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ESTIMATING MONEY DEMAND FOR GHANA

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ABSTRACT: *The study suggested that money demand function for Ghana using M1 and M2 remained relatively unstable between 1991 and 2011 as evidenced by trends in recursive residual and the cumulative sums of squared residuals derived from the estimated models. However, real money demand function for broad money (M2+) was found to be stable relative to real money demand functions estimated using for M1 and M2 as dependent variables. The study therefore concluded that real money demand function for M1 and M2 are remained relatively unstable in Ghana compared with real money demand function for broad money which exhibits some degree of stability.*

KEYWORDS: Money, Demand, Recursive, Unit Root

Introduction

Empirical money demand estimations are used by monetary authorities as a major tool in designing policies to influence real and monetary balances. Starting from the 1980's, search for the economic variables such as income, interest rates, foreign exchange rates and inflation gained importance in the literature. According to Friedman (1956), money demand function assumes that there are a stationary long-run equilibrium relationship between real money balances, real income, and the opportunity cost of holding real balances.

The hypothesis of existence of stationary long-run money demand function is tested by using cointegration method for Ghana. If money demand function shows a stationary long-run relationship among real income and opportunity cost of holding money, then it means that the stochastic trend in real money balances is related to the stochastic trend in real income and opportunity cost of holding money. Thus, by cointegrated variables, it will be constrained to equilibrium relationship in the long-run.

In the late 1970s and early 1980s, a number of central banks world-wide adopted monetary targets as a guide for monetary policy. Monetary targeting was an attempt by central banks to describe or determine the optimum money stock that will yield the desired macroeconomic objectives. Theoretically, the choice of target is normally between the stock of monetary aggregates and interest rates. Whenever the money demand function is unstable, interest rate is generally the preferred target; otherwise, the money stock is the appropriate target (see Poole, 1970, 1971; and McCallum, 1989)2. In the early 1990s, some central banks adopted numerical inflation or nominal GDP targets as guides for monetary policy in contrast to the conventional choice of interest rate or money stock. Economists and analysts attribute this departure to the unreliability of monetary aggregates as guides for monetary policy.

For the Central Bank of Ghana (BOG), the primary objective in its conduct of monetary policy is to maintain a stable price level that supports sustainable economic growth and employment. While other central banks adopted numerical inflation or nominal GDP targets as guides for monetary policy since the 1980s and 1990s because financial market innovations and deregulations rendered monetary aggregates less reliable policy guides, the

BOG did not deviate from the conventional monetary aggregate as the appropriate intermediate target. An implicit assumption with respect to this choice was that the intermediate target chosen is measurable, controllable, and predictable. In addition, it is assumed that the money demand function is stable in the conduct and implementation of monetary policy. This is very important because the money demand function is used both as a means of identifying medium term growth targets for money supply and as a way of manipulating the interest rate and reserve money for the purpose of controlling the total liquidity in the economy and for controlling inflation rate.

The objective to investigate the long-run stability of the real money demand function is based on the fact that the stability of the money demand function has important implications for the conduct and implementation of monetary policy. In other words, these are some of the important issues for empirical analyses because it is possible that the implementation of SAP in 1983 may have altered the stability of real money demand function. With respect to the choice of intermediate targets by monetary authorities, economic theory suggests that the success or failure of such policy stance depends on the level of commitment to targets, therefore, this raises a fundamental question as to level of commitment by the BOG to its annual growth targets set for M2, and if it deviated from its annual growth targets for M2 during the period, how did this impact real GDP growth and inflation rate? This is at the core in terms of the linkage between target achievement, or lack thereof, and the overall objectives of monetary policy5. To shed some light on this issue, we examined not only the level of success or failure of the BOG in keeping with its annual target set for M2 growth but also the effects of the deviations of actual M2 growth rates from targets on real output growth and inflation rate during the period.

After the implementation of SAP in 1983, the Ghana economy went through some significant structural and institutional changes. These changes included the liberalization of the external trade and payment systems, substantial degree of financial deepening and innovations in the banking sector, the adoption of a managed float exchange rate system, the elimination of price and interest rate controls, changes in monetary policy, and the emphasis on market determined indirect instruments of monetary policy. It is conceivable that these developments may have altered the relationship between money, income, prices, and other key economic variables; and this may have caused the money demand function to become structurally unstable. Consequently, determining whether the financial reforms undertaken under the SAP impacted the money demand relationship is important to the effective formulation and implementation of monetary policy in Ghana. This is so because issues or factors that affect the behavior and stability of the money demand relationship assume greater urgency when the broad monetary aggregate became the official intermediate target for monetary policy.

In order to ensure that our results are robust, we adopted the Johansen/Juselius (1990) multivariate cointegration method to find the appropriate real money demand function and to analyze its behavior both in the short-run and long-run. Even though the Johansen/Juselius cointegration technique is not informative relative to the stability of the parameters in the model [Bahmani-Oskooee and Shin (2002, p.86)], however, one cannot overlook its usefulness for empirical modeling in industrialized and developing countries. To test for the stability of the parameter estimates in this study, we employed the CUSUM and CUSUMSQ tests which Brown, et al. (1975) developed in order to examine the stability of short-run dynamics and long-run coefficients of the money demand function. From the CUSUM and CUSUMSQ test results, we found the real money M2 demand function to be stable during the sample period. In addition, from the visual inspection of the M2 money growth data, we observed that the actual from M2 growth rates deviated from the target growth rates, therefore, one can easily conclude that the CBN was not strongly committed to the annual M2 growth targets and may have formed the basis for the adopting of inflation targeting framework by the Bank.

The Model

The transactionary and speculative demands for money as given in Keynes liquidity preference theory suggest that money demand is predicated on two major factors, income and interest rate. From this stand point, we assume a money demand function in which real money balance is determined by interest rates, exchange rate and real income. Formally, the money demand function is given as:

$$m = f(\text{int}, rdgp, ex) \qquad (1)$$

where m is real cash balance is the economy defined as *M/P*. The general price level *P*, which measures transaction costs, is homogenous of degree one, this implies that there is absence of money illusion in the economy. Interest rate *I*, is a measure of returns on alternatives to money. Exchange rate is represented as ex, and it captures currency substitution (degree of dollarization). *Real* gross domestic product (GDP) *rgdp*, is used to represent transactionary and precautionary demand for money motives. Equation (1) can therefore be transformed into an estimatable equation with its attendant model prior expectations as follows:

$$mp_t = \beta_0 + \beta_1 rgdp_t + \beta_2 \text{int}_t + \beta_3 ex_t + \varepsilon_t \qquad (2)$$

Where $\beta_0, \beta_1, \beta_2, \beta_3$ are the expected coefficients with prior expectations as $\beta_1 \rangle 0, \beta_2 \langle 0, \beta_3 \langle 0$, while ε_t is the disturbance term which is assumed to be white- noise (i.e. normally distributed).

Data Sources

In estimating money demand for Ghana, we use data spanning from 1991:1 to 2014:4. All the series are available in quarterly form, with the exception of GDP. As a result, annual series are interpolated to generate quarterly series for real GDP. Data for Ghana are derived from the International Financial Statistics. The log of aggregate real money demand (mp), real GDP (rgdp), and exchange rate (ex) are used in the estimation procedure. The Government's Treasury bill rate was used as a proxy for rate of return on alternative investment asset (for interest rate).

Estimating Long-Run Money Demand

In estimating money demand function, it is very important to test whether the relevant variables involved are stationary and to determine the order of integration of the variables. A standard Dickey-Fuller (ADF) methodology could be applied to test for the presence of units in the levels and first differences of the variables. To test for the orders of integration of the variables under investigation in the model, Johasen Cointegration procedure or the generated residuals of the the estimated long run model could also be used to whether there exist a linear combination among the selected series.

Unit Root Test

When all the variables were tested in levels using optimal lag length 4 based on the Scwarz Information Criterion(SIC), the test results in the table below indicates that all the variables are non-stationary, suggesting the presence of unit root. This shows that if the model is regressed using the level variables, it may give spurious regression results.

Table 1: Augmented Dickey-Fuller Unit Root Test (Level Variables)

Variable	ADF Statistics	Probability Value
lmp1	0.025958	0.9571
lpm2	0.138167	0.9662
lmp3	-0.35064	0.9105
rgdp	-1.40792	0.573
int	-0.95179	0.573
ex	-1.51201	0.5214

Note: * and ** indicate 1% and 5% per cent level of significance

In order to determine the level at which the series become stationary, we followed the extension suggested by Dickey and Pantula(1987) by performing standard Dickey-Fuller tests on successive differences of the variables. These variables after being differenced once became stationary. The results of these are reported in the Table below.

Table 2: Augmented Dickey-Fuller Unit Root Test (Differenced Variables)

Variable	ADF Statistics	Probability Value
Dlmp1	-10.0872	0.0000*
Dlmp2	-8.17986	0.0000*
Dlmp3	-8.07629	0.0000*
Drgdp	-14.8583	0.0000*
Dint	-5.08242	0.0001*
Dex	-4.29006	0.0010*

Note: * and ** indicate 1% and 5% per cent level of significance

Co-integration Test

The purpose of the co-integration test is to determine whether groups of non-stationary series are co-integrated or not. As explained below, the presence of a co-integrating relation forms the basis of the Vector Error Correction specification. Using the Johansen Cointegration methodology (1991, 1995a), the trace tests indicate that, the hull hypotheses of no co-integration have been rejected at 5% level of significance in all the three demand functions. This suggests that unique long-run cointegrating relation therefore exists between lmp1,ly lr, le; lmp2, ly, lr, le and finally, lmp3, ly, lr, le respectively. all the variables under investigation are co-integrated. Hence, the Error Correction Model can be used to establish the short-run relationship between the series in the model.

The economic interpretation of the results can be obtained by normalizing the co-integrating vectors on lmp1, lmp2 and lmp3. After normalizing co-integrating vector on lmp1,all the series have the correct signs. The result suggests a long-run income elasticity estimate of 0.66 and interest elasticity estimate of 0.48. The exchange rate elasticity estimate of 0.51 was also obtained from the normalized co-integrating vector on lmp1. The exchange rate elasticity estimate indicates that the degree of currency substitution in the Ghanaian economy is relatively manageable.

Table 3: Johansen Co-integration Test for Lmp1, Lrgdp, Lint, Lex

Sample (adjusted): 1991Q1 2011Q4				
Included observations: 64 after adjustments				
Trend assumption: Linear deterministic trend				
Series: LMP1 Lrgdp Lin Llex				
Lags interval (in first differences): 1 to 3				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.574501	69.21605	47.85613	0.0002
At most 1	0.133671	14.52857	29.79707	0.8097
At most 2	0.047213	5.345205	15.49471	0.7711
At most 3	0.034544	2.249892	3.841466	0.1336
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				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.574501	54.68748	27.58434	0.0000
At most 1	0.133671	9.183368	21.13162	0.8174
At most 2	0.047213	3.095313	14.26460	0.9402
At most 3	0.034544	2.249892	3.841466	0.1336
Max-eigenvalue 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				
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):				
LMP1	LY	LR	LE	
7.899503	-5.229105	3.808584	4.048660	
6.251217	5.751668	5.649704	-7.550494	
0.938551	-3.35855	-0.992392	2.376297	
-6.087862	1.497837	0.328672	-0.147408	
Unrestricted Adjustment Coefficients (alpha):				
D(Lmp1)	-0.018457	-0.022208	-0.005581	0.002494
D(Lrgdp)	0.034507	-0.000441	0.004280	-0.000346
D(Lint)	-0.026132	-0.002316	0.021414	-0.007389
D(Lex)	-0.013915	0.001908	0.006881	0.006365
1 Cointegrating Equation(s):		Log likelihood	372.1413	
Normalized cointegrating coefficients (standard error in parentheses)				
Lmp1	Lrgdp	Lint	Lex	
1.000000	-0.661954	0.482130	0.512521	
	(0.13048)	(0.06808)	(0.13609)	

Table 4: Co-integration Test for Lmp2, Lrgdp, Lint, Lex

Sample (adjusted): 1991Q1 2011Q4				
Included observations: 64 after adjustments				
Trend assumption: Linear deterministic trend				
Series: Lmp2 Lrgdp Lint Lex				
Lags interval (in first differences): 1 to 3				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.603495	70.53041	47.85613	0.0001
At most 1	0.106415	11.32609	29.79707	0.9528
At most 2	0.044216	4.125243	15.49471	0.8932
At most 3	0.019050	1.230954	3.841466	0.2672
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				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.603495	59.20432	27.58434	0.0000
At most 1	0.106415	7.200849	21.13162	0.9456
At most 2	0.044216	2.894290	14.26460	0.9535
At most 3	0.019050	1.230954	3.841466	0.2672
Max-eigenvalue 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				
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):				
Lmp2	Lrgdp	Lint	Lex	
8.925890	-5.397018	4.115977	3.713738	
7.188415	6.054079	6.254543	-8.055096	
3.778559	-2.439543	0.179867	0.675317	
6.729438	-0.987615	0.201272	-0.524013	
Unrestricted Adjustment Coefficients (alpha):				
D(LMP2)	-0.017406	-0.013707	-0.0057	-0.003368
D(LY)	0.036998	-0.001791	0.003299	0.000984
D(LR)	-0.021883	-0.009088	0.020791	0.005231
D(LE)	-0.008996	0.002935	0.007578	-0.004447
1 Cointegrating Equation(s):		Log likelihood	385.2655	
Normalized cointegrating coefficients (standard error in parentheses)				
Lmp2	Lrgdp	Lint	Lex	
1.000000	-0.604648	0.461128	0.416064	
	(0.10783)	(0.05658)	(0.11191)	

Source: Author's Own Estimation

Table 5: Co-integration Test for Lmp2+, Lrgdp, Lint, Lex

Sample (adjusted): 1991Q1 2011Q4				
Included observations: 64 after adjustments				
Trend assumption: Linear deterministic trend				
Series: Lmp3 Lrgdp Lin Lex				
Lags interval (in first differences): 1 to 3				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.614582	72.51566	47.85613	0.0001
At most 1	0.107029	11.49629	29.79707	0.9480
At most 2	0.043716	4.251413	15.49471	0.8822
At most 3	0.021494	1.390592	3.841466	0.2383
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				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.614582	61.01937	27.58434	0.0000
At most 1	0.107029	7.244878	21.13162	0.9436
At most 2	0.043716	2.860821	14.26460	0.9556
At most 3	0.021494	1.390592	3.841466	0.2383
Max-eigenvalue 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				
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):				
Lmp3	Lrgdp	Lint	Lex	
8.033334	-5.78969	2.705197	3.777440	
3.765656	6.530540	5.338921	-7.737794	
-4.72017	1.107365	-0.763715	1.233850	
-6.88919	-0.428856	-0.405981	2.434646	
Unrestricted Adjustment Coefficients (alpha):				
D(LmpP3)	-0.020477	-0.01157	0.004531	0.003591
D(rgdp)	0.039134	-0.001618	-0.002853	-0.000701
D(int)	-0.013346	-0.009641	-0.020598	-0.006066
D(Lex)	-0.009774	0.001636	-0.007785	0.004593
1 Cointegrating Equation(s):		Log likelihood	394.6906	
Normalized cointegrating coefficients (standard error in parentheses)				
Lmp3	Lrgdp	Lint	Lex	
1.000000	-0.720708	0.336746	0.470221	
	(0.11963)	(0.06373)	(0.12353)	

Source: Author's Own Estimation

When the co-integrating vector on lmp2 is normalized, the result indicates income elasticity of 0.60 and interest elasticity of 0.46, which is relatively similar to the result obtained from normalizing the co-integrating vector on lmp1. The result further suggests an exchange elasticity of 0.41, which does not differ significantly from the earlier estimate, thus re-emphasizing the manageability of currency substitution problem in the country.

Again, when the co-integrating vector was normalized on lmp3, the output result indicates income elasticity of 0.72, interest elasticity of 0.33 and exchange elasticity of 0.47. All the series in the model have the right theoretic signs which are the general position of the empirical literature. All the derived money demand elastitcities from the three demand functions falls within the stability band, which suggests that the money demand function for Ghana remains fairly stable during the period under investigation.

Short Run Money Demand

Since all the series are co-integrated, the second step of the Engle and Granger procedure shows how the short-run dynamic version of the long-run model estimated can be estimated. In selecting the lag length of the models involving all three definitions of money in Ghana(i.e.M1, M2, M2+), a popular technique is the Hendry's general-to-specific approach which proceeds by eliminating lags which enter the model insignificantly(Miller,1990).Hence, the following parsimonious money demand functions for M1,M2 AND M2+ were estimated:

For M1 money demand function, the model passes all the diagnostic tests performed. The model was free from the presence of Autocorrelation-conditional Heteroschedasticity as indicated by low F-statistics of 0.538652. The model simultaneously passed serial correlation LM test as shown by the low F-statistics and model specification test at 5% level of significance. The High F-statistics indicates the significance of the explanatory variables at 1% level of significance. The value of R-Squared shows that, 70% of the variation in M1 is explained by the variation in the explanatory variables. The Durbin-Watson indicates no serial correlation.

Table 6: Dependent Variable: DLmp1
Sample (adjusted): 1991Q2 2011Q4
Included observations: 63 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.010365	0.012713	-0.815323	0.4182
ECM11(-1)	-0.346167	0.073279	-4.723938	0.0000
DLrgdp(-3)	0.741609	0.082512	8.987918	0.0000
DLint	-0.003399	0.002399	-1.416842	0.1619
DLex(-4)	-0.306801	0.151002	-2.031763	0.0468

R-squared	0.700938	Mean dependent var	0.022478
Adjusted R-squared	0.680313	S.D. dependent var	0.128900
S.E. of regression	0.072881	Akaike info criterion	-2.323941
Sum squared resid	0.308074	Schwarz criterion	-2.153851
Log likelihood	78.20415	F-statistic	33.98490
Durbin-Watson stat	1.856397	Prob(F-statistic)	0.000000

Source: Author's Own Estimation

The error correction term (ECT), which signifies the speed of adjustment to long-run equilibrium is negative and significant at 1% level of significance. The absolute value being less than one implies a stable error correction mechanism with eventual convergence to long-run equilibrium values. The speed of adjustment is 35% as shown by the coefficient of the error correction term. All the variables have the correct signs and thus confirm the empirical evidence. The coefficients of income and exchange rate are significant in the model except the coefficient of the interest rate variable. The result indicates real money balance depend income is a key determinant of real money balance and also suggests that an expected depreciation of the domestic currency will lead to increase in demand for foreign currency, thus decreasing domestic money demand.

ARCH Test:	F(3,56)= 0.538652	Prob.	0.657766
AR Test:	F(3,55)= 0.309363	Prob.	0.818512
Reset Test:	F(9,49)=2.263151	Prob.	0.032998

A cursory look at the trends in the recursive residual and the cumulative sums of squared residuals generated from the model indicates that the money demand function in some periods shows some level of instability in M1 money demand function.

Chart 1: Recursive test for the Dlmp1 Model

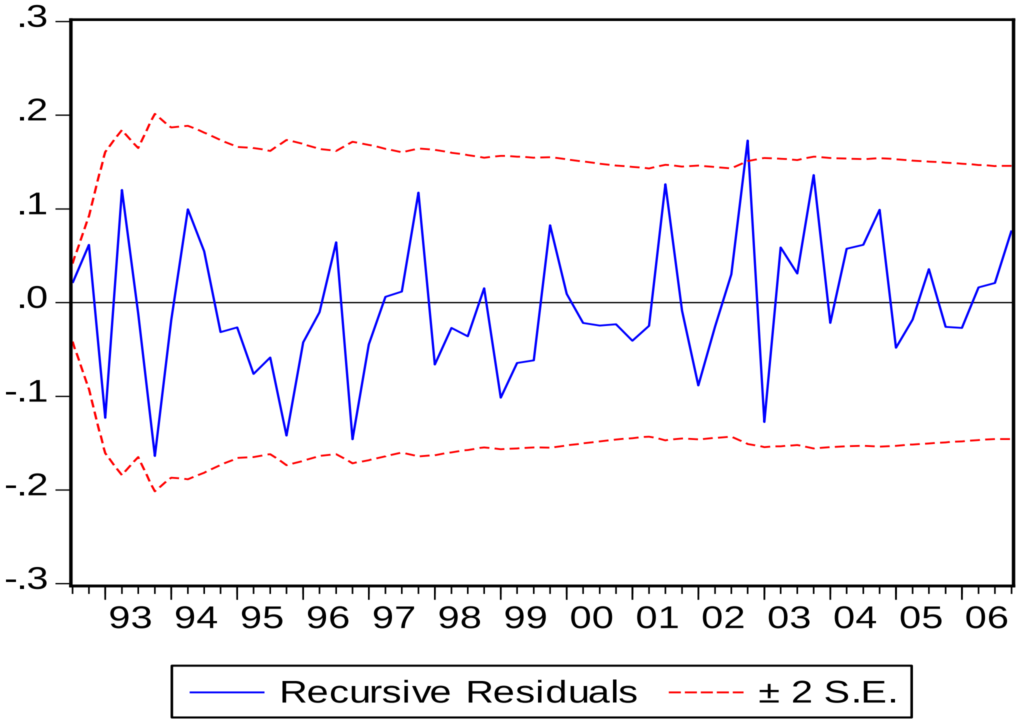
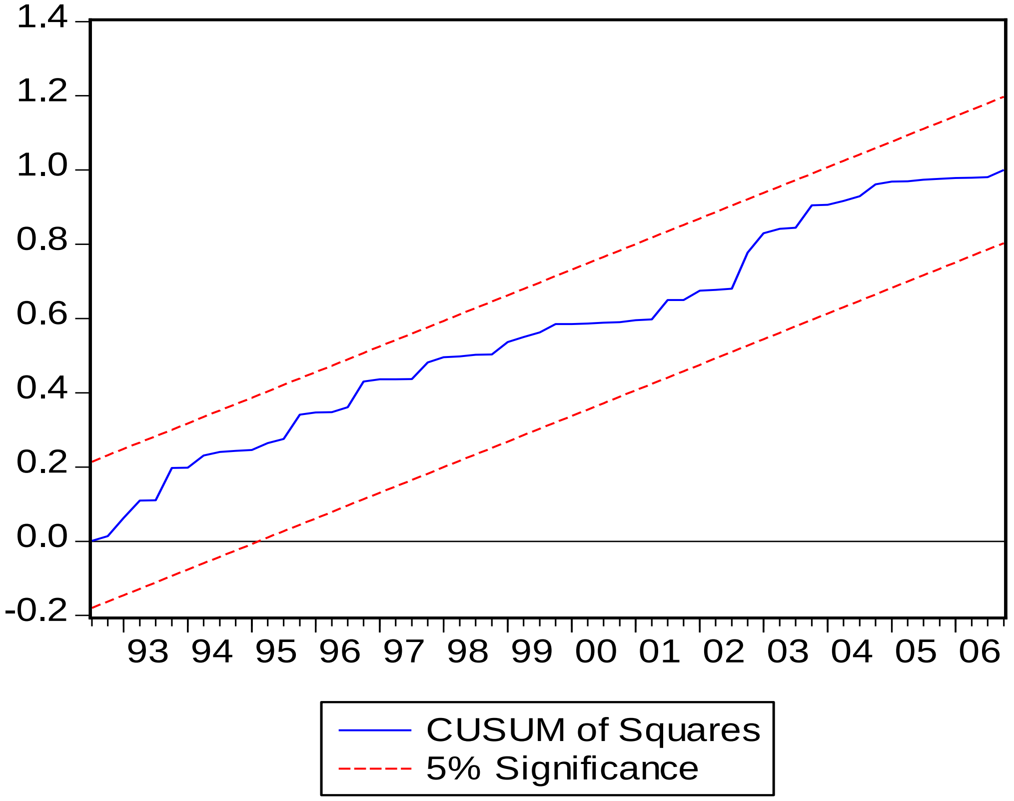


Chart 2: CUSUMQ Test for Dlmp1 Model



For the real money demand function using lmp2, the result of the estimated Error-Correction Model is depicted below. The result indicates that, the model passed all the relevant diagnostic tests. The Error-correction term is negative and also significant at 1% level of significance. The speed of adjustments to eventual equilibrium given by 35%. The value of the R-Squared also indicates that 64% variation in real money balance is explained by variation in income, interest rate and exchange rate, which captures currency substitution in the model. All the coefficients of the independent variables enter the model with the right signs and are all significant at different levels of significance. The income variable is significant at 1% level of significance. The interest rate variable is significant at 5% level of significance, while the coefficient of the exchange rate variable is significant at 10%.

Table 7: Dependent Variable: DLmp2
Sample (adjusted): 1991Q2 2011Q4
Included observations: 63 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003893	0.010451	0.372528	0.7109
ECM22(-1)	-0.353459	0.075281	-4.695200	0.0000
DLrgdp(-3)	0.524882	0.066989	7.835308	0.0000
DLint	-0.004109	0.001971	-2.084067	0.0416
DLex(-4)	-0.232270	0.123709	-1.877553	0.0655

R-squared	0.649543	Mean dependent var	0.025136
Adjusted R-squared	0.625374	S.D. dependent var	0.097884
S.E. of regression	0.059912	Akaike info criterion	-2.715846
Sum squared resid	0.208187	Schwarz criterion	-2.545756
Log likelihood	90.54914	F-statistic	26.87455
Durbin-Watson stat	1.937834	Prob(F-statistic)	0.000000

ARCH Test:	F(3,56)= 0.600714	Prob.	0.617238
AR Test:	F(3,55)= 0.420399	Prob.	0.739086
Reset Test:	F(9,49)=1.903624	Prob.	0.73481

Source: Author's Own Estimation

The recursive residual test and cumulative sums of squared test for stability in the real money function suggests that the model exhibits some level of stability over the years even though some periods indicate some level of instability.

Chart 3: Recursive Residual Test for lmp2 model

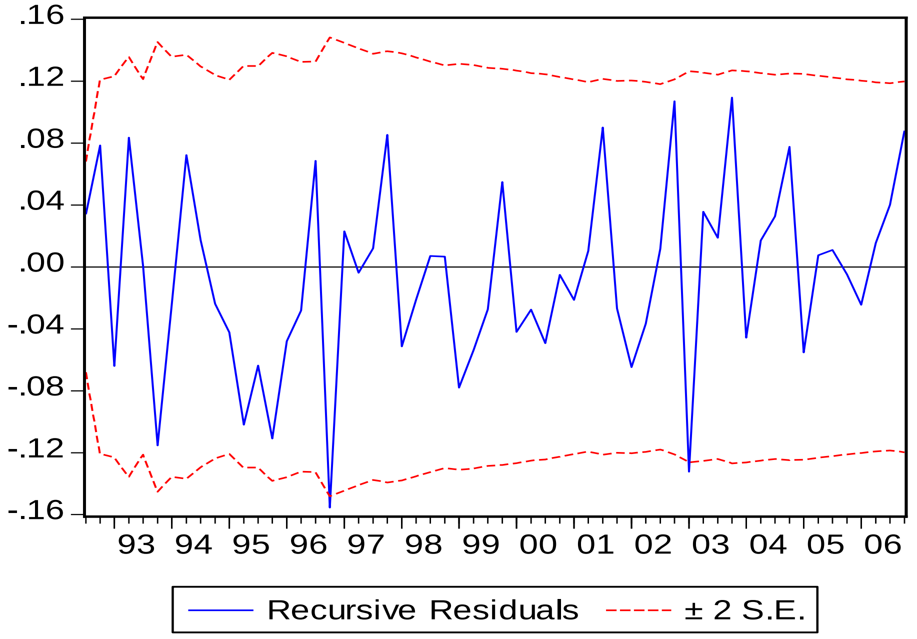
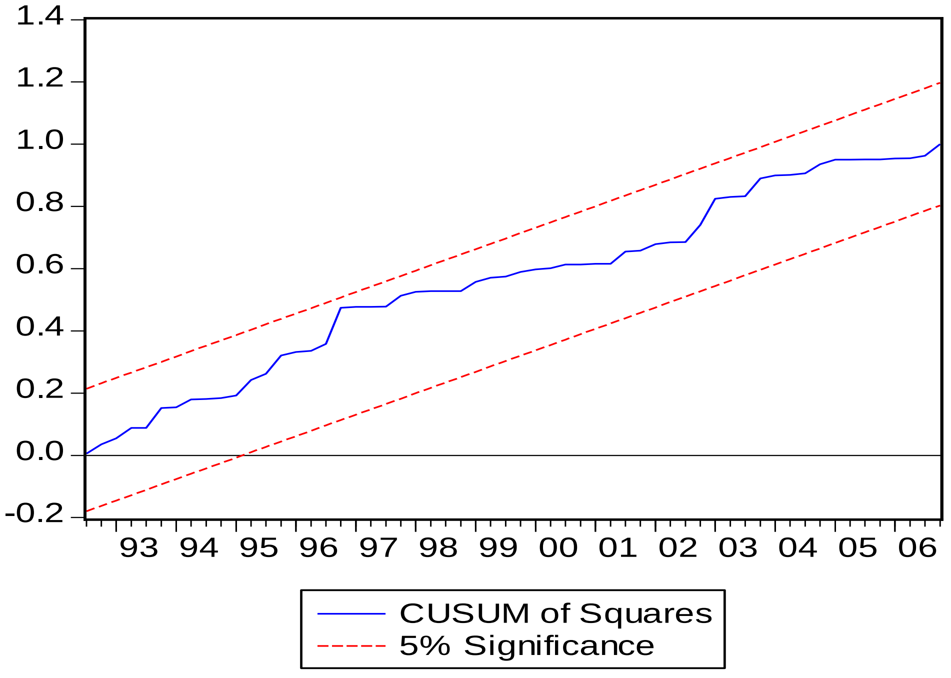


Chart 4: CUMUMQ Test for the lmp2 model



For the lmp2+ real money demand function, the ECM results indicates that the model is well specified as suggested by the Ramsey Reset model specification test, which is significant at 5% level. The model also passed the Serial Correlation LM test, indicating the absence of serial correlation which normally affects the efficiency of the parameter interpretation. The model further passed the Autocorrelation Conditional Heteroschedasticity test as indicated by low F-statistics as shown in the results.

The R-squared suggests that 59% of the variations in real money balance could be explained by the variations in income, interest rate and exchange all together. All of the variables have the correct signs and are all significant except the exchange rate variable, which is insignificant even at 10%. The ECM term has the right sign and is also significant at both 1% and 5% levels. The estimated parameter of the ECM term indicates 28% speed of adjustments to eventual equilibrium in a disequibria conditions.

Table 8: Dependent Variable: DLmp3
Method: Least Squares
Included observations: 64 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.003585	0.009924	-0.361237	0.7192
ECM33(-1)	-0.283634	0.070402	-4.028799	0.0002
DLrgdp(-3)	0.461025	0.061746	7.466453	0.0000
DLint	-0.003329	0.001891	-1.760141	0.0836
DLex(-1)	0.029919	0.116963	0.255801	0.7990

R-squared	0.598826	Mean dependent var	0.026416
Adjusted R-squared	0.571628	S.D. dependent var	0.085831
S.E. of regression	0.056177	Akaike info criterion	-2.845725
Sum squared resid	0.186193	Schwarz criterion	-2.677062
Log likelihood	96.06320	F-statistic	22.01709
Durbin-Watson stat	1.665796	Prob(F-statistic)	0.000000

ARCH Test:	F(3,56)=	1.252026	Prob.	0.299494
AR Test:	F(3,55)=	0.718672	Prob.	0.545017
Reset Test:	F(9,49)=	3.958944	Prob.	0.024550

Source: Author’s Own Estimation

Testing for the stability of real money demand for lmp2+(broad money), the Recursive Residual test and Cumulative Sums of Square Residual(CUMUQ) test was applied and the results suggests that the real money demand function for broad money is relatively stable compared to the other two real money demand functions for lmp1 and lmp2 which also show some degree of stability even though some periods falls outside the band.

Chart 5: Recursive Residual Stability Test for lmp2+ model

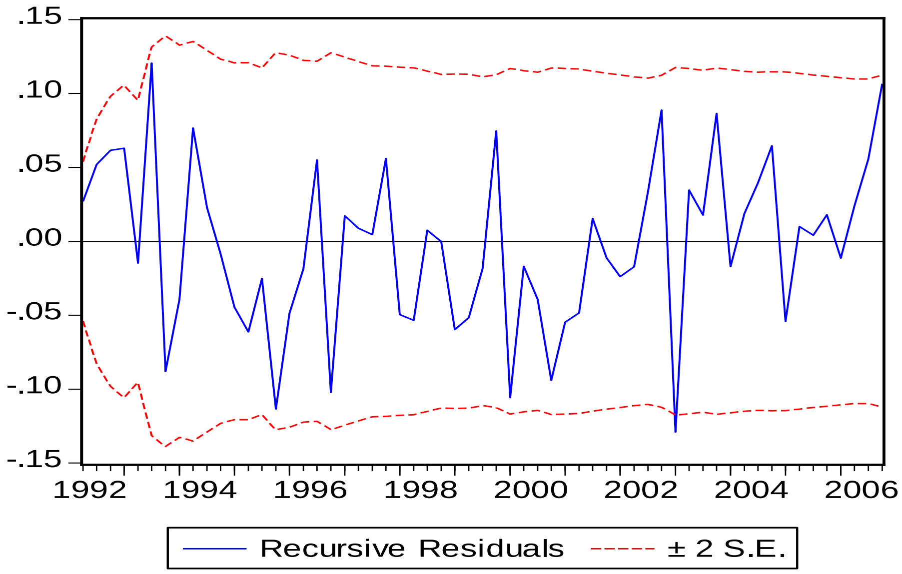
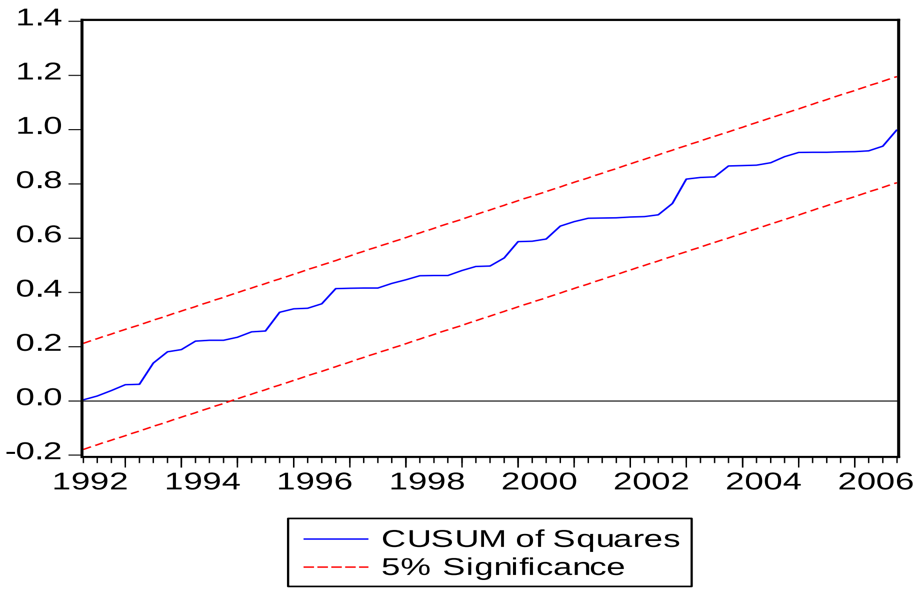


Chart 6: CUMUQ Residual Stability Test for lmp2+ Model



CONCLUSION

The study suggested that trends in the recursive residual and the cumulative sums of squared residuals generated from the model indicate that the money demand function in some periods shows some level of instability in the estimated money demand function using M1. Also, the recursive residual test and cumulative sums of squared test for stability in the real money function using M2 as depended variable revealed that the model exhibits some level of stability over the years even though some periods indicate some level of instability. Similarly, testing for stability of real money demand for lmp2+(broad money), the Recursive Residual test and Cumulative Sums of Square Residual(CUMUQ) tests were applied and the results suggests that the real money demand function for broad money is relatively stable compared to the other two real money demand functions for M1 and M2 which also show some degree of instability in some periods. The study concludes that real money demand function for M1 and M2 are remained relatively unstable compared with real money demand function for broad money which exhibits degree of stability.

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