Journal of Economics and Behavioral Studies (ISSN: 2220-6140)
Vol. 7, No. 5, pp. 79-90, October 2015

Structural Breaks, Stability and Demand for Money in South Africa

Sambulo Malumisa
University of South Africa, UNISA, South Africa
malumisas@gmail.com

Abstract: The paper tests the null hypothesis of a stable long-run money demand in South Africa over the period 1970-2013. We employ the Gregory-Hansen (GH) method to test for the possibility of structural breaks in the money demand function. The Johansen Maximum likelihood procedure is carried out to determine the cointegration vector from which existence of one cointegrating vector is supported. Also based on the GH criterion, there is existence of one cointegrating vector. GH proposes three structural breaks for the money demand function. Results suggest that endogenous breaks occurred in 1991 and 1994. The GH cointegration equations reject M1 whilst M2 and M3 pass and we proceed to estimate the error-correction model. Complemented by the CUSUM and CUSUM of squares, the tests carried out suggest that monetary policy shifts did not introduce instability.

Keywords: *Structural break, Money demand, Cointegration, error correction*

1. Introduction

The money demand function is crucial in the conduct of monetary policy in many economies in the world. One such important application is in the alignment of money supply consistent with targets in real economic growth and inflation (Wesso, 2002). As such studies on structural breaks and money demand functions continue to receive interest amongst researchers as they try and unlock the understanding behind the conduct of monetary policy. Many countries moved from use of direct monetary instruments post financial market developments. South Africa's financial sector also went through changes including credit controls, exchange rate and political; all of which affect its conduct of the monetary policy. Furthermore financial innovation has also been at the core of the changes. It therefore merits the case to test for stability in money demand post financial innovation and as well test as to whether there was a structural change. This also comes a time when interest rates have been at record low post global financial crisis. A question to reflect on will be; is the money demand function still stable? This also allows us to gauge the feasibility of price stability objective as the case in South Africa.

A number of studies have been considered for investigating money demand stability. However in these studies, contributing to mixed empirical findings have been different methodology, data frequency and even choice of variables. Dube (2013), Mutsau (2013), Tlelima and Turner (2004), Nell (2003), Johnson (2001) and Moll (2000) all estimated the money demand in South Africa using different approaches with different variables and data frequencies. At the same time they considered different monetary aggregates.
For instance Dube (2013) considered a Shopping-Time Technology and an ADL model testing for a stable long-run relationship between M3 and its determinants such as income, interest rates, inflation, and stock market prices. The results suggest a cointegration relationship between M3 and its determinants. Another interesting finding is the stock prices as a determinant. However the introduction of a dummy variable to capture inflation targeting turned out insignificant. Hall et al. (2009) associate the changes in M3 to changes in real wealth. However the difficulty in sourcing accurate wealth data poses a challenge in including it as a variable in the money demand function. Mutsau (2013) used an Autoregressive Distributed Lag (ARDL) approach for the money demand model. The results suggested cointegrating relationships for M2 and M3 and that money demand has remained stable.

This study contributes to knowledge in the field on a methodological approach in modelling money demand and as well to find answers considering mixed results from literature using annual data from 1980-2013. We also test for stability of money demand for different aggregates of money supply. This enables us to find a justifiable representation of the monetary aggregates. In this we consider M1, M2 and M3. Furthermore the study determines choice variables have the best combination in obtaining meaningful results. The study employs the GH cointegration methodology for structural breaks together with Johansen Maximum likelihood procedure to capture the presence of cointegration amongst variables. The major motivation for the GH procedure is that it allows one to test for cointegration when regime shifts are present in the data used since conventional approaches may lead to erroneous conclusions (Gregory et al., 1996). Furthermore, the GH approach is designed to be robust when there is a shift in the cointegrating vector. Other researchers have found the GH to be favourable especially when there are less frequent breaks (Gabriel and Martins, 2010); this is the case for South Africa. The data used in this study covers different regimes in the economy. As such the method permits changes in the intercept or slope coefficients. Furthermore, we make a specification for the money demand function wherein demand for money as a function of interest rate and real output fares best. Results suggest that the money demand function is still stable covering tumultuous periods in the financial markets. The remainder of the paper is structured as follows; section 2 presents literature review, Section 3 data characteristics and methodology. Results are presented in section 4 and section 5 concludes.

2. Literature Review

Economic theory posits the use of money supply as a target by the central bank towards realising output growth and reigning on inflation. Most importantly, a stable money demand function is positive for the attainment of these goals. It serves well that the relationship between money demand, real income, interest rates and exchange rates has captured interest amongst researchers in formulating the money demand function. Other studies have stressed the importance of a stable money demand function in an era of inflation targeting (see for example Hayo, 1999). It is assumed that as real GDP increases; the demand for money will also increase, supporting a positive relationship. Furthermore, when the price level increases, real money demand for transactions is expected to increase as well. Demand for money negatively relates with nominal interest rates. A number of studies have examined money demand stability with different considerations for the money demand function.

Literature has shown the use of various aggregates and their components for money demand. Akinlo (2006) applied the autoregressive distributed lag (ARDL) technique to examine the cointegrating property and stability of M2 for Nigeria. The findings from the study showed M2 to be cointegrated with income, interest and exchange rates. Inoue and Hamori (2008) for their study in India deduced that equilibrium relation exists when money supply is defined as M1 and M2 with cointegration results suggesting a cointegrating vector. The results for the money demand function in South Africa are somewhat mixed. Nell (1999) carried out a research on the existence of a stable long-run demand for money in South Africa. Results from the research showed that M3 was stable whilst M1 and M2 were unstable. Duca and VanHoose (2004) in their study highlight the unstable nature of M2.Related studies for South Africa verify the use M3 in the money demand function (Wesso, 2002; Stals, 1997; Mohr and Rogers, 1995). However, Tlelima and Turner (2004) and Johnsson (1999) both find parameter instability in the money demand function. Moll (2000) using M3 as a monetary aggregate applied general to specific specification for a money demand function and found that the parameters were stable and there was no evidence of structural change.

Studies also detail interest rate as an important variable affecting money demand function though with differences on choice between nominal and real interest (Apergis, 1999; Poole, 1970). Foreign indicator variables like the exchange rate and foreign interest rate have also been considered to play a role in the money demand function (Chowdhury, 1997; Carruth and Sanchez-Fung, 1997). Another prominent feature has been the consideration of the government bond yield as an opportunity cost proxy (Anderson and Duka, 2013; Wesso, 2002; Nell, 1999; Anwar and Asghar, 2012; Carstensen, 2004). Wesso (2002) and Brand et al. (2002) use time varying parameters (TVP) regression in investigating the stability of money demand for South Africa and euro area respectively. The findings suggest that the model can be considered for periods when the economy undergoes structural changes.

3. Data Characteristics and Methodology

Annual time series data from 1970-2013 is used, sourced from World Bank and the South African Reserve Bank (SARB).The money supply proxies in M1, M2 and M3 were scaled by the GDP deflator to get the real money supply. For short term nominal interest rate we used the bond yield rate as an opportunity cost proxy. Real GDP was sourced from the SARB. All variables used are in logarithmic form, except for interest rate. We used three model specifications initially to estimate the demand for money in the South African scenario. Below we specify the equations followed and also give a brief review of the GH methodology. For the data in use, logarithmic representation was considered for money demand, CPI, real GDP and interest rates. The relation can be expressed as follows;

$$\frac{M_t}{P_t} = L(Y_t, r_t) \quad (1)$$

M_t is nominal money supply;

P_t is the consumer price index;

Y_t represents real GDP and

r_t is the appropriate nominal interest rate

Within this model, the coefficient of Y is expected to bear a positive sign and we anticipate a negative sign for the coefficient of r. Our preference for nominal interest rates is that they show less variability when compared to the real interest rate brought about by inflation.
The logarithmic representation of (1) becomes thus;

$$\ln M_t - \ln P_t = \alpha_0 + \alpha_1 \ln Y_t + \alpha_2 \ln r_t + \varepsilon_t \quad (2)$$

The Gregory-Hansen Methodology: Gregory and Hansen's (GH) (1996a and 1996b) approach allows one to test for structural breaks. The method propounded allows residuals-based tests of the null hypothesis of no cointegration for the variables which areI(1) in the presence of structural breaks against the alternative of rejecting the null hypothesis. The GH methodology extends the Engle-Granger (1987) cointegration specification and thus is a multivariate extension of the univariate tests of Perron and Vogelsang (1992) and Zivot and Andrews (1992). Thus the GH approach allows one to test the presence of cointegration among variables given that they are I(1) with the regime change in the long run relationship at an unknown point. GH proposes four model specifications to take into account structural breaks in the cointegrating relationship. Specifications for the models are as set below;

$$Y_t = \alpha_0 + \delta_0 X_t + \varepsilon_t \quad (3)$$

The first model, equation (3) is the standard cointegration where Y_t represents a scalar variable and X_t is a vector of explanatory variables, ε_t is the disturbance term. The second model is the level shift denoted by C and is presented as;

$$Y_t = \alpha_0 + \alpha_1 \varphi_{tk} + \delta_0 X_t + \varepsilon_t \quad (4)$$

Where α_0 represents the intercept before the shift and α_1 is the change in intercept at the time of the shift. *k* is the break date and φ is a dummy variable such that:

$$\varphi_{tk} = \begin{cases} 0, & \alpha v \quad t \le k \\ 1 & \alpha v \quad t > k \end{cases}$$

The third model is the level shift with a trend, denoted. by C/T

$$Y_t = \alpha_0 + \alpha_1 \varphi_{tk} + \beta_1 t + \delta_0 X_t + \varepsilon_t \quad (5)$$

Where β_1 is the time trend coefficient

Lastly, the final model below allows for regime shift in the parameter of cointegrating vector

$$Y_t = \alpha_0 + \alpha_1 \varphi_{tk} + \delta_0 X_t + \delta_1 X_t \varphi_{tk} + \varepsilon_t \quad (6)$$

Here δ_0 and δ_1 denotes the cointegrating slope coefficient before the regime shift and the change in the slope coefficient respectively.

GH (1996b) built the statistics for the tests; ADF*, Z_α^* and Z_t^* which correspond to the traditional ADF test and Phillips test for unit root on residuals. In this application the null hypothesis of no cointegration with structural break is tested against the alternative of cointegration in the GH case. Furthermore, GH tabulated the critical values by modifying the Mackinnon (1991) procedure wherein the null hypothesis is rejected if the statistic ADF*, Z_α^* and Z_t^* is less than the critical value.

The GH criterion is superior to unit root test in that variables are more likely to have different structural break dates and therefore making it difficult to test the null of no cointegration with regime shift. Furthermore, in analysing the long term behaviour of variables, GH performs better than generic cointegration tests. GH tests are residual based and the null hypothesis of no cointegration corresponds to a unit root in the OLS residuals of models C, C/T, C/S and C/S/T. The logarithmic representations for the GH with structural breaks are as follows;

$$\ln M_t = \alpha_0 + \beta_1 \ln Y_t - \beta_2 \ln r_t - \varepsilon_t \quad (7)$$

$$\ln M_t = \alpha_0 + \alpha_1 \varphi_{tk} + \beta_1 \ln Y_t - \beta_2 \ln r_t + \varepsilon_t \quad (8)$$

$$\ln M_t = \alpha_0 + \alpha_1 \varphi_{tk} + \delta_0 t + \beta_1 \ln Y_t - \beta_2 \ln r_t + \varepsilon_t \quad (9)$$

$$\ln M_t = \alpha_0 + \alpha_1 \varphi_{tk} + \beta_1 \ln Y_t + \beta_{11} \ln Y_t \varphi_{tk} - \beta_2 \ln r_t - \beta_{22} \ln r_t \varphi_{tk} + \varepsilon_t \quad (10)$$

Vector Error Correction Model: Variables are cointegrated before consideration of a Vector Error Correction Model (VECM). The relationship of a VECM includes the lagged value of the residual from cointegration together with stationary variables as part of explanatory variables.

4. Results and Discussion

The section presents the unit root test, cointegration and error correction model results. To avoid spurious regression we check whether the variables have a unit root.

Stationarity Results: The unit root tests in table 1 show that the null hypothesis of unit root cannot be rejected in levels but is rejected in first differences as seen in both the PP and DF-GLS tests. We can conclude that the variables are stationary with first differencing.

Table 1: Unit Root Test Result

Variables	PP[1] test (with trend and intercept)		DF-GLS test [2](with trend and intercept)	
	Levels	1st Diff	Levels	1st Diff
Y	-1.332	-4.433***	-1.739	-4.56***
M_1/p	-3.358*	-6.9***	-2.454	-6.323***
M_2/p	-3.521*	-8.338***	-2.64	-6.266***
M_3/p	-3.634**	-10.434***	-2.713	-6.463***
Inflation	-3.41*	-11.521***	-2.59	-5.967***
R	-1.543	-10.597***	-1.822	-5.79***
Yield on bond	-1.753	-17.444***	-1.835	-7.137***

* ** *** stationary at 10% , 5% and 1% levels of significance respectively

Cointegration Results: Where variables in the model are non-stationary and only become stationary with first differencing, it becomes necessary to perform a cointegration test to determine whether a linear

[1] Phillips and Perron(1990)
[2] Dickey and Fuller (1979)

combination of the variables does converge to equilibrium. In this regard we applied Johansen and Juselius (1990), Johansen (1988) and the GH (1996a) representation.

Johansen's Cointegration Results

Table 2: M2 Johansen-Juselius maximum likelihood cointegration tests

LM	**Trace Test**			**Maximum Eigen value Test**		
Null Hypothesis	Alternative Hypothesis	Statistic	95% Critical Value	Alternative Hypothesis	Statistic	95% Critical Value
r=0	r≥1	34.8	29.8	r=1	20.69	21.13
r=1	r≥2	14.1	15.49	r=2	13.15	14.26

Table 3: M3 Johansen-Juselius maximum likelihood cointegration tests

LM	**Trace Test**			**Maximum Eigen value Test**		
Null Hypothesis	Alternative Hypothesis	Statistic	95% Critical Value	Alternative Hypothesis	Statistic	95% Critical Value
r=0	r≥1	30.25	29.8	r=1	21.36	21.13
r=1	r≥2	8.89	15.49	r=2	8.54	14.26

The test statistics reject the null hypothesis of no cointegration at 5 % significance level for both M2 and M3. The results suggest the presence of one cointegrating vector in both scenarios. This confirms the long run relationship between money demand, real GDP and interest rate over the sample period 1980-2013.

Gregory-Hansen Cointegration Results: Tables 4-6 present the cointegration results for the three models of GH with structural breaks for all proxies of money supply,M1, M2 and M3. For M1, the null hypothesis of no cointegration is rejected in the second model case of level shift with trend. For M2 the null hypothesis of no cointegration is rejected for models I and II. For M3 the null hypothesis is rejected for all models I-III. Results suggest endogenous breaks in 1991 and 1994 for both M2 and M3 monetary aggregates. It should be noted that the prominent break date of 1994 identifies with a period shortly after when trade sanctions on South Africa were removed. More positives can also be seen in the economy dominating the African scene, consistently attracting global FDI, hosting one of the leading stock exchanges in the world, inflation contained within target and pro-GDP growth monetary policy instruments.

Table 4: M1Gregory-Hansen Cointegration Test Result [3]

Model1	**Break date**	**G-H test statistic**	**5% critical value**
GH-I	1992	-4.64	-4.92
GH-II	1995	-5.86***	-5.29
GH-III	1992	-5.05	-5.5

Table 5: M2 Gregory-Hansen Cointegration Test Result

Model2	**Break date**	**G-H test statistic**	**5% critical value**
GH-I	1991	-4.82*	-4.92
GH-II	1994	-6.26***	-5.29
GH-III	1992	-5.12	-5.5

Table 6: M3 4Gregory-Hansen Cointegration Test Result

Model3	**Break date**	**G-H test statistic**	**5% critical value**
GH-I	1991	-5.1**	-4.92
GH-II	1994	-6.29***	-5.29
GH-III	1992	-5.39*	-5.5

[3] Gregory and Hansen's critical values are a modified version of the work by Mackinnon (1991)
[4] Nominal values for M1, M2 and M3 scaled by GDP Deflator

Table 7: M1 Cointegrating Equations

Variables	GH-I (1998)	GH-II (1981)	GH-III (1998)
Intercept	-106.39(-15.67)***	47.95(2.38)**	-108.07(-15.29)***
Trend		0.24(7.85)***	-
Break Date Dummy	-1.22(-2.9)**	-0.08(0.25)	71.26(0.84)
Y	8.3(16.32)***	-3.15(-2.11)	8.44(15.83)
Break Date Dummy*Y			-5.01(-0.87)
Govt Bond yield (lb)	-0.18(-0.66)	-0.25(-1.42)	-0.28(-0.90)
Break Date Dummy*lb			-0.18(-0.14)

* ***

Table 8: M2 Cointegrating Equations

Variables	GH-I (1991)	GH-II (1990)	GH-III (1991)
Intercept	-99.93(-16.42)***	42.15(2.45)**	-101.48(-16.04)***
Trend		0.22(8.44)***	
Break Date Dummy	-1.08(-2.87)**	0.12(0.43)	66.37(0.87)
Y	7.88(17.29)***	-2.66(-2.08)**	8(16.78)***
Break Date Dummy*Y			-4.66(-0.9)
Govt Bond yield (lb)	-0.11(-0.44)	-0.17(-1.15)	-0.2(-0.72)
Break Date Dummy*lb			-0.18(-0.15)

From the results of the cointegrating equations in tables 7-9, equation II for M1 rejected the null hypothesis of no cointegration however the corresponding cointegrating equation bore wrong sign for real GDP. For M2 equations I and II rejected the null hypothesis of no cointegration though the most plausible cointegration equation corresponds to equation I as it has expected signs and magnitudes. The real GDP elasticity of demand for money is 7.9 at 1% level, and the rate of interest elasticity of demand for money is 0.11. Finally for M3, all three GH equations rejected the null of no cointegration. However, cointegrating equations I and III have expected signs with real GDP elasticity of demand at 7.3 and 7.5 respectively at 1% level. The rate of interest elasticity of demand for money is at 0.2 and 0.28 respectively. Since for M1 the cointegrating equation bore incorrect signs, we therefore proceed to use the residuals for M2 and M3 obtained in the cointegrating equations to estimate the short run dynamic equation for the demand for money with the error adjustment model.

Table 9: M3 Cointegrating Equations

Variables	GH-I (1991)	GH-II (1994)	GH-III (1992)
Intercept	-92.15(-16.84)***	30.92(1.88)*	-93.45(-16.39)***
Trend		0.19(7.64)***	
Break Date Dummy	-0.88(-2.59)**	0.16(0.62)	54.89(0.80)
Y	7.3(17.9)***	-1.78(-1.45)*	7.46(17.34)***
Break Date Dummy*Y			-3.85(-0.83)
Govt Bond yield (lb)	-0.20(-0.90)	-0.26(-1.79)	-0.28(-1.12)
Break Date Dummy*lb			-0.13(-0.12)

Error Correction Models: In getting the short term ECM model we applied the LSE-Hendry general to specific modelling framework (Hoque and Al-Mutairi, 1996; Miller, 1991). To obtain the model the regression used differenced series of money demand (M) on differenced series of real GDP, interest rates, their lagged terms and with lagged terms of M. Using the LSE-Hendry methodology we reduced the number of lags across variables to get the best model. The culmination of this exercise resulted with the following parsimonious models;

Results for M2 for most coefficients are statistically significant. The coefficient of interest rate has the correct sign. Real GDP is significant at 5% level suggesting that a 1% increase in real GDP will result with money demand increasing by 1.1%. This confirms theory and empirical findings for South Africa that real GDP positively relates with money demand (for example Dube, 2013). Incorporating short-term dynamics in the error correction model we included the lagged M2 which turned out significant at 5%. The error correction term also bear the correct sign though with a speed of adjustment at 5%. The low error correction term might suggest the smoothing in M2growth which however is not observable in M3. This may also mask the unsuitability of the M2 aggregate as consensus literature supports M3. Crudely, the implication for the result is that for departures from equilibrium in the previous period, the current period corrects 5% of departures. For M3, the coefficient of interest rate is significant at 5%, highlighting the opportunity cost of holding money. Over the past years South Africa's government bonds have attracted attention locally and even internationally. The result also supports postulations in theory. However, real GDP is insignificant. The speed of adjustment for the error correction term is higher than for M2 at 18%, suggesting 18% current period corrections from departure in equilibrium in the [previous period. The model was also run with structural break dates. Though positive, the break date parameter was insignificant. This then confirms previous studies in South Africa highlighted in the literature which did not deuce structural breaks.

Testing the stability demand for money: Testing for the stability demand for money is important since the supply of money is one of the key instruments of monetary policy conduct by SARB. If for instance, the demand for money is stable then money supply can be considered suitable as a policy tool but if money demand function is not stable then the central bank can use interest rates as an appropriate tool for monetary policy. We applied the conventional methods to test for stability in the demand for money including the CUSUM, CUSUM of squares and recursive residuals. The plots for these are given in figures 1 and 2in the appendix. From the plots the demand for money function over the period 1970-2013 is stable.

Table 10: Regression Results[5]

Variable	ΔM2	ΔM3
Constant	0.075 (3.39)**	0.124 (2.09)**
Δi_{-2}	-0.04 (-1.11)	-0.63 (-3.49)**
ΔLGDP	1.115 (2.87)**	-
$\Delta LGDP_{t-2}$	-	0.39 (0.22)
$\Delta LM2_{t-1}$	0.36 (2.77)**	-
$\Delta LM3_{t-2}$	-	0.072 (0.56)
ECT(-1)	-0.05 (-2.73)**	-0.184 (-1.91)*
Break Date $_{1994}$	-	-
R^2	0.49	0.34
Adjusted R^2	0.35	0.28
SE of regression	0.20	0.24

[5] Incorporating the beak in the error correction model weakened the results and as such here we present results without the dummy variable for the structural break. The CUSUM and CUSUM of squares in the appendix also does not suggest structural breaks

Sum of squared resid.	1.14	1.01
Log likelihood	43.85	41.64
F-statistic	6.2	5.1
Prob.(F-statistic)	0.005	0.003
Mean dependent var.	0.16	0.17
S.D dependent var.	0.22	0.27
AIC	0.21	0.14
Hannan-Quinn crit.	-0.13	-0.32
DW	2.01	1.7

1.
2.

5. Conclusion and Recommendation

The study attempted to determine the existence of long-run equilibrium money demand function in South Africa over the period 1970-2013. The study was informed by the fact that South Africa underwent structural changes over the past three decades including the relaxation of exchange controls in the economy. As such these changes might have impacted the money demand function, making it unstable. To test this we employed the Johansen maximum likelihood procedure and the Gregory and Hansen tests, testing for possible structural breaks and estimating cointegration vectors. Furthermore, the error correction representation investigated the departure from equilibrium using two different proxies for money supply. From the results, money demand function is stable for South Africa over the study period. Cointegration results from the Johansen method show that there is one cointegrating vector both for M2 and M3 as proxies of money supply. For the Gregory and Hansen approach, the prominent endogenous structural break is 1994 for M2 and M3. This period coincides with trade sanctions lifted against South Africa. This paved way for liberalisation in the economy and financial innovation. Furthermore this translated to the adoption of a more flexible exchange rate as one of prudential macroeconomic fundamentals in South Africa. Results from cointegrating equations support M2 and M3 as they had expected signs. The error correction model representation shows a non-explosive adjustment to equilibrium at 5% and 18% for M2 and M3 respectively. Stability results based on the error correction model show that the demand for money in South Africa is stable for the sample period. Overall, M3 fared better in cointegration equations. In a way this suggests that financial innovations in South Africa have contributed to stability even in an era of inflation targeting. We can conclude that there is no evidence of structural change in the money demand relation

Monetary policy plays a pivotal role in an economy. As part of the major objectives of monetary policy is price stability. However, the evolution and development of the financial market has brought about volatility in the demand for money function. It is therefore important that appropriate levels of money supply are kept to balance the functioning of an economy. Results from the study point out that the conduct of monetary policy necessitates reliable quantitative estimates of money demand function. It would be advisable that the monetary authorities maintain the current stable levels in the monetary aggregate. A future extension of this study can consider time varying parameters with inclusion of additional explanatory factors as informed in the literature.

References

Akinlo, A. E. (2006). The Stability of Money Demand in Nigeria: An Autoregressive Distributed Lag Approach. *Journal of Policy Modeling*, 28, 445-452.

Anderson, R. G. & Duca, J. V. (2013). Money Demand and the Liquidity Accelerator in an Era of Financial Uncertainty and Innovation. Federal Reserve Bank of St. Louis, December 18, 2013.

Anwar, S. & Asghar, N. (2012). Is Demand For Money Stable in Pakistan? *Pakistan Economic and Social Review*, 50(1), 1-22.

Apergis, N. (1999). Inflation uncertainty and money demand: Evidence from a monetary regime change and the case of Greece. *International Economic Journal*, 13(2), 21-30.

Carruth, A. & Sanchez-Fung, J. R. (1997). Money Demand in the Dominican Republic. *Applied Economics*, 32, 1439-1449.

Carstensen, K. (2004). Is European Money Demand Still Stable. *Kiel Working Paper*, 1179, 1-43.

Chowdhury, A. R. (1997). The financial structure and the demand for money in Thailand. *Applied Economics*, 29, 401-409.

Dickey, D. A. & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, 74, 427-431.

Dube, S. (2013). The Stability of Broad Money Demand (M3) in South Africa: Evidence from a Shopping-Time TEchnology ad an ARDL Model. *Journal of Applied Finance & a* 3(6), 225-247.

Duca, J. & VanHoose, D. (2004). Recent developments in understanding the demand for money. *Journal of Economics and Business*, 56, 247-272.

Engle, R. & Granger, C. (1987). Cointegration and Error Correction: Representation, Estimation and Testing. *Econometrica*, 55, 251-276.

Gabriel, V. J. & MArtins, L. F. (2010). Cointegration TEsts Under Multiple Regime Shifts: An Application To The Stock Price-Dividend Relationship. Discussion Papers in Economics DP09/10 (University of Surrey), 2010.

Gregory, A. W. & Hansen, B. E. (1996a). Residual-based ests for cointegration in models with regime shifts. *Journal of Econometrics*, 70(1), 99-126.

Gregory, A. W. & Hansen, B. E. (1996b). Tests for cointegration in models with regime and trend shifts. *Oxford Bulletin of Economics and Statistics*, 58(3), 555-559.

Gregory, A. W., Nason, J. M. & Watt, P. G. (1996). Testing for structural breaks in cointegrated relationships. *Journal of Econometrics ,* 71, 321-341.

Hall, S., Hondroyiannis, G., Swamy, P. A. V. B. & Tavlas, G. (2009). Where has all the Money Gone? Wealth and Demand for Money in South Africa. *Journal of African Economies*, 18(1), 84-112.

Hayo, B. (1999). Estimating a European money demand function. *Scottish Journal of Political Economy*, 46(3), 221-224.

Hoque, A. & Al-Mutairi, N. (1996). Financial deregulation, demand for narrow money and mnetary policy in Australia. *Applied Financial Economics*, 6, 301-305.

Inoue, T. & Shigeyuki, H. (2008). An Empirical Analysis of the Money Demand Function in India. Economics Discussion Paper 66, September 2008.

Johansen, S. (1988). Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control*, 12(203), 231-254.

Johansen, S. & Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointragration with Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, 52(2), 169-210.

Johnson, G. (2001). Inflation, Money Demand and Purchasing Power Parity in South Africa. *IMF Staff Papers*, 48(2), 243-265.

Jonsson, G. (1999). Inflation, Money Demand and Purchasing Powe Parity in South Africa. *International Monetay Fund Staff Papers*, 48(2), 243-265.

Mackinnon, J. G. (1991). Critical values for cointegration tests. In Long run Economic Relationship: Readings in Cointegration, edited by R.F Engle and C.W.J Granger, 267-276. Oxford University Press, 1991.

Miller, S. M. (1991). Monetary Dynamics: An application of cointegration and error-correction modeling. *Journal of Money, Credit and Banking*, 23, 139-154.

Mohr, P. & Rogers, C. (1995). *Macroeconomics.* Third. Johannesburg: Lexicon Publishers, 1995.

Moll, P. G. (2000). The Demand for Money in South Africa: Parameter Stability and Predictive Capacity. *South African Journal of Economics*, 68(2), 190-211.

Moll, P. G. (2000). The Demand for Money in South Africa:Parameter Stability and Predictive Capacity." *South African Journal of Economics*, 68(2), 190-208.

Mutsau, I. (2013). Empirical Analysis of Money Demand in South Africa (1980-2011). Mcom Economics Dissertation, Richards Bay, South Africa: University of Zululand, 2013.

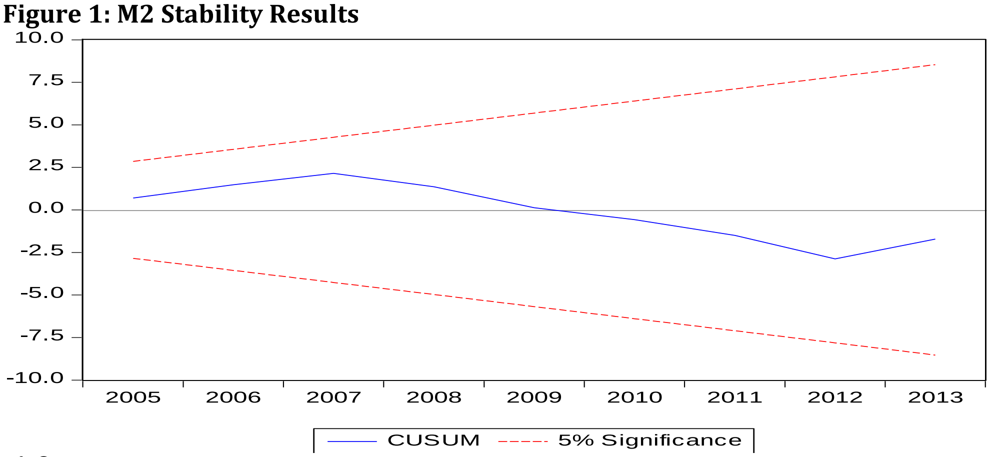
Nell, K. S. (1999). The Stability of Money Demand in South Africa, 1965-1997." *Studies in Economics*, 99(5).

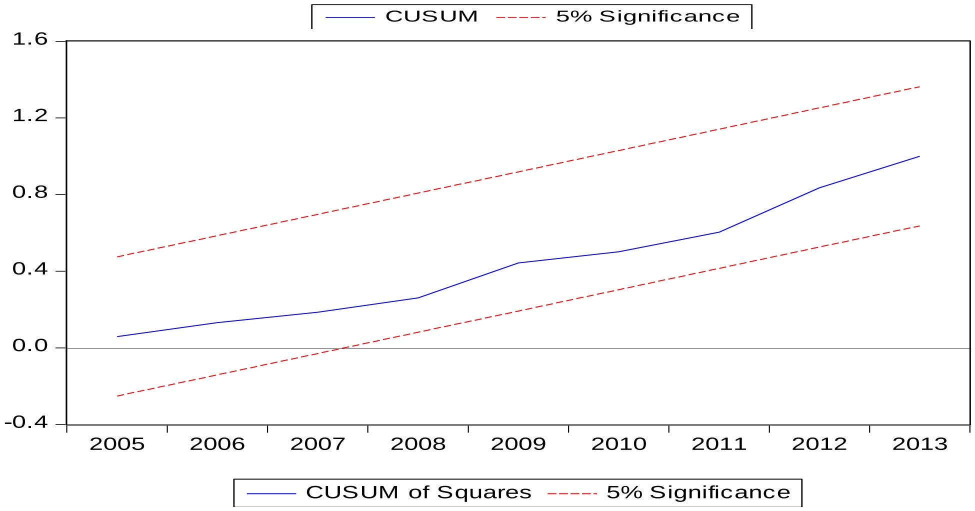
Nell, K. S. (2003). The Stability of M3 Money Demand and Monetary Growth Targets: The case of South Africa. *Journal of Developments Studies*, 39(3), 233-252.

Perron, P. & Vogelsang, T. J. (1992). Nonstationarity and level shifts with an applicatinon to purchasing power parity. *Journal of Business and Economic Statistics*, 10, 301-320.

Phillips, P. C. B. & Peron, D. (1988). Testing for a unit root in time series regressions. *Biometrica*, 75(2), 335-346.
Poole, W. (1970). The Optimal Choice of Monetary Policy Instruments in a Simple Macro Model. *Quarterly Journal of Econometrics*, 84, 192-216.
Stals, C. (1997). The current monetary situation and implications for 1998. Huysamer Stals Investment Conference. Johannesburg, 1997.
Tlelima, T. & Turner, P. (2004). The Demand for Money in South Africa: Specification and Tests for Instability. *South African Journal of Economics*, 72(2), 25-36.
Wesso, G. R. (2002). Broad money demand and financial liberalisation in South Africa. Occasional Paper No 18 (South African Reserve Bank).
Zivot, E. & Andrews, D. W. K. (1992). Further Evidence on the Great Crash, The Oil-Price Shock and the Unit Root Hypothesis. *Journal of Business and Economic Statistics*, 10, 251-270.

Figure 1: M2 Stability Results





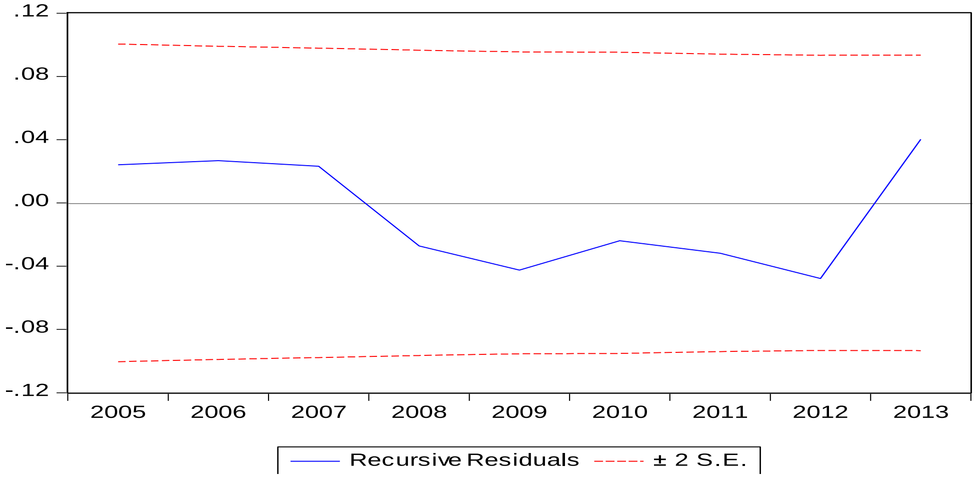
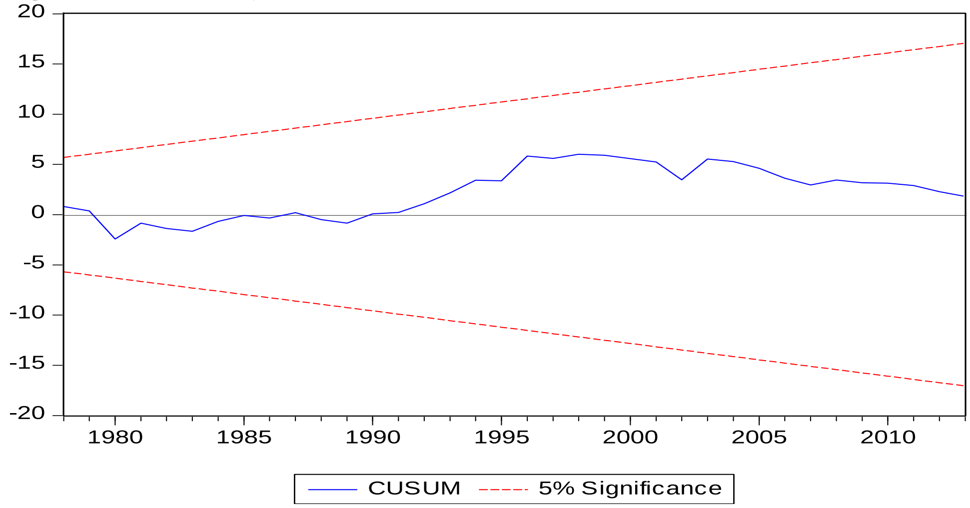
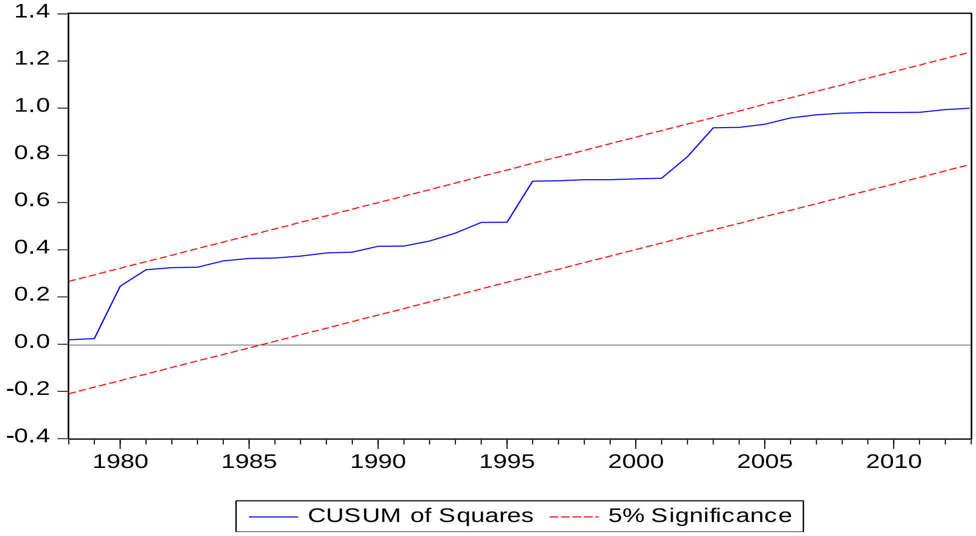
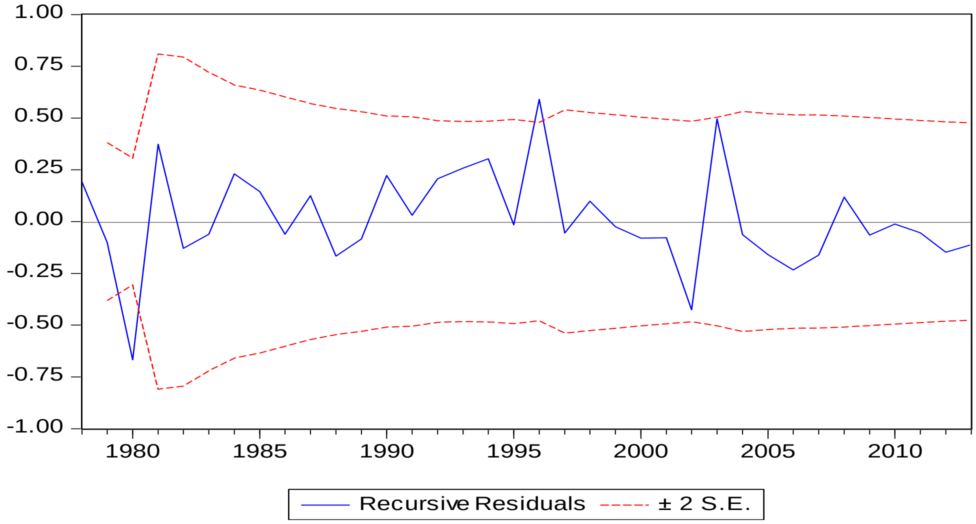


Figure 2: M3 Stability Results






1.00
0.75
0.50
0.25
0.00
-0.25
-0.50
-0.75
-1.00
1980
1985
1990
1995
2000
2005
2010
Recursive Residuals
± 2 S.E.