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An Analysis of the Money Demand Function for Zambia: A Gregory Hansen Cointegration Approach

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Abstract: The objective of this study was to analyze the money demand function for Zambia for the period 1978 – 2018 using annual time series data. The study employed the Gregory Hansen cointegration technique. The study also employed Hendry's General to Specific technique to estimate the error correction model by obtaining a parsimonious model. The results of the Gregory Hansen test confirmed the presence of a cointegrating relationship and selected the GH-2 model as the most plausible model with a level shift and a trend. The results also endogenously determined 1994 as the break year in the money demand function. Other interesting results obtained by the study suggest that inflation and interest rate are the robust determinants of real money demand both in the short and long run. Furthermore, unlike many other developing countries, the results show that money is a necessity in Zambia. The other interesting results suggested by the study are that the financial sector reforms of 1994 diminished the demand for real money; however, the positive time trend suggests that there has been an increase in real money holdings over time in Zambia. The low-interest elasticity of money demand also potentially compromises the effectiveness of money supply as a monetary policy tool for economic stabilization. The results of the CUSUM and CUSUMSQ confirm the stability of the money demand function in Zambia.

Keywords: *Gregory-Hansen, Money demand function, Structural break.*

1. Introduction

Monetary policies have been widely used by many developed and developing countries to achieve low levels of inflation and to stimulate economic growth. Arguably, the money demand function assumes a significant part in the detailing of monetary policy strategies. According to Cinar and Nur (2018), the money demand function relates money demand that is made by various motives to its determinants. A sound comprehension of the stability and determinants of the money demand function is key in the implementation of monetary policy. This enables the Central Bank to implementation of policy-driven changes in monetary aggregates to influences macroeconomic variables [1] (Subraram, 1999; Nachega, 2011; Halicioglu & Ugur, 2005). Over the past three decades, many countries have revised their economic structures. Starting from the deregulation policies of the 1980s, where industrial and labor policies in most developed countries moved from direct government intervention policies to market forces and competition[2]. Initially, market-based monetary policy instruments were not plausible. This was due to the perceived underdeveloped financial markets and the control of interest rates. Consequently, many developing countries later started adopting similar structural changes.

Hence, many countries later abandoned the use of direct monetary policy instruments (Omotor, 2011). Advocates of financial liberalization supported the shift to a more robust system in which monetary variables would be determined by market forces and competition. In Zambia, financial liberalization began in 1987 through to 1993, after the cancellation of the structural adjustment program and the 1989-1993 Economic Recovery Program (ERP) (Maimbika & Mumangeni, 2016). From 1964, Zambia has explored at least three monetary policy frameworks. This has entailed the shift in monetary policy instruments and their targets. It is opined that developments in the monetary system might affect the stability of the money demand function (Al Rasasi, 2016; Soto & Tapia, 2001). Generally, there is scant literature on the stability of money demand especially in Sub-Saharan Africa (SSA). Although some researchers have estimated the stability of money demand (Al Rasasi, 2016; Kjosevski, 2013; Soto & Tapia, 2001), a limited number of studies have explored the

[1]For more details on the importance of a stable money demand function, see Nduka (2014).
[2]The objective of this move was to enhance the resilience of economies, promote resource allocation and, to facilitate economic growth, see Pera (1989).

money demand function stability in light of structural breaks (Nyong, 2014; Omotor (2011); Nachega, 2011; Soto & Tapia, 2001).

Particularly, in Zambia, Zgambo and Chileshe (2014) empirically analyzed money demand stability in Zambia but their study did not account for structural breaks. Therefore, this study purposes to fill this literature gap. Furthermore, this study purposes to endogenously determine the break date in the cointegrated money demand function for Zambia. Additionally, it purposes to investigate the robust determinants and stability of the money demand function for Zambia in light of the endogenously determined break date. Such an empirical inquiry can be done by applying cointegration methods in models with the regime and trend shifts[3]. The rest of this paper is organized as follows; section 2 looks at the overview of the Zambian monetary policy frameworks, then the relevant literature reviewed is presented in section 3. Section 4 gives the theoretical framework and outlines the specific methodology that is employed. The results are presented in section 5. Section 6 presents the conclusion and recommendations from the study.

Review of the Regime shifts and Macroeconomic Performance in Zambia: The monetary policy framework in Zambia has undergone some changes in the recent past particularly following multiparty political independence in 1964, the Structural Adjustment Programme (SAP) of the late 1980s and financial liberalization of the early 1990s.

The Period 1964 – 1991: After Zambia's independence in 1964, all economic activities were controlled by the Government through nationalization and monetary policy in Zambia were performed using direct instruments and were guided by multiple objectives. Because of this, the economy plunged into long-term stagflation[4]. This to a large extent propagated the emergence of a new Government in 1991[5] (Maimbika & Mumangeni, 2016; Kalyalya, 2001; Zgambo & Chileshe, 2014).

The Period 1991 – 2011: The new government liberalized the economy in 1991[6]. After 1991, the Bank of Zambia (BoZ) adopted the Monetary Aggregate Targeting (MAT) framework. According to Zgambo and Chileshe (2014), the MAT framework was based on a strong and stable relationship between monetary aggregates and inflation which was the primary monetary policy target. This framework is believed to have been effective looking at the reduction in inflation rates from triple digits such as 165.7% in 1990 and 183.34% in 1991 to current single digits; 6.6% in 2015 and 7.5% in 2016 (World Development Indicators). In 1996, the Bank of Zambia was given autonomy to conduct monetary policy and began making use of indirect instruments (Kalyalya, 2001). These changes led to an improvement in Zambia's macroeconomic environment.

The Period After 2011: In 2012, inspired by a new modernized monetary policy framework, BoZ introduced the Policy Rate in retaliation to the MAT framework to achieve price stability. The Policy Rate provides a credible anchor in determining interest rates. Following the introduction of the Policy Rate, the operational target of monetary policy shifted to interest rates from reserve money (BoZ Monetary Policy Statement, December 2012). The introduction of the policy rate also poses several advantages for macroeconomic management in Zambia[7].

2. Literature Review

Although there is scant empirical work on the stability of money demand and its function. Some studies have made use of panel data techniques such as Naraya et al. (2009) who assessed the money demand function for five South Asian countries between 1974 and 2002. The study employed panel cointegration tests and established that money demand is cointegrated with its determinants. These include real exchange rates, real

[3] See Gregory and Hansen (1996a; 1996b).
[4] This was as a result of the global oil price shocks of the 1970s and the plunge in the global prices of copper.
[5] Movement for Multi-party Democracy (MMD) which adopted economic and structural reforms
[6] This included the decontrolling of interest rates and the removal of exchange rate controls among others, see Kalyalya (2001).
[7] See Zgambo and Chileshe (2014) and BoZ Monetary Policy Statement (December, 2012)

income, and both the short-term domestic and foreign interest rates. Hamdi et al. (2015) also made a similar inquiry in the Gulf Cooperation Council Countries between 1980Q1 and 2011Q4. The study applied panel cointegration tests. The results reveal that there is cointegration in the model. The results suggest a stable long-run money demand function.

These results are similar to the ones obtained by Narayan et al. (2009) who used a similar methodology. The Granger non-causality test procedure suggests bidirectional causality. Other studies have explored time series techniques making use of the error correction model. Vega (1998) estimated the money demand stability for Spain using structural stability tests in regressions with variables integrated of order one between 1979 and 1995. This study also used the error correction model. The results indicate that financial system openness affects the long-run stability of the money demand function. Lestano et al. (2011) estimated the stability of narrow money demand in Indonesia between 1980Q1 and 2004Q4 making use of an Autoregressive Distributed Lag (ARDL) model. The findings suggest that broad and narrow money demand equations are cointegrated. The results also reveal that the narrow money demand is stable, whereas the converse is true for broad money demand. Cziraky and Gillman (2006) used monthly data to estimate the money demand for Croatia from 1994 to 2002. A two-equation cointegrated system was used and evidence shows that there is a stable money demand that rapidly convergences back to equilibrium after-shocks. Other studies also used the unrestricted error correction model such as Al Rassai (2016) for Saudi Arabia, who assessed the stability of money demand between 1993Q1 and 2015Q3. The study applied the Johansen cointegration test and the findings suggest stability of money demand in the long run. Likewise, the results also suggest that the long-run estimates are consistent with theoretical expectations. As opposed to using the conventional CUSUM and CUSUMSQ stability tests, this study used Hansen (1992) stability tests and established that the money demand.

In the same way, Kjosevski (2013) investigated the determinants and stability of money demand in Macedonia. This study employed monthly data from January 2005 to October 2012. The results of the VECM provide evidence that exchange rate and interest rates explain most long-run variations of money. A few studies have used estimation techniques that allow for structural changes. Omotor (2011) used the Gregory and Hansen procedure to analyze the demand for money in Nigeria in light of structural breaks for the period 1960 - 2008. The study determined that 1994 was the endogenous break date. Like previous studies, the findings of this study also suggest a stable money demand function for Nigeria**.** Kumar, Webber and Fargher (2013) also made use of the same methodology to determine the level and stability of narrow money demand in Nigeria for the same period. However, unlike the results obtained by Omotor (2011), the findings of this paper suggest that the improved the scale economies of money demand to a less extent and money demand is stable. These results agree with those obtained by Nduka (2014) who also made use of the same methodology by analyzing the behavior of money demand in India between 1953 and 2008. The results of this study confirm the presence of cointegration. The results also suggest a break in the year 1965. Additionally, the study suggests a reduction in the demand for money by about 0.33% around the break year. The results also suggest that the demand for money is stable except between the years 1975 and 1998. These results are similar to those obtained by Omotor (2011) and; Kumar et al. (2013). Similarly, Nyong (2014) estimated the demand for money in the Gambia between 1986Q1 and 2012Q4 in light or regime shifts. The findings show that there exists a cointegrating relationship between money and its determinants namely income, inflation, exchange rate and interest rate. The results further suggest a structural break in 1995Q1.

The results also suggest the instability of money demand. However, the stability results are contrary to the findings for Omotor (2011) mainly due to the military coup in the Gambia and fall in foreign aid during the period. Very few studies on the stability of the money demand function have been done in Zambia. Zgambo and Chileshe (2014) modelled the money demand function in Zambia using the Autoregressive Distributed Lag (ARDL). The findings indicate that exchange rates, treasury bills rates and real income affect the money demand function in the long-run while inflation plays a similar role in the short-run. The findings also show that the money demand function stable and this iterates the relevance of monetary aggregates in the implementation of monetary policy in Zambia. Mutoti et al. (2012) in a similar study established that income, exchange rate and 90 days Treasury bill rate all affect money demand. The study also shows that the time trend which was used as a proxy for financial liberalization is positively related to money demand. The study also established that Zambia's demand for money function is stable. All these results confirm the finds of

Zgambo and Chileshe (2014). Another study by Adam (1999) analyzed monetary policy reforms in Zambia. The findings of the study suggest a stable money demand function with a break in the long run. These results are in agreement with the results of other studies like Zgambo and Chileshe (2014) and Mutoti et al. (2012). Also, the findings suggest that there is an increase in the variation of money demand around 1989, but it begins to reduce around 1994. From the literature reviewed, researchers have explored various methodologies on various data sets there is, however, a gap in empirical work on the stability of the money demand function allowing.

3. Theoretical Framework and Methodology

Money demand theory originated from the Keynesian Liquidity preference theory of holding money and the contributions from the monetarists such as Milton Friedman (1956). Additionally, the inventory theory[8] also contributed to the extensions of the Keynesian Liquidity preference theory of holding money (Nyong, 2014). Keynes Liquidity preference theory postulates that there are three motives for holding real money balances: transaction motives; precautionary motives; and speculative motives for money demand. Under Classical economics, the transactions and precautionary motives of money demand argue that the demand for real money balances depends on the interest rates (Zgambo & Chileshe, 2014). Under the speculative motive, Keynes argued that interest rates cause uncertainty about the future and this may influence the demand for money. For structural breaks especially in Zambia, no study has used the Gregory-Hansen cointegration approach in the presence of an endogenously determined structural break. Keynes believed that money does not earn any interest because it is a perfectly liquid asset. On the other hand, bonds pay interest on future income.

Several authors (Baumol, 1952; Tobin, 1956; Friedman, 1956) have contributed to theoretical literature by outlining theoretical distinctions between the transactions demand and the asset motive. Theoretically, real GDP positively affects the demand for money whilst interest rates negatively affect the price level as shown below (Zgambo & Chileshe, 2014). These relationships have been summarized in Keynes liquidity preferences theory equation below:

$$\frac{M^d}{P} = (Y^{(+)}, I^{(-)}) \qquad (4.1)$$

Where M is the demand for nominal demand for money; P is the nominal price level; therefore $\frac{M^d}{P}$ is the demand for real money; Y is real income; I is the interest rate. The interest rate is the rate of return on money and also the opportunity cost of holding money. The liquidity preferences theory equation assumes a unit elasticity of the nominal cash balances concerning the price level. On the other hand, an unstable money demand function implies that changes in money supply will not be closely related to prices and income hence it will be difficult to control inflation using adjustments in money supply (Zgambo & Chileshe, 2014). Based on the theoretical framework and empirical the suitable real money demand function is one in which real money demand a function of income, domestic interest rates and expected inflation. Furthermore, the Error Correction Model (ECM) is also observed to be the model of choice by many authors (Zgambo and Chileshe, 2014; Al Rassai (2016); Lestano et al. (2011) among others). This study adopts the model used by Lungu et al. (2012) and Zgambo and Chileshe (2014). This study also estimates money demand in the log-linear form, allowing the monetary aggregates and the scale variables to be expressed in logarithms (Akinlo, 2006; Omotor, 2011).

The model is therefore specified as follows:

$$In\frac{M^d}{P_t} = \beta_0 + \beta_1 lnY_t + \beta_2 E_t + \beta_3 R_t + \beta_4 INF_t + \varepsilon_t \qquad (4.2)$$

$$\beta_1, \beta_3 > 0\,;\ \beta_2, \beta_4 < 0\ or > 0$$

Where: $In\frac{M^d}{P_t}$ is the natural logarithm of the real demand for money *(lnRM)* which is broad money divided by the consumer price index (*M3 / annual change in inflation rate*), lnY_t is the natural logarithm of *GDP*, E_t is the real effective exchange rate, R_t is the real interest rate, INF_t is the annual *GDP* deflator and ε_t is the error, term. This study makes use of secondary annual data for the period 1978 to 2018. Real effective exchange

[8] See Baumol (1952) and Tobin (1956, 1958).

rate data were obtained from Bruegel data sets and the rest of the data from the World Development Indicators. When dealing with time-series data, it is common practice to test for the presence of a unit root to avoid spurious regressions which offer misleading estimates. It is important to note that Zambia has experienced regime changes as a result of the reforms put forward by the IMF. Hence, the data is likely to have structural breaks. Therefore, it is not enough to rely on conventional unit root tests[9]. Therefore, this study further employs the Zivot and Andrews (ZA) unit root test in the presence of a structural break. Due to a potential structural break, standard cointegration tests are not appropriate.

Therefore, this study employs the Gregory-Hansen (G-H) (1996a; 1996b)[10] cointegration technique that allows the structural break to be endogenously determined by the model (Sadeghi & Ramakrishna, 2014). It has many advantages over conventional cointegration tests in light of structural breaks. It can test cointegration in the presence of structural changes (Gregory & Hansen, 1992). The G-H is cointegration tests on the residuals that propose against the alternative hypothesis that there may be one break in the cointegrating vector. The G-H makes use of three models to test for cointegration in light of a structural break in the cointegrating vector. According to Sadeghi and Ramakrishna (2014), these three models take into account the existence of a potentially unknown endogenous single break date. They allow for structural changes in either the intercept alone, in both trend and level shift and a full break. The G-H is based on the *ADF,* Z_α and Z tests for cointegration and they do not provide any information concerning the timing of the break (Gregory & Hansen, 1996). Considering cointegration with a trend and no structural change:

$$y_{1t} = \mu + \beta_t + \alpha^T y_{2t} + \varepsilon_t \qquad t = 1, \dots, n \qquad (4.3)$$

Where y_{2t} is I (1) and ε_t is I (0). The general structural change considered in The Gregory and Hansen (1996) considers a general structure change that only allows changes in the intercept μ and/or the slope α but not the trend β. To model the structural change, a structural dummy variable as defined below is used:

$$D_{tb} = \begin{cases} 0, & if\ t \leq [Tb] \\ 1, & if\ t > [Tb] \end{cases}$$

Where the unknown parameter $b \in (0, 1)$ is the change point, and [ ] is the integer part. The G-H, three models follow the pattern of the structural change as follows:

Model 1: Level Shift (C)

$$Y_{1t} = \alpha_0 + \alpha_1 D_{tb} + \beta_1^T y_{2t} + \varepsilon_t \qquad t = 1, \dots, T \qquad (4.4)$$

Model 2: Level Shift with Trend (C/T)

$$Y_{1t} = \alpha_0 + \alpha_1 D_{tb} + \gamma t + \beta_1^T y_{2t} + \varepsilon_t \qquad t = 1, \dots, T \qquad (4.5)$$

Model 3: Regime Shift (C/S)

$$Y_{1t} = \alpha_0 + \alpha_1 D_{tb} + \beta_1^T y_{2t} + \beta_{11}^T y_{2t} D_{tb} + \varepsilon_t \qquad t = 1, \dots, T \qquad (4.6)$$

Where; equation (4.4) is the level shift, equation (4.5) is the level shift with a trend and equation (4.6) is the regime shift (structural change) and D is the break dummy. The G-H cointegration test is based on three test statistics. The small values of the test statistics provide enough evidence against the null hypothesis. These test statistics are:

$$Z_\alpha^* = \inf_{b \epsilon T} Z_\alpha(b) \qquad (4.7)$$

$$Z_t^* = \inf_{b \epsilon T} Z_t(b) \qquad (4.8)$$

$$ADF^* = \inf_{b \epsilon T} ADF(b) \qquad (4.9)$$

According to Gregory and Hansen (1996), simulation is used to approximate the limiting distribution of the test statistics (4.7) - (4.9) which are then calculated by fitting a response surface (MacKinnon, 1991). Therefore, to analyze the stability of the money demand function for Zambia, equation (4.2) is applied to equations (4.7) – (4.9).

GH-1: C: The crush model

[9] These tests might give misleading results if the series have structural breaks by failing to reject the hypothesis that series have unit root in the presence of structural break.

[10] The Gregory-Hansen methodology draws it's foundations from the Engle-Granger (1987) cointegration analysis (Omotor, 2011).

$$In\frac{M^d}{P_t} = \alpha_0 + \alpha_1 D_{tb} + \beta_1 lnY_t + \beta_2 E_t + \beta_3 R_t + \beta_4 INF_t + \varepsilon_{1t} \quad (4.10)$$

GH-2: C/T: Changing growth model

$$In\frac{M^d}{P_t} = \alpha_0 + \alpha_1 D_{tb} + \gamma t + \beta_1 lnY_t + \beta_2 E_t + \beta_3 R_t + \beta_4 INF_t + \varepsilon_{1t} \quad (4.11)$$

GH-3: C/S: Regime Shift

$$In\frac{M^d}{P_t} = \alpha_0 + \alpha_1 D_{tb} + \beta_1 lnY_t + \beta_{11} lnY_t D_{tb} + \beta_2 E_t + \beta_{22} E_t D_{tb} + \beta_3 R_t + \beta_{33} R_t D_{tb} + \beta_4 INF_t + \beta_{44} INF_t D_{tb} + \varepsilon_{1t}$$

(4.12)

Where; D_{tb} is the shift in the slope, intercept or trend coefficient, b is the break date. The parameter α_0, is the intercept prior to the shift, α_1 is the change in the intercept at the time of the break.

In model GH-3; β_1, β_2, β_3 and β_4 are the slope coefficients before the regime change. β_{11}, β_{22}, β_{33} and β_{44} are the change in slope coefficients at the time of the break. Following the cointegration test, the residuals from the selected model of the canonical specifications are used to estimate the Error-Correction Model (ECM). Hendry's General to Specific (GETS) technique is used to estimate the ECM by obtaining a parsimonious model. To test the stability of the parsimonious model, the CUSUM and CUSUMSQ tests are used.

4. Empirical Results and Analysis

According to table 1, the unit root results show that all the variables are I (1). However, both the ADF and PP unit root tests might be misleading in the presence of structural breaks due to their shortcomings. Therefore, the ZA unit root test in the presence of a structural break is used to complement these tests and the results are presented in Table 2.

Table 1: ADF and PP Unit Root Tests

Variables		ADF		PP	
		Levels	First Difference	Levels	First Difference
lnRM	***Intercept***	-0.228328	-9.773299***	-0.868210	-9.694295***
	Trend & Int	-1.161654	-10.00791***	-1.738280	-9.910215***
lnY	***Intercept***	0.114075	-4.598012***	0.114075	-4.554694***
	Trend & Int	-2.218635	-4.688897***	-1.712389	-4.580111***
E	***Intercept***	-1.120869	-5.925513***	-1.047277	-6.138222***
	Trend & Int	-2.385512	-5.876143***	-2.211517	-6.506151***
R	***Intercept***	-1.951388	-7.251833***	-2.023902	-7.201539***
	Trend & Int	-2.174016	-7.161103***	-2.291245	-7.114582***
INF	***Intercept***	-1.869009	-5.430166***	-1.975870	-5.444447***
	Trend & Int	-2.484109	-5.380117***	-2.329027	-5.394862***

Source: Author's computations. **Note:** *, ** and *** denote rejection of the null hypothesis at 10%, 5% and 1% significance level respectively.

Table 2: Zivot and Andrews (1992) unit root tests in the presence of a structural break

	lnRM	***lnY***	***E***	***INF***	***R***
Break Date	1992	2005	2005	1995	1993
t-statistic	-10.23425***	-3.387936	-4.079244	-8.170064***	-5.904098***

Source: Author's computations. **Note:** *, ** and *** denote rejection of the null hypothesis at 10%, 5% and 1% significance level respectively.

The ZA unit root test results show that all variables; M, Y, E, INF and R have breaks in 1992, 2005, 2005, 1995 and 1993 respectively. Due to the presence of breaks, conventional cointegration tests will not be feasible; hence, the G-H cointegration test is performed[11]. The results of the G-H cointegration test in table 3 suggest a

[11] The G-H cointegration test is performed with the null hypothesis of no cointegration tested against the alternative hypothesis of cointegration with breaks on unknown dates.

strong presence of cointegration in the ADF and the Z_t statistics. The results suggest that GH-2 with a break date in 1994 is the most plausible model[12]. Based on this rule of thumb[2], it is evident that the break was in 1994 and if it is ignored, the estimation will lead to wrong inferences which are not best for the model. The identified structural break date reflects the year in which several financial sector reforms were enacted[13].
According to the GH-2 cointegration estimates suggested in table 4, income is less than unity but has a positive and insignificant relationship with real money demand, implying that real money demand is income inelastic. This suggests that money is a necessity and supports the transactions motive for holding money. This is consistent with the findings of Omotor (2011) and Yesigat, Rao and Nagaraja (2018) who argue that financial sector reforms and technological improvements in payment systems among other factors decrease the income elasticity of money demand. However, this is inconsistent with the findings of Nyong (2014) and Simawu, Mlambo and Muriwirapachena (2018). Meanwhile, like the results obtained by Nyong (2014) and Kjosevski (2013), the exchange rate has a negative but insignificant relationship with real money demand.

This negative relationship suggests that economic players may exchange foreign currency assets for domestic currency assets following a depreciation of the Zambian Kwacha (Zgambo & Chileshe, 2014). However, this contradicts with the findings of Asongu, Folarin, and Biekpe (2019) who found a positive effect for some West African countries. On the other hand, real money demand negatively and significantly responds to variations in both the real interest rate and inflation rate. This suggests that money and financial assets are substitutes. It also suggests that interest rate is the appropriate opportunity cost variable in the long run. These findings conform with the findings of Nyumuah (2017) and Mansaray and Swaray (2012) but contradict with the findings of Narayan, Narayan and Mishra (2007) and Asongu, Folarin, and Biekpe (2019).

Table 3: The Gregory and Hansen (1996) Cointegration Test with Structural Breaks

Gregory Hansen Models	***ADF***		Z_t		Z_α	
	GH test statistic	**Break-Point**	**GH test statistic**	**Break-Point**	**GH test statistic**	**Break-Point**
GH-1	-6.76 ***	2012	-6.85***	2012	-44.03	2012
GH-2	-9.33***	1994	-9.45***	1990	-56.99	1990
GH-3	-7.17***	1998	-7.26***	1998	-45.99	1998

Source: Author's computations. **Note:** *** denotes rejection of the null hypothesis at the 1% significance level.

However, the low-interest elasticity of money demand compromises the effectiveness of money supply as a monetary policy tool for economic stabilization in Zambia. Furthermore, financial sector reforms diminished the demand for real money as seen from the negative and significant break dummy. This finding is not as expected because the financial sector reforms were targeted towards improving financial competitiveness and hence, increasing demand for real money. However, these findings conform with the findings of but contradict the findings of Nyong (2014) and Mansaray and Swaray (2012). Both the time trend and intercept have positive and significant coefficients. This also supports the selection of the GH-2 equation which implies that the endogenous change was indeed a level shift with a time trend. A positive and significant time trend suggests an increase in real money demand over time. This finding is consistent with the findings of Mansaray and Swaray (2012).

[12] The break date is determined at the point where the absolute value of the ADF test statistic is at its maximum.
[13] Towards the end of 1993, interest rates where decontrolled, exchange rates where then liberalized in 1994 following the cessation of the Exchange Control Act in 1994. Another notable event was the introduction of the Treasury bill tender system, the establishment of the Lusaka Stock Exchange (LuSE) in February 1994 and the strengthening of the financial sector by the enactment of the Banking and Financial Services Act in December 1994.

Table 4: Cointegrating Equation

Variables (Break date)	GH–1 (2012)	GH–2 (1994)	GH–3 (1998)
Intercept			
	12.10856***	18.23676***	28.73105***
	(0.0002)	(0.0000)	(0.0005)
Trend	-	0.052915***	0.023068
	-	(0.0000)	(0.1315)
LnY	0.310715**	0.019275	-0.486991
	(0.0355)	(0.9098)	(0.1757)
E	-0.003048	-0.002143	0.007844
	(0.5206)	(0.5966)	(0.2716)
R	-0.017990***	-0.012047***	-0.022052***
	(0.0000)	(0.0070)	(0.0004)
INF	-0.011072***	-0.013567***	-0.012500***
	(0.0000)	(0.0000)	(0.0000)
Dum_1994	-	-0.965599***	-
	-	(0.0000)	-
Dum_1998	-	-	-26.89540***
	-	-	(0.0075)
Dum_2012	0.341683**	-	-
	(0.0213)	-	-
LnY_1998	-	-	1.237588***
	-	-	(0.0073)
E_1998	-	-	-0.020916**
	-	-	(0.0312)
R_1998	-	-	0.021016
	-	-	(0.2034)
INF_1998	-	-	0.019541
	-	-	(0.2627)

Source: Author's computations. P-values are in parenthesis. **Note:** *, ** and *** denote rejection of the null hypothesis at the 10%, 5% and 1% significance level respectively.

The ECM is estimated using the GETS technique[14]. The results of the parsimonious short-run regression in table 5 reveal that real money balances are influenced by income, real interest rate, the dynamics of inflation and the past values of real money demand. The results also show that the ECT has a negative and highly significant coefficient. This implies that real money demand is cointegrated into its determinants in the pre and post-financial liberalization periods. The ECT implies that approximately 98.7 percent of the disequilibrium in real money demand from the previous period's shocks on the determinants will converge back to the long-run equilibrium in the current year. The diagnostic tests also confirm the robustness of the results obtained in this study[15]. The results of CUSUM and CUSUM Square tests in figures 1 and 2 respectively

[14] The ECM is performed on the preferred model; the GH-2. To achieve this, the optimal number of lags to be used in the estimation of the over-parameterised model are selected based on the AIC criterion. The AIC criterion selects a lag length of three. Using three lags, the differenced series of real money demand are regressed on its lags, the differenced and lagged terms of real GDP, real interest rate, exchange rate, inflation and the lagged residuals from GH-2 hence obtaining the over-parameterised model. Hendry's GETS technique is then applied to reduce the number of the regressors until the most parsimonious model is obtained.

[15] The DW statistic confirms that the model has no autocorrelation. The LM test confirms that there is no serial correlation among the variables. The Breusch-Pagan-Godfrey test confirms the presence of homoscedasticity and the Ramsey RESET test also confirms that the model is correctly specified at 1% significance level.

suggest that despite the presence of a policy-induced structural break, real money demand is stable over time. These findings conform to the findings of Zgambo and Chileshe (2014) and Doguwa et al. (2014) but contradict the findings of Nyong (2014).

5. Conclusion and Policy Recommendations

A stable money demand function is an important ingredient for the formulation of sound monetary policy and economic growth. A number of authors have argued the effect of financial sector reforms on real money demand. Owing to the financial sector reforms in Zambia during the early 1990s, this study investigated the money demand function for Zambia. The main departure of this study from other studies is that it incorporates a dummy variable for financial sector reforms and puts forward the Gregory Hansen cointegration approach which is the recommended cointegration test in light of structural breaks. After testing three models with different endogenously determined break dates, the study identified 1994 as the break date. This was the year in which exchange rates were liberalized following the cessation of the Exchange Control Act in 1994. Another notable event was the introduction of the Treasury bill tender system, the establishment of the Lusaka Stock Exchange (LuSE) in February 1994 and the strengthening of the financial sector by the enactment of the Banking and Financial Services Act in December 1994.

The results of the study suggest that both in the long run and short run, real interest rate and inflation are the significant determinants for real money demand in Zambia. However, the interest elasticity is very low hence this seems to compromise the effectiveness of the money supply in economic stabilization. The negative inflation elasticity supports the theoretical expectations of Milton Friedman and suggests that increases in inflation will lead to substitution between money and other financial assets. Additionally, although insignificant, the positive income inelasticity supports the transactions motive for holding money and suggests that money is a necessity in Zambia. The negative insignificant exchange rate suggests that agents may substitution between foreign currency assets and domestic currency assets following depreciation in the Kwacha. The other interesting results suggested by the study are that the introduction of financial sector reforms diminished the demand for real money in Zambia. Also, the positive and significant time trend suggests an increase in real money holdings over time. Additionally, after estimating a parsimonious ECM, it is evident that the model is stable and appropriate as the error correction term is highly significant. Finally, the stability tests suggest evidence of the stability of the money demand.

This finding conforms to the unitary elasticity of the demand for money. This implies that the Central Bank can effectively target interest rates using monetary policy. The findings of this study pose several policy implications. The stability of real money demand suggests that the Bank of Zambia can still use the money supply for monetary policy implementation. However, the low-interest elasticity would mean that the money supply would not be very effective. Therefore, even as the Bank of Zambia has opted to modernize monetary policy by introducing the policy rate as the key operating target, it would, therefore, be suggested that the central bank adopts a mixture of operating targets. Finally, the Bank of Zambia should also closely monitor the real interest rate and inflation rate. The low-interest elasticity could also be due to the underdeveloped financial sector in Zambia. Therefore, efforts to develop the financial sector could also increase the effectiveness of the money supply for monetary policy implementation. The central bank should also try to keep moderate and stable levels of inflation to minimize agents from substituting money for other assets. This is because increasing levels of inflation tend to exert downward pressure on the demand for real money by increasing the return on other assets.

Table 5: Parsimonious Dynamic Short –Run Money Demand Estimates, Dependent Variable: LNRM

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.034084	0.021331	1.597881	0.1257
D(LNRM(-2))	0.367667	0.121771	3.019340	0.0068***
D(LNRM(-3))	0.270466	0.122554	2.206911	0.0392**
D(LNY)	-0.315490	0.125427	-2.515320	0.0205**
D(LNY(-2))	-0.359191	0.234679	-1.530563	0.1415

D(LNY(-3))	0.312739	0.259568	1.204844	0.2423
D(E(-1))	-0.000519	0.002459	-0.211085	0.8350
D(E(-2))	0.003064	0.003649	0.839487	0.4111
D(E(-3))	-0.008593	0.004340	-1.979785	0.0617
D(R)	-0.015922	0.004120	-3.864189	0.0010***
D(R(-1))	0.003876	0.003818	1.015203	0.3221
D(R(-2))	-0.006583	0.004199	-1.567733	0.1326
D(INF)	-0.017174	0.002029	-8.462084	0.0000***
D(INF(-1))	0.005532	0.001829	3.025468	0.0067***
D(INF(-2))	-0.005842	0.002193	-2.663506	0.0149**
D(INF(-3))	0.004349	0.001311	3.317271	0.0034***
ECT(-1)	-0.986690	0.148404	-6.648676	0.0000***

Source: Author's computations. **Note:** *, ** and *** denote rejection of the null hypothesis at the 1%, 5% and 10% significance level respectively.

Figure 1: Stability Test for Short-Run Money Demand (CUSUM)

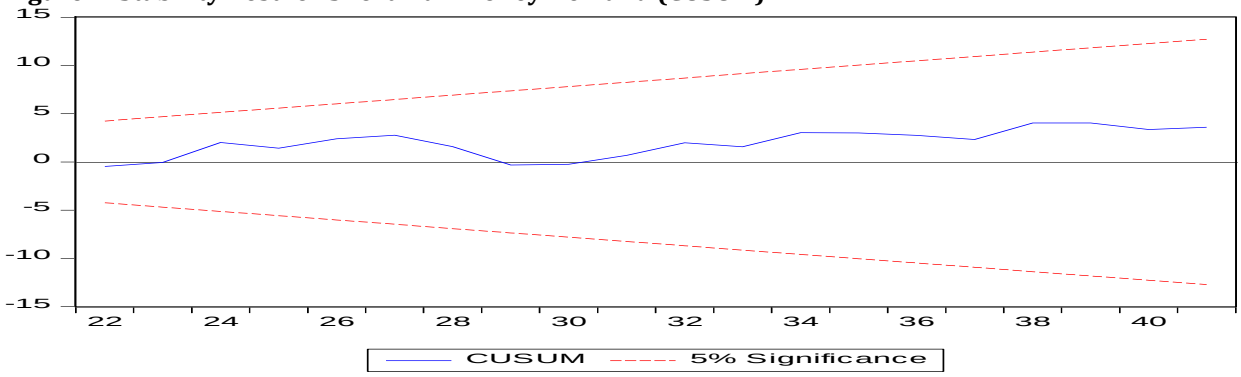
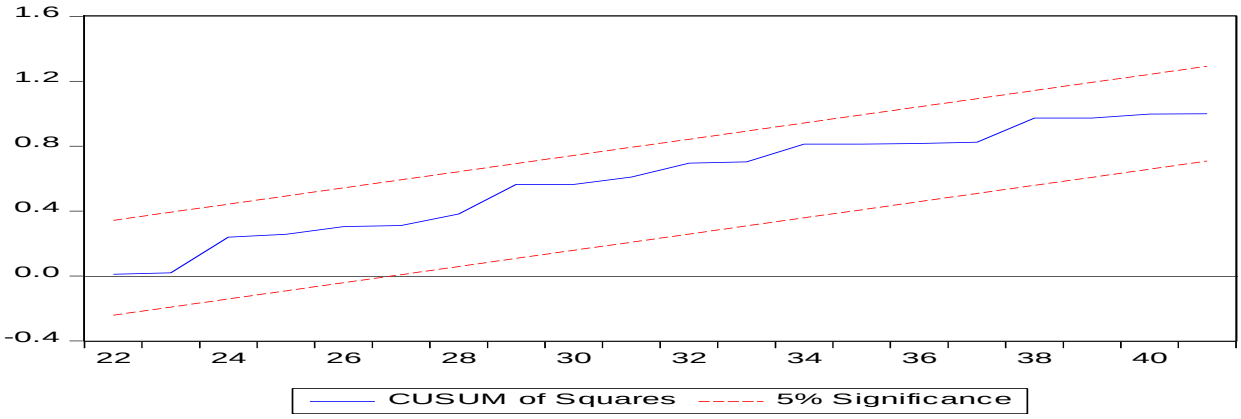


Figure 2: Stability Test for Short-Run Money Demand (CUSUMSQ)



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