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FINANCIAL SECTOR REFORMS, MONETARY AND OUTPUT UNCERTAINTIES AND THE BEHAVIOR OF MONEY DEMAND IN KENYA: THE DIVISIA INDEX APPROACH

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ABSTRACT

The financial sector reforms implemented by the Central Bank of Kenya (CBK) resulted in rapid financial innovation (such as the popular M-Pesa mobile money services) growth, and expansion of several interest earning financial instruments. These developments affect the definition and composition of monetary aggregates, posing a question on the correctness of the current money measures used by CBK. The simple sum aggregates were identified with several theoretical and empirical shortcomings. The rapid financial sector development might affect the stability of money demand function. This study constructs Divisia monetary aggregates for Kenya over the period of 2000's first quarter to 2015's third quarter and applies the ARDL method in investigating the stability of money demand function. For the first time, monetary uncertainty and output uncertainty variables are introduced to the Kenyan money demand model. The results reveal that both monetary and output uncertainty has significant influence on money demand in Kenya. This implies that omitting the two variables in the Kenya money demand function might lead to a wrong specification. The money demand function is stable over the period. It means that monetary aggregates targeting is the right framework for monetary policy formulation by the CBK.

Contribution/ Originality: This study constructs Divisia monetary aggregates for Kenya over the period of 2000's first quarter to 2015's third quarter and applies the ARDL method in investigating the stability of money demand function.

1. INTRODUCTION

In any open economy, it has been established that for a monetary policy to be effective irrespective of the policy framework in use, the money demand has to be stable (Sriram, 2001). A stable money demand function facilitates a policy induced change in monetary aggregates to exert a foreseeable impact on macroeconomic series such as income, rate of interest, and prices of goods and services. This has prompted countries in both developed and developing stages to investigate the factors influencing the money demand with the sole aim of ensuring its stability.

However, the reason for focusing on the Kenyan money demand function stability derives from the fact that the Kenyan financial sector has witnessed some remarkable financial reforms enshrined in the IMF supported economic liberalization programme adopted in the late 1980s. The policy change from a fixed system to a floating system of

exchange rate during 1991 coupled with the Kenyan balance of payments capital account liberalization that took place in 1995 which apart from expanding the variety of financial assets accessible by an economic agent, do equally turn the rate of domestic currency exchange into an indirect monetary policy instrument, thereby making the money supply process exogenous. These transformations might have affected the stability of money demand function. More so, the resulting financial innovations realized from the financial sector reforms and progress might have an effect on the Kenyan monetary aggregates which might also affect the definition and measurement of money and also influence the money demand stability.

The Kenyan economy has undergone several financial transformations over time. These transformations have brought about innovations and created new and more sophisticated ways of dealing with financial transactions. Kenya has developed its own mobile money services through a popular M-Pesa product in 2007. This has expanded the transactions volume for mobile money and also raised its share in the GDP contributions. From a total sum of Kenya Shillings KSHs 166.6billion (representing about 8%of the total GDP) in year 2008, the mobile money transactions grew to KSHs 1.9 trillion (almost 50% of the country`s GDP) in the period of 2013 to 2014 (Ndirangu and Nyamongo, 2014). This rapid development in the financial system through the usage of mobile money has been ascribed to an increase of almost 100% in the formal sector financial services accessibility, raising from a mere 32% in the year 2006 to 67% in 2013 (Ndirangu and Nyamongo, 2014). This also corresponds to a fall in the number of people patronizing the financial services from the informal sector to just 8% from 33% during the same time frame. Other policies adopted by the Central Bank of Kenya (CBK) with the sole aim of further enhancing and expanding the financial sector include the amendment of the regulatory and legal frameworks to further open up financial inclusion and the electronic system of payments to form the basis of all transactions of financial services and other settlements.

There was an enactment of the Payment System Act of 2011 and the introduction of new guidelines to provide for transfers using electronic and e-money in 2012. Similarly, CBK issued another set of guidelines for agency banking in 2010 and allowed the licensing of new micro finance outlets. These policies facilitate the expansion of the Kenyan monetary base. The uncertainty presented by financial innovation to the monetary policy atmosphere requires a revisit of the central bank's conventional meaning of money. The importance of this is because if narrow money (M1) growth was to rely on e-money, for example, then it will be an insufficient measure of money supply, thus weakening the conduct of open market operations (Frame and White, 2004).

Therefore, investigating the problem of whether the money demand in Kenya is stable after financial sector reform was adopted in the late 1980s is very vital for monetary policy design. Researchers have advanced an argument that financial sector reforms could disturb the stability of money demand function particularly in an emerging developing economy like Kenya (Kumar, 2011). This will affect the monetary policy frameworks. Accordingly, the monetary theory and empirical evidence has offered that a clearer understanding of factors influencing money demand function and its stability forms the foundation for the conduct of monetary policy (Sriram, 2001).

Several studies have shown that financial sector reforms affect the stability of money demand more especially in an emerging economy like Kenya. Such studies include Nell (1999); Wesso (2002); Bahmani-Oskooee and Rehman (2005); James (2005) and Narayan (2007). Nonetheless, it is pertinent to note that financial sector reforms by most developing nations began in the late 1980s with only few starting during the 1990s (Wesso, 2002). To the best of our knowledge, there is no empirical study that investigated the effects of monetary uncertainty and output uncertainty on money demand for Kenya.

A money demand's stability is tested using the Divisia monetary aggregates. This study employed the Pesaran *et al.* (2001) approach to cointegration which appears to have more advantages over the other forms of traditional cointegration methods (Bahmani-Oskooee *et al.*, 2013).

The money supply measure used by the CBK is the simple sum type where monetary components such as currency and deposits are summed up together in a linear way. Barnett (1980) and subsequent studies have established several weaknesses of the simple sum method at both theoretical and empirical grounds. Barnett (1978;1980) used economic aggregation together with an index number theory to produce monetary aggregates that were consistent with the Diewert (1976) set of superlative quantity index numbers. Barnett`s type monetary aggregates correspond to the Tornqvist-Theil Divisia quantity index for discrete time. Barnett`s indices are named after a French economist Francois Divisia, who first introduced the continuous time based index in 1925 used in the aggregation of goods.

Therefore, this study attempted to construct Divisia monetary aggregates for Kenya and use it to study the money demand model incorporating two measures of instability; monetary uncertainty and output uncertainty to ascertain the stability of the function. Drawing from the studies of Choi and Oh (2003) and Bahmani-Oskooee *et al.* (2013) we included the monetary uncertainty and output uncertainty variables in the Kenyan money demand function for the first time in addition to the traditional determinants of money demand. Investigating the effects of monetary uncertainty and output uncertainty on the money demand is vital to a developing nation like Kenya which has been experiencing significant changes in its monetary and output growth resulting from financial and other economic reforms. The remaining part of the paper is structured into different sections. Following the introduction, section two is the literature review, section three is the methodology and data used, and section four discusses the results findings while section five concludes the paper.

2. LITERATURE REVIEW

Majority of the empirical works on money demand focus on the developed nations. Few studies were done on Kenya. A cursory look at the literature on the demand for money in Kenya show that studies such as; Pathak (1981); Darrat (1985); Mwega and Killick (1990); Adam (1992); Fielding (1994); Ndung'u (1994); Bahmani-Oskooee and Gelan (2009); Sichei and Kamau (2012); Kiptui (2014) all attempted to investigate the money demand for Kenya using different data structures and employing different econometric techniques. Mwega and Killick (1990) studied a group of African countries including Cameroun, Ivory Coast, Kenya and Nigeria using a quarterly data spanning over the period from first quarter of 1976 to the second quarter of 1987, applying Johansen cointegration, they found that real income, interest rate, inflation, exchange rate were the main determinants of money demand and that the function is stable. In a similar study, Bahmani-Oskooee and Gelan (2009) used quarterly data for 21 African countries including Kenya and found that the money demand function for all the countries was stable. They drew a conclusion that income, inflation and exchange rates are the key drivers of money demand.

In a more recent study, Kiptui (2014) investigated the Kenyan money demand stability using quarterly data for the period from the first quarter of 2000 to the last quarter of 2013 and adopting an ARDL approach. The study found a stable money demand function and also identified income, interest rate, inflation and exchange rate as the influencing forces on money demand.

However, in a study by Sichei and Kamau (2012) employing quarterly data for first quarter 1997 to second quarter 2011 adopting VAR methodology, they concluded that real income, interest rate and exchange rate were the variables that matter in money demand relationships. They found that money demand in Kenya was not stable.

The literature above indicates a lack of consensus on the stability of money demand function in Kenya. Nonetheless, instability in money demand might be as a result of misspecification of the model or omission of an important variable (Choi and Oh, 2003). Instability could be from measurement error in the monetary aggregates as evidenced in the developed countries during the 1980s era of missing money (Hendrickson, 2014). This study aimed at constructing Divisia monetary aggregates for Kenya and reexamining the Kenyan money demand model by adding two new volatility measures that were previously omitted in the money demand studies by earlier authors (Haseeb *et al.*, 2018; Suryanto *et al.*, 2018; Ali and Haseeb, 2019).

However, academic researchers have made efforts to study the effect of monetary and output uncertainty on the money demand function stability adopting different countries' data and using different methodologies. Some of these studies include: Brüggemann and Nautz (1997) study of Germany. Choi and Oh (2003) investigated the effects of monetary and output uncertainties on the US money demand. Later, Bahmani-Oskooee and Xi (2011); Bahmani-Oskooee *et al.* (2012) studied Australia and China respectively. Bahmani-Oskooee *et al.* (2013) carried out a study on the economic impact of monetary and output uncertainties on ten emerging economies comprising of Armenia, Czech Republic, Bulgaria, Coulmbia, Poland, Hungary, Bolivia, South Africa, Malaysia and Russia. Bahmani-Oskooee and Xi (2014) also investigated a group of Asian countries of Malaysia, Indonesia, Philippines, Singapore, Pakistan and India. Others included Bahmani-Oskooee *et al.* (2015) for Thailand and Bahmani-Oskooee and Baek (2017) for Korea. A cursory look at these studies indicated an absence of any study on Kenya.

As an emerging developing nation, Kenya is faced with several economic and financial volatilities resulting from the implementation of various economic reform policies (Misati *et al.*, 2010). Additionally, the recent developments in the financial sector and the increased openness of the Kenyan economy might have affected the stability of the money demand function. This is because the money demand function could have been distorted by the series of financial changes that took place within the reform period. Therefore, an uncertainty emanating from money and output volatility should be accounted for in the study of money demand in Kenya. This distinguishes our study from other similar studies.

3. METHODOLOGY AND DATA

This section discusses the data type and sources for the study and also explains the econometric methodology used. The model specification and construction of the Divisia monetary aggregates are discussed under different sub sections.

3.1. Divisia Monetary Aggregates Construction

The Kenya central bank (CBK) breaks down their monetary aggregates into M0, M1, M2 and M3 based on the composition of each category. The narrow money M0 includes money in public hands outside the banking system; M1 is M0 plus demand deposits, while M2 is M1 plus savings and time deposits. The broad monetary aggregate comprised of M3 and the foreign currency deposits denominated in local currencies. We constructed Divisia monetary aggregates corresponding to each component mentioned above.

Following Barnett *et al.* (2013) and Dahalan *et al.* (2005) the Divisia money (DM) for narrow and broad aggregates were constructed using equations below;

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

Where, D_t is the amount of Divisia index, S_{it} symbolize expenditure share of the ith constituent, π_{it} is the financial instrument`s user cost i in a given time, t . The expenditure share is computed using;

$$S_{it} = \frac{\pi_{it}M_{it}}{\sum_{j=1}^{N}\pi_{jt}M_{jt}} \tag{2}$$

Where π_{it} is the user cost as defined in Equation 2 , M_{it} is the monetary asset, and N is the ith component.

By taking the logs of Equation 1, it is simple to see that for the Divisia monetary index, the growth rate (i.e the log change) of the aggregate is a share-weighted average of the growth rates of component quantities as shown in Equation 3.

$$\log(D_t)-\log(D_{t-1})=\sum_{i=1}^{N}S_{it}^{*}\left(\log(M_{it})-\log(M_{it-1})\right) \quad (3)$$

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

Barnett (1978) derived the user cost of money and expressed it as follows Equation 4;

$$\pi_{it}=\frac{P_t\left(R_t-r_{it}\right)}{\left(1+R_t\right)} \quad (4)$$

Where R_t represents benchmark rate, r_{it} stand for an assets own return rate, and P_t is the price index represented by consumer's price index. The benchmark rate is usually the maximum rate of return over a defined class of monetary assets (Barnett, 1978). It is assumed not to provide any liquidity or other financial services, but rather kept exclusively to transfer wealth inter temporally. Accordingly, based on the monetary assets and their respective earnings in Kenya, we define the benchmark rate as Equation 5;

$$R_t=Max\left(idd_t,isd_t,itd_t,91-dayTB_t,istl_t\right)+c \quad (5)$$

Where, idd_t is rate of interest on demand deposits , isd_t is interest return on savings deposits, itd_t is interest on time deposits, $91-dayTB_t$, is 91day Treasury bills rate, $istl_t$ interest on short-term loan. Where c is a constant term with a figure of 0.001. The addition of the constant c is to guarantee that the rate of return on any monetary asset is lower than the benchmark rate (Anderson *et al.*, 1997). Using Equation 3 we construct the Divisia index aggregates for Kenya over the period 2000Q1 to 2015Q3.

3.2. Model Specification

The money demand theories postulated that money demand is influenced by scale and opportunity cost variables. While the scale variables measure economic activities and are proxied by series like income, opportunity cost variables are measures of opportunity cost proxied by variables like interest rate, inflation. Later Mundell (1963) introduced exchange rate variables into the determinants of money demand function. Choi and Oh (2003) drew a theoretical linkage for monetary uncertainty and output uncertainty with the money demand. Based on the theoretical derivation by Choi and Oh (2003) we derived the following money demand model for Kenya.

$$LDM_t=\alpha+\alpha_1 LGDP_t+\alpha_2 ITR_t+\alpha_3 LCPI_t+\alpha_4 EXR_t+\alpha_5 MOU=\alpha_6 OUU_t+\varepsilon_t \quad (6)$$

Where; DM_t is the measure of Divisia index monetary aggregates, GDP_t is measure of income; ITR_t is the rate of interest; CPI_t is the consumer price index; EXR_t is the exchange rate; MOU_t is a measure of monetary uncertainty, OUU_t is the output uncertainty variable and ε_t is the error term assumed to be iid. It is anticipated that the estimates of α_1 to be positive, α_2 and α_3 to be negative. The coefficient for the exchange rate, α_4 could either be positive or negative (Arango and Nadiri, 1981). According to Choi and Oh (2003) the coefficients of monetary and output uncertainty could be positive or negative.

Following Pesaran *et al.* (2001) bound cointegration approach, we re-specify Equation 6 into an error correction ARDL model as follows;

$$\Delta LDM_t = a_0 + \sum_{i=1}^{\rho} b_i \Delta LDM_{t-i} + \sum_{i=0}^{\rho} c_i \Delta LGDP_{t-i} + \sum_{i=0}^{\rho} d_i \Delta ITR_{t-i} + \sum_{i=0}^{\rho} e_i \Delta LCPI_{t-i} + \sum_{i=0}^{\rho} f_i \Delta EXR_{t-i} + \sum_{i=0}^{\rho} g_i \Delta MOU_{t-i} + \sum_{i=0}^{\rho} h_i \Delta OUU_{t-i} + \delta_1 LDM_{t-i} + \delta_2 LGDP_{t-i} + \delta_3 ITR_{t-i} + \delta_4 LCPI_{t-i} + \delta_5 EXR_{t-i} + \delta_6 MOU_{t-i} + \delta_7 OUU_{t-i} + \varepsilon_t \quad (7)$$

The initial step for conducting ARDL bound test was the estimation of our money demand Equation 7 with the use of ordinary least squares (OLS). To do that, we first selected the appropriate lag levels, determined the error terms serial independence, and ensured that the model is stable dynamically. We then examined the existence of cointegration amongst the variables in the model. This can be done by carrying out a bound F-test for a joint significance of coefficients of the lagged levels of the series in the model, i.e. $H_0 = \beta_i = 0; i = 1, 2, ...8$. Rejection of H_0 suggest the presence of a long run relationship. The F-statistic distribution for the bound test is nonstandard regardless of whether series in the model are I (0), or I (1).

Pesaran *et al.* (2001) and Narayan (2005) provides the critical values of F-statistic. In the tables two sets of critical values were provided where one set was calculated under the assumption that all series in the model are of order 1 that is I(1), and the other had the assumption that the series are of I(0) order. When the calculated F-statistic is greater than the corresponding upper value, then we would reject the null hypothesis of no cointegration, when it falls lower than the lower bound value, we would fail to reject the null and when it stays within the bound of lower and upper region, our results remain inconclusive. If a cointegration was established we would then move ahead with the estimation of short and long run relationships. Statistical data used were sourced from the World Bank World development indicators and the IMF International Financial Statistics for the period of the first quarter of 2000 to the third quarter of 2015.

Monetary and output uncertainty variables were produced from the money supply and GDP variables respectively by the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) volatility based models. Details of the procedure can be obtained in Bahmani-Oskooee *et al.* (2014).

4. RESULTS AND DISCUSSIONS

For any time series analysis we first unveiled the unit root properties of the series to avoid spurious regression outcomes (Enders, 2008). To test for the integration order of the variables in the model we employed the Augmented Dickey Fuller test (Dickey and Fuller, 1979) and P-P unit root test (Phillips and Perron, 1988). Tables 1 and Table 2 in the appendix present the results of the respective tests. The null hypothesis for the presence of unit root in the series of interest rate and inflation was rejected at the 5% significance level for both the ADF and PP tests at levels with trend and trend and intercept. However, for the other series we failed to reject the null and have to take the variables to first difference. At first difference, Divisia money, income exchange rate, money uncertainty and output uncertainty became stationary. It then showed that our series were of mixed order of integration of I(0) and I(1) order. None of the variables exceeded the first difference order. This therefore justified the use of the Pesaran *et al.* (2001) bound test approach to estimate Equation 7.

Next we ran the bound test of cointegration based on the Pesaran *et al.* (2001). Table 3 depicts the results of the bound tests. From the results, the F calculated value of 4.487 shows that it was higher than the upper value of the critical bound statistic at the 1% level of significance. We then rejected the null hypothesis of no cointegration and instead concluded that there was a cointegration between Divisia money, income, interest rate, and exchange rate, monetary and output uncertainties.

Table-1. 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***

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 variables 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).

Table-2. Phillip-Perron Unit Root Test.

Variable	Level		First Difference	
	Intercept	With Trend	Intercept	With Trend
LDM3	0.966	-43.078	-3.597***	-4.015***
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***

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).

It further showed that Divisia money moves together with its determining factors; income, interest rate, inflation, exchange rate monetary uncertainty and output uncertainty. After establishing the presence of cointegration we then proceeded to look at the long run ARDL estimates.

Table-3. Bound Cointegration Test Results.

Model	Fc	Sign Level	Fc 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. Long Run ARDL Results.

Variable	Long Run Estimates
Constant	29.248***(5.121)
LGDP	1.048***(0.201)
LITR	-0.077***(0.016)
INF	-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 show the long run estimates for the money demand model. A closer look at the results reveals that monetary uncertainty has a positive and significant long run relationship with Divisia money. This imply that volatility in money supply affects the long run money demand positively. It also suggest that a 1 percent change in

money volatility will leads to a less than one percent change in the quantity of money people are willing to hold. Output uncertainty has a significantly positive coefficient also, implying that in the long run, increase in output uncertainty will lead to an increase in the public desire to keep money. Our results is in line with the risk-adverse theory for an economic agent in which during the period of output uncertainty an individual change his risky security holdings for more money (Choi and Oh, 2003).

The other control variables in the model bear their anticipated sign in the results and had highly significant coefficients. Of interest here is that the coefficient of income was positive and significant implying a transaction demand for money as postulated in the theory. The income elasticity was statistically unified suggesting that a percent growth in output requires an equal and exact amount of monetary stock. This further supports the monetarist's postulations that excess growth in money supply induces inflation. The results agreed with those reported by Ndirangu and Nyamongo (2014). But it differed from the results of Sichei and Kamau (2012) who found that income elasticity was above unity. Nonetheless, Laidler (1982) contended that a reasonably quantified income elasticity should be in the range of 0.5 to 1.0. Studies like Ndung'u (1994) and Ndele (1991) also found an income elasticity that was above unity.

The coefficient of the interest rate was negative and significant and in line with the theoretical postulations. This was because that at a higher interest rate, it meant more returns on alternative assets, therefore economic agents will hold less money and more of the alternative assets. Studies such as Ndung'u (1994); Sichei and Kamau (2012) and Kiptui (2014) all reported similar findings.

Inflation had a negatively significant relationship with the long run money demand based on the estimate. This suggested that increasing inflation encourages economic agents to diversify their portfolio holdings away from cash balances to other non-monetary assets. The exchange rate bears the a priori expected sign and was significant suggesting a wealth effect. Depreciation in the value of domestic currency increased the money demand remarkably.

Table-5. Short run ARDL Results.

Variable	Estimated Coefficient
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(LITR)	-0.025***(0.006)
Δ(LITR-1)	0.001(0.006)
Δ(LITR-2)	-0.013**(0.006)
Δ(LITR-3)	-0.027***(0.006)
Δ(INF)	-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.

Table 5 shows the short-term estimates of the model. From the results it is evidently clear that there was at least one short-term significant estimate gotten for each first differenced variable in the model. Monetary uncertainty seems to have a short-term significant influence on the money demand for Kenya. It bears a positive sign indicating a positive impact on the money demand. But output uncertainty showed an insignificant estimate in the short-term. Of significance was that the error correction term (ECT-1) bore the correct sign that was negative and highly significant. With that, our results further confirmed the existence of cointegration relationship among

our series in the short-term money demand model. The size of the ECT-1 suggested that the short-term adjustment mechanism does offset roughly 42 percent of disequilibrium in Divisia money demand every quarter.

The diagnostic tests results presented in Table 6 showed that our model passes through all the tests. It confirmed that our residuals series were normally distributed no serial correlation, no specification error and the model was homoscedastic.

Table-6. 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
Heteroscedasticity	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.

To confirm the stability of the estimated model, the tests of CUSUM and CUSUMSQ were applied based on Brown *et al.* (1975). Figures 1 shows the graphs for the CUSUM while Figure 2 presents CUSUMSQ tests results. The two figures indicated that the plots of both statistics stay within the two lines region signifying that our estimates were stable. This also suggested that incorporating the two uncertainty measure series into the money demand model for Kenya produced a stable money demand. Omitting these variables from the model might result in misspecification error (Enders, 2008).

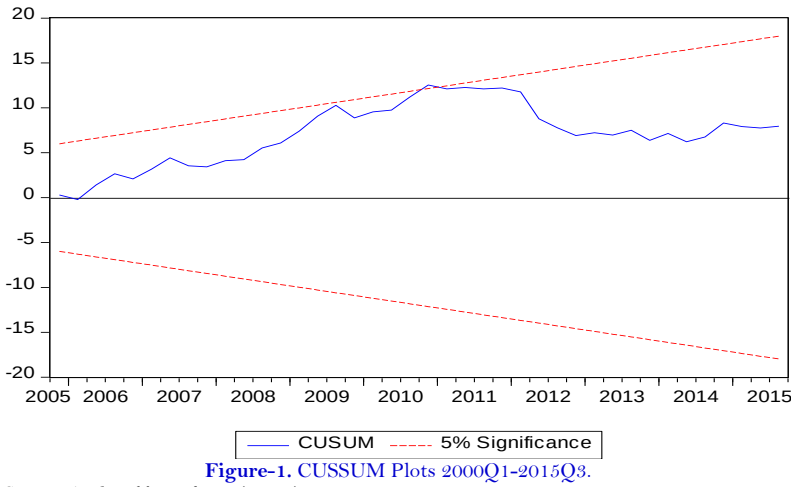

Figure-1. CUSSUM Plots 2000Q1-2015Q3.

Source: Analyzed by author using Eviews.

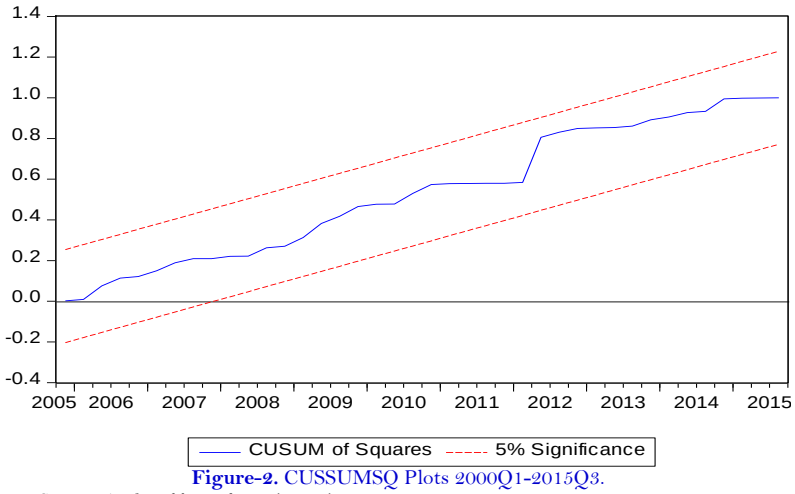

Figure-2. CUSSUMSQ Plots 2000Q1-2015Q3.

Source: Analyzed by author using Eviews.

5. CONCLUSIONS

The study constructed the Divisia monetary aggregates for Kenya and examined the impact of monetary and output uncertainties on the stability of money demand function in Kenya over the period from the first quarter of 2000 to the third quarter of 2015. A methodology of Pesaran *et al.* (2001) was employed in estimating the money demand model for Kenya. The results showed that monetary and output uncertainties have both short and long term significant impact on the money demand for Kenya and were omitted by the previous studies. The Divisia monetary aggregates served well in the stability of money demand in Kenya. Therefore, adopting the Divisia monetary aggregates and incorporating the monetary and output uncertainty variables will produce a stable money demand function. The CBK could focus more on the monetary aggregates targeting in their monetary policy formulation rather than the current interest rate targeting framework.

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