent in those variables affect negatively money demand by 3.75%,0.33% and 0.45 %.

7.4. Integration Based Pairwise Granger Causality Tests

Granger (1996) causality test has been performed in order to examine the linear causation between the concerned variables. Granger causality is useful in determining the direction of the relationships. By checking Granger pairwise causality we conclude by saying that between all variables undertaken there is no pairwise Granger Causality because between all variables theP-Value is over than 5%.

7.5. Error Correction Model of Money Demand Function in Rwanda

The existence of at least one co-integrating vector among the variables implies that an ECM can be estimated. The ECM approach used here is useful for the formulation of a short term price adjustment model, which models changes in Rwanda prices in terms of changes in the other variables in the model, and the adjustment towards the long run equilibrium in each time period.

This draws upon the error correction formulation, which is the counterpart of every long run co-integrating relationship. After the determination of the co-integrating relationship, the next step is to estimate the short-run demand for broad money using Vector error correction model(VECM). The short-run model coefficients measure the dynamics of the model, the VECM measures the speed of adjustment to the long run equilibrium which is taking place.

Regressors	Coefficient	T.Statistics	Probability
Intercept	0.142827	3.99775	0.0357
DLLEXR(-1)	-0.221902	-1.007221	0.3231
DLTBR(-1)	-0.04929	-0.15192	0.8804
DL LDR(-1)	-0.479032	-1.071074	0.2946
DL LLR(-1)	1.682342	1.810245	0.0818
DLLY (-1)	-0.221902	-1.007221	0.3231
$VECM_{(-1)}$	-0.918199	-3.036457	0.0054

Table 6:Short Run Relationship

R-Squared: 0.689100Prob(F-Statistic): 0.0003Source: Elaborated by the Researcher from E-Views 7, June 2015

The negative coefficient of the error correction term (-0.918) is significant, assuring that the cointegration relationship between the included variables is valid.The error correction model demonstrates that this previous disequilibrium is progressively corrected in order to re-establish the long- run equilibrium situation among cointegrating variables.

VECM *t-1* presents the convergence of the model towards equilibrium by its negative sign and the value 0.918shows money demand function adjusts to restore 91.8% ofdisequilibrium from the previous year to the current year.

Only interest rate on other financial assets isinsignificant in short run. The coefficient -0.049 shows that one percent decrease in interest rate on other financial assets on leads to a decrease of 0.49 % in money demand function in short-run period of time.TheR-square value is high and F statistic is significant because is 68% all independent variable jointly influence dependent variable.

7.6. Diagnostic Tests

Having presented the result from the empirical analysis, it is also necessary to examine the statistical properties of the estimated model. The model was tested for normality, serial correlation, and autoregressive conditional heteroscedasticity. Suggest that the model is well specified.

The diagnostics indicate that the residuals are normally distributed, homoscedasticity, and serial uncorrelation. After testing the VEC equation, the supplementary tests are necessary to verify if the hypothesis of classical regression are confirmed.

The test that we have used here are the following:

- Normality test (jarque-Bera)
- Test for serial correction (Breusch-Godfrey and Jung-Box)
- Test for heteroscedasticity (ARCH LM& white)
- Test for misspecification of the model (Ramsey Reset)
- Test for parameters stability(CUSUM&CUSUMQ)

The three first tests are conducted on the residuals and others are for the model.

4.8.1.Normality Test

This test helps to determine whether the residuals are normally distributed or not, the following are the hypothesis of the test for normality.

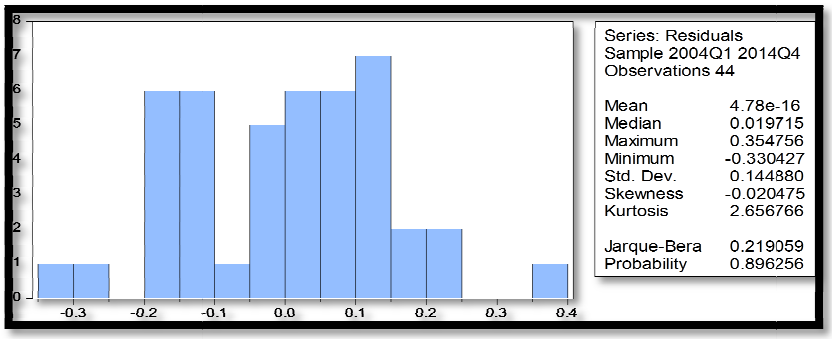

Figure 1: Jarque-Bera Test (Normality Test)
Source: E-Views 7, June 2015

The assumptions of this test are as follows:

- Ho (Null Hypothesis): The residuals are normally distributed
- H1: The residuals are not normally distributes.

The null hypothesis is rejected when the probability is less than 10%
The null hypothesis is rejected when the probability is less than 10% to our variable isnot rejected.

7.8. Heteroscedasticity test

This test indicates whether there is homoscedasticity or not,the tests used are white and ARCH LM.

Heteroskedasticity Test: ARCH			
F-statistic	0.658563	Prob. F(1,41)	0.4218
Obs*R-squared	0.679769	Prob. Chi-Square(1)	0.4097
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.674140	Prob. F(5,38)	0.1644
Obs*R-squared	0.942748	Prob. Chi-Square(5)	0.1594
Scaled explained SS	4.907538	Prob. Chi-Square(5)	0.4273

Table 7: ARCH Heteroscedasticity Test
Source: E-views 7, June 2015

White & ARCH heteroscedasticity prove that there is no heteroscedasticity as the probability of obs*R-squared (67% and 94%) is greater than 10% level of significance. This means that our model is homoscedastic.

7.9. Serial Correlation

This test helps to determine whether the residuals of the period t depend on the residuals of period t-1.

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	3.185216	Prob. F(2,36)	0.0532
Obs*R-squared	0.615439	Prob. Chi-Square(2)	0.3667

Table 8: SerialCorrelation
Prob(F-Statistic) 0.509808
Source: E-Views 7, June 2015

- Ho: No serial correlation (errors are not correlated).
- H1: There is serial correlation.

The null hypothesis is rejected when the probability is less than 10%. The results show that there is no serial correlation, as we fail to reject the null hypothesis because we have the probability of 50%.

7.10. Misspecification of the Model

This test helps to test whether the model is correctly specified or not using the RAMSEY RESET test.As the probability of likelihood ratio is equal to 44.15% greater than 5% level of significance, it means that the model does not contain any specification error.

Ramsey RESET Test				
	Value	Df	Probability	
t-statistic	0.708131	37	0.4833	
F-statistic	0.501450	(1, 37)	0.4833	
Likelihood ratio	0.592314	1	0.4415	

Table 9: Ramsey Reset Test
Source: E-Views 7, June 2015

7.11. Parameter Constancy and Stability Test

The study implemented the methodology based on the cumulative sum (CUSUM) tests and cumulative sum of Squares (CUSUMQ) test proposed by Brown et al. (1975). The advantageof such a test over some other tests (Like Chow test) is that the former test requires the specification of the break points, while the latter test uses the cumulative sum of recursive residuals based on the first n observations and is updated recursively and plotted against break point (Ouattara, 2004). On the other hand,CUSUMQ test uses the squared recursive residuals in the same manner CUSUMQ test. The decision about the parameter stability relies on the position of the plot relative to the 5% critical bound.
The CUSUMQ test on the other Hand is based on the cumulative sum of squares of recursive residuals. Both The CUSUM and CUSUMQ test statistics are updated recursively and plotted against break points in the data.

For stability of the short-run dynamics and the long-run parameters of the real money demand function, it is important that the CUSUM and CUSUMQ statistics stay within the 5% critical bound (represented by two straight lines whose equations are detailed in Brown et al., 1975 aforementioned).

After estimating equation by OLS, the next step is to apply the CUSUM and CUSUMSQ tests to the residuals of the equation. Fig.4.8.5. below shows the stability results for money demand function. From Figure 2., it is clear that both CUSUM and CUSUMSQ plots stay within the 5 percent critical bound, which provide evidence that the parameters are stable over the study period that is there is no structural change.

We can safely conclude that the estimated parameters for the short-dynamics and long-run of Money demand function in Rwanda are stable. In other words, stable money demand function exists over the entire sample period.
A graphical presentation of the tests is provided in:

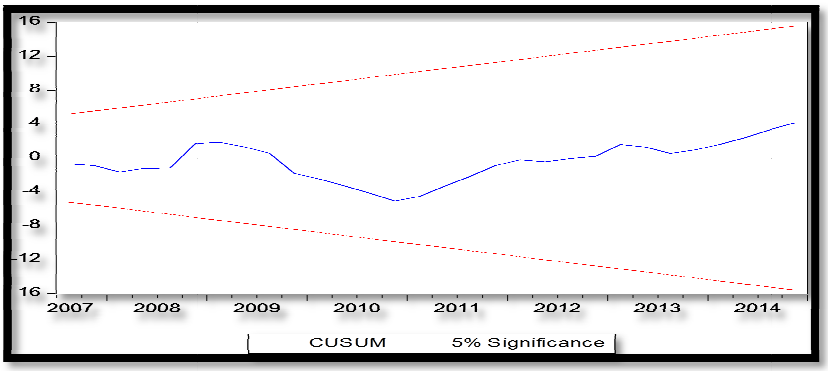

Figure 2: The CUSUM Test
Source: E-Views 7, June 2015

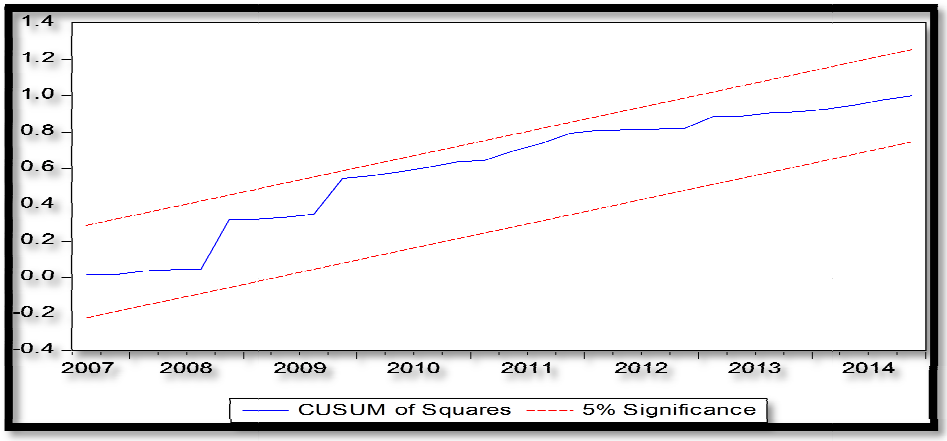

Figure 3: The CUSUMQ Test
Source: E-views 7, June 2015

8. Conclusion

The question of whether the demand function for money is stable is one of the most important recurring issues in the theory and application of macroeconomic policy (Judd and Scadding, 1982). A stable money demand function is at the core of the conduct of monetary policy as it enables a policy-driven change in monetary aggregates to have a predictable influence on output, interest rates, and ultimately prices (Sriram, 1999).

Recall that an econometric relationship is stable if the parameters in such a relation are not subject to permanent changes over time (Laumas and Mehra, 1976).Based on the presented results, the hypothesis that the estimated coefficients in the model are stable and well-defined could be confirmed. The empirical findings of this study show that the demand for M3 in the analyzed period in Rwanda is stable, indicating that on the basis of selected determinants, its long term prediction can be carried out and that all changes in money supply affect price level.

This study complements the existent economic literature by analyzing the stability of money demand and its implication on the conduct and implementation of monetary policy in Rwanda.

Due to the use of many observations (44 observations) quarterly data from 2004q1 to 2014 q4 covered by our collecteddata also permit the researcher to confirm that significance and structural adjustment in money demand determinants in Rwanda which also confirm the validity of data used and the findings. The results from the study show that, exchange rate, T-bills rate, bankaverage lending rate, bank deposit rate and the gross domestic product are significantly influence the dynamics of velocity of money demand stability in Rwanda.From the results of Error correction model (ECM), Lending rate and Gross domestic product variables are found to be of particular importance because of influence on money demand stability in Rwanda. The lagged of changes of bank average lending rate, Exchange rate and T-bills rate have the negative impact on money demand then average deposit rate and Growth domestic product have a positive impact on money demand hence influence the effectiveness of monetary policy.

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Appendix

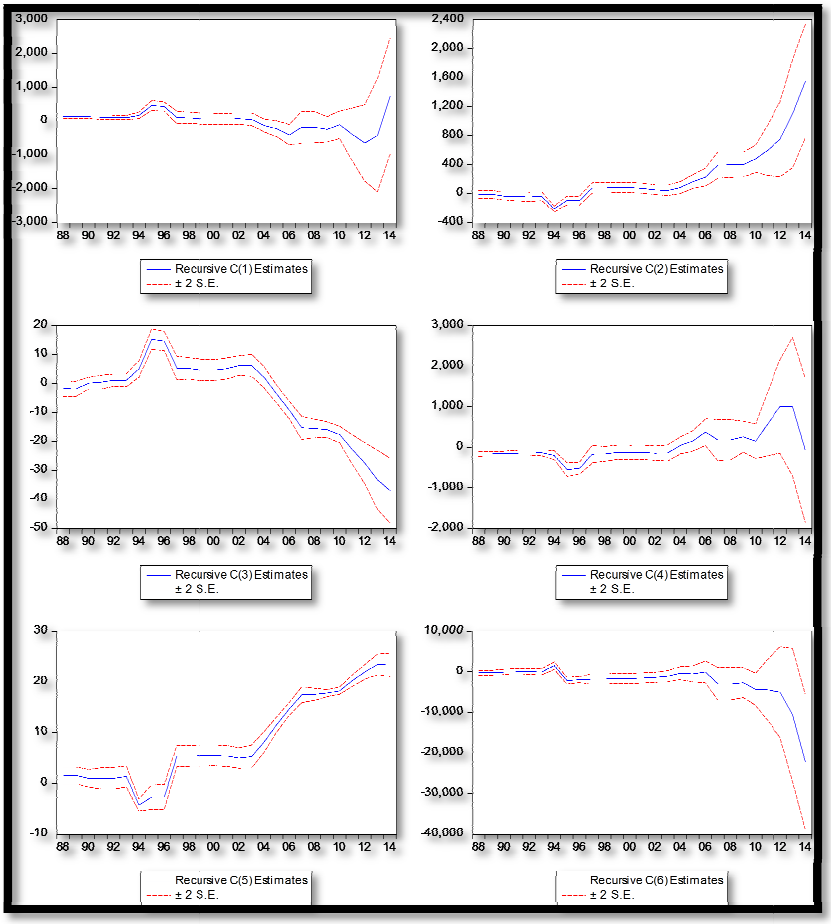

Figure 4: Stability Diagnostics –Recursive Coefficient Test Graphs