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Money Supply Exogeneity and Endogeneity Under Zimbabwe's Multiple Currency Regime, 2009 to 2017.

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Abstract

The study brings new evidence on money supply determination by inviting the exogeneity and endogeneity debate to a rare monetary system - the multiple currency regime- currently used in Zimbabwe. Using monthly data from January 2009 to May 2017, unit root tests, the Johansen Cointegration test as well as Vector Error Correction Model (VECM) were employed to test long run causality between money supply, bank credit, bank deposits, monetary base and money multiplier. Johansen Cointegration tests confirmed the existence of cointegration amongst the variables. VECM causality tests provide evidence of a strong long run association running all variables to money supply. Further long run causality tests confirmed bidirectional causality between bank credit and money supply, bank credit and bank deposits, bank credit and monetary base. These results endorse that money supply under the multiple currency regime is strongly endogenous in line with the accommodationist and liquidity preference views. Endogenous money supply calls for policy interventions which induces the demand for credit to encourage production. The findings lend support to measures such as the RBZ's Afrexim Bank Export Incentive Facility. To complement this, the RBZ should come up with a medium to long term import substitution credit facility where producers of import competing goods receive a percentage of their domestic revenue as an incentive bonus to boost domestic production and curb foreign currency leakages.

Key Words: *Endogenous; Exogenous; Money Supply; Johansen Cointegration; VECM*.

1.0 Introduction

The debate on money supply determination, split between exogenous and endogenous views, has remained controversial and inconclusive, both theoretically and empirically, since the 17th century. The undying interest in the matter largely stems from corresponding monetary policy implications. Exogenous money supply coupled with a stable money demand function are foundations upon which monetary authorities build an effective monetary policy by controlling money supply through the monetary base and open market operations, (Wary, 1992a). Under the endogenous view, money supply does not drive economic activity but is rather driven by economic activity (Howell, 2010). In this regard the role of a monetary authority is to provide an impetus which stimulates private sector economic behavior. The main objective of this study was to examine whether money supply determination in Zimbabwe is exogenous or endogenous. The motivation of the present study is not limited to the inconclusivity of previous empirical studies. More importantly, it invites the exogeneity and endogeneity debate to a rare and complex circumstance of a multiple currency regime, which has not been examined thus far. Theoretically, there is a realistic position that the Reserve Bank of Zimbabwe has "lost control" over money supply determination. If this is true, is money supply completely endogenous? Is there any way the central bank can influence economic activity? The present study provides new evidence on money supply determination in a multiple currency regime environment.

The study is organized as follows; Section 2, background to the study, details monetary developments in Zimbabwe till the demise of the local currency into the multiple currency regime. In section 3, competing theoretical views on money supply determination - exogenous money and endogenous money - are discussed. In addition, recent empirical studies are reviewed. Section 4 discusses the research methodology and econometric estimation procedures used. Results analysis and discussion flows along estimation procedures.

2.0 Background to the Study

Zimbabwe's monetary economics history is amazing to read. At independence in 1980, the Zimbabwe Dollar (ZW$) replaced the Rhodesian dollar at par and was stronger than the United States Doller (US$), exchanging at

a rate of ZW$ 1: US$1.47 (IMF, 2010). In 2008, July 2008 to be precise, exchange rate was ZW$10 billion to 0.33 US$ (Nkomazana & Niyimbanira, 2014). In February 2009 it was rendered valueless following the introduction of a multiple currency regime, dominated by the US$. A surrogate currency - bond notes and coins- was introduced late 2016 to fight growing liquidity challenges. It initially traded at par with the US$, with parity lost by mid-2017 as the US$ was trading at no less than 1.20 Bond value (unofficial sources) on the black market. These monetary developments are symptoms of an economy which gradually moved from prosperity to prolonged deterioration and recession.

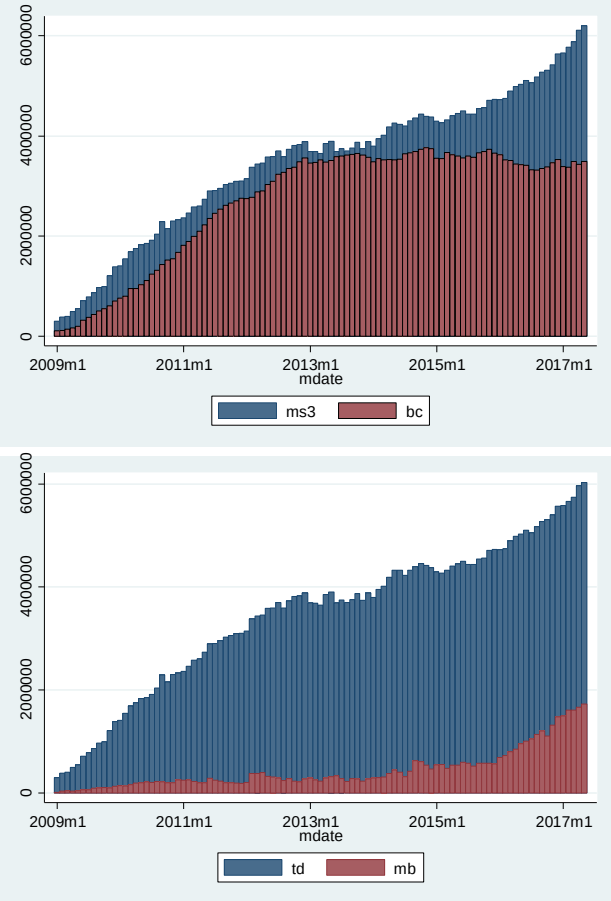
Zimbabwe inherited a vibrant and promising economy from Britain in 1980 which thrived during the first decade. The economy started to deteriorate in the 1990s following a series of events including the Economic Structural Adjustment Programme (ESAP), the unbudgeted DRC war in the late 1990s, controversial land reform programme in the early 2000s, International Monetary Fund (IMF) and World Bank (WB) isolation and deterioration of the rule of law (IMF[1], 2010; WB, 2017). From the early 2000s the RBZ engaged in quasi-fiscal policies in an attempt to equip land reform programme beneficiaries which worsened the continuously deteriorating budget deficit (Mufandaedza *et al* ,2016). Around 2008 the country was running out of foreign currency reserves and government resorted to printing money, with a 100 trillion dollar note, arguably the largest denomination of modern monetary regimes, circulating late 2008. Broad money supply (M3) growth increased sharply from 81 143.1% in January 2008 to 658 000 000 000% in December 2008 (RBZ, 2009). Zimbabwe plunged into record breaking hyperinflation with the last official memorable inflation rate recorded at 231 million % in July 2008 (ZimStat[2], 2013). In February 2009, the local currency was rendered valueless after a de-facto adoption of the multiple currency regime.

There is a contestation on whether Zimbabwe is in a multiple currency regime or a dollarized regime. According to the RBZ (2009), multiple currency is the use of a basket of currencies as legal tender. The US$ dominates the basket comprised of the South African Rand, the Botswana Pula, Chinese Yeun, Euro among others which have been officialized as legal tender. On the other hand, dollarization, according to Forbes et al (2013), occurs if the monetary authority of a country outside the United States adopts the US$ United States as the legal tender. Makochekanwa (2009) categorizes dollarization into 3 phases; unofficial, semi-official and official. Official or full dollarization occurs when a country withdraws its domestic currency and makes a foreign currency full legal tender, for both private sector and government (Borensztein and Berg, 2000). Unofficial or *de facto* dollarization, is the adoption of the US$ by the public with no recognition from government legislation (Forbes *et al*, 2013), a process in Zimbabwe from 2007 to 2009. When an economy uses foreign currency as secondary legal tender, it becomes semi-official, Makochekanwa (2009). Although facts point to a dollarized economy, the RBZ insists the economy is using a multiple currency regime.

It is mostly undisputable that multiple currency brought with it some economic sanity, particularly between 2009 and 2013. Notably, annual inflation rate which stood at an official rate of 231 million % by 31 July 2008 (ZimStat, 2013) halted overnight. Month on month rate averaged 0.02% from 2009 to October 2017 while year on year rate averaged 2.24% over the same period (RBZ, 2017). Real GDP growth resurrected from -14% in 2008 to double digit rate of 10.6 % by 2010 (SAPST[3], 2017). The economic sanity eventually experienced diminishing properties from 2013 onwards. GDP growth rate dropped from 10.6% in 2010 to just 1.1% in 2015 and 0.6% in 2016 (AEO[4], 2017). The balance of payment, which averaged 8% of GDP between 2000 and 2008 worsened to around 14.1% in 2013 (SAPST, 2017). The down turn has been caused by a liquidity crunch mainly blamed on several factors including increasing budget deficit, estimated at 7.6% of GDP (AEO, 2017), appreciation of the US$ against Zimbabwe's major trading currencies, deteriorating loan portfolio due to high non-performing loans, worsening BOP position, poor revenue collection by Zimbabwe Revenue Authotiry (ZIMRA) and low public confidence in the banking sector (SAPST, 2017). The economic challenges are reflected well by banking sector developments on money supply, bank credit and total deposits and monetary base as shown in Fig 1 below.

[1] Kramarenko V, Engstrom L, e Verdier G, Fernandez G, Oppers S.E, Hughes R, McHugh J, and Coats W
[2] Zimbabwe National Statistical Agency, 2012 Compendium of Statistics
[3] Southern African Parliamentary Support Trust, Economic Research and Advocacy Series
[4] African Economic Outlook, by Vitaliy Kramarenko *et al* (2017)

Fig 1: Money Supply (ms3), Bank Credit (bc), Total deposits (td) and Monetary Base (mb)



Source: STATA Output from RBZ (2017) Statistics

Fig 1 shows that money supply (M3), total deposits and bank credit were increasing significantly from January 2009 up to December 2013. Thereafter the growth in money supply and total deposits subdued up to mid-2016 whilst bank lending to the private sector started to decrease gradually till mid-2017. The notable increase in money supply in 2016 can be attributed to the introduction of US$ 200 million worth of bond notes and coins through the Export Incentive Facility. Under the arrangement, backed by African Export Import Bank (Afreximbank) Nostro Stabilisation and Export Finance Facility, exporters would get up to 5% incentive/bonus, inform of bond notes valued at par with the US$, on export of goods and services (RBZ, 2016). The facility also aimed at addressing externalisation of funds and/or capital flight since the bond notes and coins are legal tender only in Zimbabwe. Monetary base on the other hand has been rising steadily over the time period. Despite the increase in money supply, the cash crisis continued unabated.

As the economy slides deeper into the liquidity and financial crises, the role and ability of the RBZ in bringing sanity, particularly through money supply determination, cannot only be questioned theoretically but imperatively empirically. Empirical studies, which have been conducted for economies having their local currencies as principal medium of payments, have provided inconclusive evidence on exogeneity and endogeneity of money supply. The motivation for the present study goes beyond inconclusivity of previous studies. Over and above that, it invites the exogeneity and endogeneity debate in rare circumstance of a multiple currency regime, which has not been examined thus far. Theoretically there is a realistic position that the RBZ's wings been clipped and has "lost control" over money supply determination. If this is true, is money supply completely endogenous? Does the central bank still have any role to play in the economy? The present study provides new evidence on money supply determination in a multiple currency regime environment.

3.0 Literature Review

Money supply determination is increasingly dominating theoretical and empirical literature debate in monetary economics. Two schools of thought and extensions of the long-standing Monetarist and Keynesian rift; exogenous and endogenous determination have emerged strongly providing different explanations. The debate has been heightened not only by contrasting empirical findings, but also different policy implications. Monetarists firmly argue that exogenous money supply, coupled by a stable money demand function is a necessary condition for an effective monetary policy framework, (Fontana, 2003; Howell, 2010; Alqudair, ud[1]). This places determination of money supply in a position to influence fundamental macroeconomic variables like investment, employment and output. In contrast, post-Keynesians postulate that the main role of modern commercial banks is to extend credit in support of private sector activities which in turn determines the stock of money in circulation (Fontana, 2003). It follows that instead of money affecting fundamental variables, the opposite holds. This dismisses the role of money supply in finetuning the performance of economy.

3.1.1 Exogenous Money Supply

In general, an exogenous variable is a factor that is external to an economic model, causes the outcome of the model while it is immune to changes in the model. Particular to money supply, exogeneity may take one of either three different form as outlined by Wary (1992). Firstly, money is exogenous if it can be controlled directly by the central bank, mostly through open market operations and reserve ratio. The second form occurs if money supply is responsible for changes in endogenous variables such as price, investment, employment and output. The conventional exogenous transmission mechanism follows that an increase in money supply causes money market disequilibrium. The resulting excess money supply stimulates an increase in consumption and investment owing to a fall in nominal interest rates. Money demand will naturally adjusts (increase) to clear the market thereby causing an increase in aggregate demand (Palley, 1994)). Following the works of Moore (1983), Wary (1992b) the second form can be further divided into strong and weak exogeneity. The former allows for feedback effects on money supply whilst the latter does not. Lastly, exogeneity is more econometric, occurring if the estimated error terms are not correlated with unobserved independent variables. This study infers on the first and second forms of exogeneity. That money supply is exogenous has been met with strong friction from post Keynesians, who gave counter arguments voting for money supply endogeneity.

3.1.2 Endogenous Money Supply

Post-Keynesians, led by Kaldor (1982; 1983), Moore (1988; 1994) and Rogers (1989) found discomfort in Keynes's General Theory treating money supply as "exogenously determined". They argued that the quantity theory of money, upon which exogenous money view is rooted, fits well in a barter economy but is incompatible in a contemporary credit economy. In a fiat money economy, they posit, private sector economic activity is centered on optimisation which is driven by making money. The role of the central bank is to accommodate the demand for money by extending credit to the private sector. As the private sector borrowing increases, commercial banks borrow from the central bank to avoid the failure of the banking system (Palley, 2013). In this regard, money supply is induced by the behavior of the private sector not the central bank and is therefore endogenous (Haghighati, 2011). Unlike the monetarist view that claims an unidirectional causality that runs from money supply to aggregate spending, post-Keynesians advocate an opposite unidirectional causality which runs from aggregate spending to the money supply (Wary, 1992b). An increase in spending raises the demand for loans which in turn would increase money supply, endorsing that money supply is indeed endogenous.

With the endogeneity position gaining strength over the exogenous view, there has been a growing debate in the camp over what form of endogeneity money supply follows. Competing views have been forwarded by accomodationists, structuralists and those in support of the liquidity preference (LP) hypothesis. Elhendawy (2016) noted that the disagreements revolve on the role and extent to which the central bank accommodates demand for reserves which have an implication on the slope of the money supply curve. Accomodationists advocate that the monetary authority determines the interest rate and the commercial banks will fully accommodate the resulting demand for credit (Palley, 2013). The view postulates a unidirectional causality running from bank credit to monetary base and money supply. Structuralists (Wray, 1990; Howells, 1995, 2010); Hewitson, 1995) advance that because banks do not have complete control over total reserves, they cannot completely accommodate demand for bank credit. The implication is that there is bidirectional causality between bank credit and money multiplier and bank credit and monetary base in addition to uni-directional causality from bank credit to money supply (Elhendawy 2016).The structuralist hypothesis argue that the money supply curve is upward slopping, rather than horizontal as suggested by accomodationists.

[1] Undated

The liquidity preference hypothesis on the other hand recognizes risk aversion as a key factor determining money supply. Banks have different degrees of liquidity preference which they consider in setting the mark-up over the short-term interest rate (Elhendawy, 2016). Rationality causes banks to be thoughtful with riskier clients. Liquidity preferences therefore affects private sector behavior, commercial banks' lending, the central bank and therefore money supply (Dalzie, 1995). Central bank liquidity preference may be determined by changes in the economy such as shocks in the financial market. Such circumstances cause the monetary authority to be less willing to accommodate banks' demand for credit. In such cases, the central bank is less willing to accommodate the bank's demand for reserves. From an empirical perspective, the LP hypothesis forecasts bidirectional causality between bank lending and broad money supply, (Haghighati, 2011).

3.2 Empirical Literature

The theoretical debate on exogeneity or endogeneity of money supply has been extended to an empirical level in different economies and circumstances. Using the two-stage least squares approach, Johansen Cointegration and Granger causality tests Chigbu and Okorontah (2013) investigated the exogeneity and endogeneity of money supply in Nigeria using time series data from 1970 to 2008. They found out that money supply was endogenous to the real value of money, real interest rate and real income. The results implied that economic activities had a bigger impact in determining money supply. Haghighat (2011) also employing the Johansen Cointegration, VECM and Granger Causality tests, documented that money supply was endogenously determined in Iran. The study, which regressed money supply on bank credit, income, monetary base and money multiplier, found evidence in support of the accommodationist and liquidity preference endogeneity.

A more recent study by Elhendawy (2016) investigated the matter in Egypt using data from 1990 to 2014.The results echoed the findings by Haghighat (2011) that money supply was endogenously determined under accommodationist and liquidity preferences views. However, a study by Alqudair (ud) reminded post-Keynessians that endogeneity is not a straight jacket. Investigating the same for Saudi Arabia the study documented evidence of money exogeneity. The study employed two approaches; (1) the conventional Johansen-VECM-Granger Causality approach and the (2) Wu-Hausman Exogeneity tests. The first approach, which found unidirectional long run causality from deposits to loans, invalidated the post Keynesian view that economic activity (demand for loans) determines deposits (money supply). In addition, the Wu-Hausman test could not find statistically significant evidence to reject the null hypothesis of exogenous money supply. The finding lends support to the monetarist view that the central bank controls money supply which endorses an effective monetary policy.

Despite the studies above providing inconclusive evidence on exogeneity and endogeneity, the common aspect between them is that they were conducted for economies using their local currencies as principal medium of payments. The motivation for the present study goes beyond inconclusivity of previous studies. Over and above that, it invites the exogeneity and endogeneity debate to a rare circumstance of a multiple currency regime, which has not been examined thus far. Theoretically there is a realistic position that the RBZ's wings are clipped and has "lost control" over money supply determination. If this is true, is money supply completely determined endogenously? Does the central bank still have a role to play in the economy? The present study provides new evidence on money supply determination in a multiple currency regime environment.

4.0 Research Methodology, Econometric Estimation and Results Analysis

This section presents the econometric model and estimations used to determine the exogeneity and endogeneity of money supply in Zimbabwe under the multiple currency regime between January 2009 and May 2017. It spells out the econometric model used, econometric diagnostics tests carried out. Results analysis and discussion flows throughout the econometric estimation. Following the works of, Haghighati (2011), Chigbu and Okorontah(2013), Elhendaway (2016), Alqudair (ud), a three-stage econometric procedure was used. Firstly, time series properties of the logarithm of monthly time series on money supply (M3), bank credit (BC), bank deposits (BD) and consumer price index (CPI) are examined using the Augmented Dick-Fuller (ADF) test. The Johannsen cointegration method was conducted to determine the existence of long run association amongst the monetary variables. Lastly short-run and long run causality tests for exogeneity and endogeneity were run using VECM.

The use of the variables above feeds from both the Monetarist and Keynesians (exogenous view) and post-Keynesians (endogenous view) on money supply determination. Both views agree, though disagreeing on the direction of causality, that there is at least unidirectional causality linking money supply to bank credit, bank deposits, monetary base and money multiplier. M3 was used ahead of other narrower monetary aggregates (M1 and M2) because its more broad, covers more monetary economic activities and therefore better represent the

involvement of the private sector in money supply determination. Table 1 below presents summary statistics for the variables.

4.1 Descriptive Statistics

The table shows a strong correlation between money supply (m3) and deposits. This is because M3 is broad and comprises of savings, demand deposits, short-term and long-term deposits. The minimum money supply and deposits of $297 625.60 was recorded in January 2009 when the central bank officially adopted the multiple currency regime.

Table 1: Descriptive Statistics

	Money Supply	Bank Credit	Deposits	CPI
Mean	3,459,282	2,697,089	3,459,282	96.4832
Median	3,741,753	3,383,325	3,741,753	97.0224
Maximum	6,200,282	3,765,916	6,024,512	101.2264
Minimum	297625.6	104591.9	297625.6	87.3828
Stand Dev	1,449,992	1,181,481	1,437,856	3.7154
Variance	2.10E+12	1.40E+12	2.07E+12	13.8045
Skewness	-0.481469	-1.030144	-0.526537	-0.7756
Kurtosis	2.517153	2.2557688	2.490856	2.6594
Observations	101	101	101	101

Source: Authors's compilation from STATA 14 output

Maximum values of money supply and deposits were recorded for the months of May 2017. Maximum bank credit to the private sector was recorded for the month of November 2014, thereafter it has been generally decreasing reaching 3,495,107.25 in May 2017. The mean bank credit of $2,697,089.00 against mean deposits of $3,459,282.00 implies that on average, 77.97% of deposits were loaned out to the private sector. Mean and maximum CPI statistics of 96.4832 and 101.2264 respectively shows that over the time period, monthly inflation rate was largely negative with a highest increase of 1.226% being recorded for March 2013.

4.2 Unit Root Tests

Conventional empirical literature has documented that time series data are non-stationary (Nelson and Plosser; 1982; Hjalmarsson & Österholm, 2007; Zapata *et al* 2011; Dwyer, 2015). A time series is said to be non-stationary if it contains a unit root and implies that the mean and variance and/or covariance of the series are stochastic (Gujarati, 2004). It has been a widely agreed position that the use of non-stationary time series in econometric regressions gives misguiding parameter estimates of the relationship among variables (Gujarati, 2004). It follows that testing for unit root is foundation upon which econometric analysis is built on and this study firmly recognizes that. A number of econometric tests have been suggested to examine the time series properties of data. Early and pioneering work is credited to Dickey and Fuller (1981) and Said and Dickey (1984) and Phillips and Perron (1988). The gist of the tests is to estimate whether the variables observed have a tendency to return to the long term trend (stationary) or follow a random walk (non-stationary) following a shock. The Augmented Dick-Fuller (ADF) Dick and Fuller (1979) test was employed in this study and the results are given in Table 2 below.

Table 2: Unit Root Tests Results

	ADF Statistic	Probability	Decision
Lnms	-6.065***	0.0000	I(0) Stationary
Lnbc	-7.846***	0.0000	I(0) Stationary
Lntd	-6.290***	0.0000	I(0) Stationary
Lncpi	-3.561***	0.0065	I(0) Stationary

*** , ** and * denote statistical significance at 1%, 5% and 10% respectively

Critical Values

At 1%	**At 5%**	**At 10%**
-3.513	-2.892	-2.581

The results show that the null hypothesis for presence of unit root was rejected, at 1% level of significance, for all the four variables. The ADF statistics are greater than the 1% critical value for all variable. It can be concluded that the four variables are cointegrated of order zero, I(0).

4.3 Cointegration Test

Since all variables are integrated of the same order Johansen test for integration was conducted to test for the existence of long run association amongst money supply, bank credit, bank deposits and consumer price index (cpi). Although Johansen's methodology is typically used in a setting where all variables in the system are integrated of order 1, I(1), Hjalmarsson & Österholm (2007) advanced that having stationary variables in the system is not a worrying issue. This echoes a suggestion by Johansen (1995) who argues that pre-testing the variables to establish the order of integration may be of little importance. Despite a number of cointegration tests exisisting including the Engle and Granger (1987) and the recent Auto Regressive Distributed Lag (ARDL) model, the Johansen technique was chosen basing on empirical evidence that it is better for small samples and multivariate tests (DeJong, 1992), is not sensitive to choice of dependent variables (Hjalmarsson & Österholm (2007) and it determines the number of existing cointegrating relationships (Dawyer, 2015).In addition unlike the static Engle Granger method , the Johansen cointegration has been advanced to incorporate dynamic components of the model by introducing lags of variables which according to Monte Carlo estimates, provide more efficient results (Inder,1993).

4.3.1 Lag Length Selection

Empirical evidence on Johansen's (1988) cointegrations processes documents that results depends on the number of lags length used in the VAR process. The optimum lag lengths of the VAR were chosen by minimising the FPE, AIC, HQIC and the Schwarz (1978) Bayesian Information Criteria (SBIC). Results of the process are presented in Table 3 below.

Table 3: Optimum Lag Length

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	632.315				2.80E-11	-12.955	-12.912	-12.8488
1	1258.76	1252.9	16	0.000	9.5e-17*	-25.5415*	-25.3269*	-25.0106*
2	1274.05	30.567	16	0.015	9.70E-17	-25.5267	-25.1404	-24.5712
3	1287.96	27.833	16	0.033	1.00E-16	-25.4838	-24.9257	-24.1035
4	1305.33	34.729*	16	0.004	9.90E-17	-25.5119	-24.7821	-23.707

Source: Author's compilation from STATA 14 output

All the four criteria unanimously chose one (1) lag length as the optimal, and the VAR processes undertaken hereafter use lag 1.

4.3.2 Johansen Test for Cointegration

To test for cointegration, two statistics based on the log-likelihood test, the trace statistic (λ_{trace}) and maximum eigenvalue (λ_{max}), were used at 5% and 1% level of significance.

Table 4(a) :Trace Statistics

Maximum Rank	Parms	LL	Eigenvalues	Trace Statistics	5% Critical Value	1% Critical Value
0**	20	1236.4681		98.7708	47.21	54.46
1*	27	1270.3056	0.49520	31.0958	29.68	35.65
2	32	1279.7143	0.17310	12.2785	15.41	20.04
3	35	1285.0120	0.10500	1.6830	3.76	6.65
4	36	1285.8535	0.01686			

**(**) denotes rejection of null hypothesis at 5% and 1% respectively*

Table 4(b) : Johansen Cointegration Test (Maximum Eigenvalue)

Maximum Rank	Parms	LL	Eigenvalues	Max-Eigen Statistics	5% Critical Value	1% Critical Value
0**	20	1236.4681		67.6750	27.07	32.24
1	27	1270.3056	0.49520	18.8173	20.97	25.52
2	32	1279.7143	0.17310	10.5955	14.07	18.63
3	35	1285.0120	0.10500	1.6830	3.76	6.65
4	36	1285.8535	0.01686			

**(**) denotes rejection of null hypothesis at 5% and 1% respectively*

From table 4(a) the null hypothesis of zero cointegration was strongly rejected at both 5% and 1% levels since the trace statistic of 98.7708 is greater than the critical values of 47.21 and 54.46 respectively. The null hypothesis of one cointegration equation was rejected at 5% but accepted at 1% level of significance. As shown in table 4(b), the maximum eigenvalues test also rejects the null of no cointegration at both 5% and 1% given that the test statistic of 67.6750 is greater than the critical values of 27.07 and 32.24 respectively. However, the alternative hypothesis of at least one cointegration equation could not be rejected at both 5% and 1% levels of significance. The 1% significance level was given precedence over 5% in both tests basing on more reliability hence one cointegration is accepted. Jointly, the two tests provide strong evidence of cointegration amongst money supply, bank credit to the private sector and total bank deposits and CPI. Evidence of cointegration amongst the time series under investigation implies two econometric relationships; (1) that there is a long run relationship and (2) that there is causality in at least one direction between them, Granger (1988). VECM was used to establish these relationships and the results are presented and tabulated below.

4.4.0 Vector Error Correction Model (VECM)

Following the work of Johansen– Juselius (1990) if variables in a VAR are cointegrated, the direction of causality between the concerned variables in the short run and long run is examined using the vector error correction models (VECM). The VECM also estimates the error correction term, which measures speed of adjustment of variables following the effect of a shock. The error correction model is based on the following equations;

$$\Delta lnMS_t = \alpha_0 + \alpha_1 e_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta lnMS_{t-i} + \sum_{j=1}^{n} \alpha_j \Delta lnBC_{t-j} + \sum_{k=1}^{O} \alpha_k \Delta lnBD_{t-k} + \sum_{l=1}^{P} \alpha_l \Delta lnCPI_{t-l} + \varepsilon_t \quad (1)$$

$$\Delta lnBC_t = \beta_0 + \beta_1 e_{t-1} + \sum_{i=1}^{m} \beta_i \Delta lnBC_{t-i} + \sum_{j=1}^{n} \beta_j \Delta lnMS_{t-j} + \sum_{k=1}^{O} \beta_k \Delta lnBD_{t-k} + \sum_{l=1}^{P} \beta_l \Delta lnCPI_{t-l} + \mu_t \quad (2)$$

$$\Delta lnBD_t = \rho_0 + \rho_1 e_{t-1} + \sum_{i=1}^{m} \rho_i \Delta lnBD_{t-i} + \sum_{j=1}^{n} \rho_j \Delta lnMS_{t-j} + \sum_{k=1}^{O} \rho_k \Delta lnBC_{t-k} + \sum_{l=1}^{P} \rho_l \Delta lnCPI_{t-l} + \tau_t \quad (3)$$

$$\Delta lnCP_t = \varphi_0 + \varphi_1 e_{t-1} + \sum_{i=1}^{m} \varphi_i \Delta lnCPI_{t-i} + \sum_{j=1}^{n} \varphi_j \Delta lnMS_{t-j} + \sum_{k=1}^{O} \varphi_k \Delta lnBC_{t-k} + \sum_{l=1}^{P} \varphi_l \Delta lnBD_{t-l} + \omega_t (4)$$

Δ is the difference operator. The term e_{t-1} represents the error correction term, the magnitude by which the dependent variable deviates from its long-run equilibrium in the previous period. $\alpha_1, \beta_1, \rho_1, \varphi_1$ are coefficients to the error terms which are expected to be negative and represent the amount of correction of period t-1 disequilibrium in period t. $\varepsilon, \mu, \tau, \omega$ are stochastic error terms for the respective models. The VECM results of the models above are presented in Table 5. The VECM results for the parent model (Model 1) is stated below:

$$\Delta(lnms) = 0.0032257 + 0.3480722lnms(-1) + 0.0921877lnbc(-1) - 0.7925339lntd(-1) + 0.8141598lncpi(-) + \mu$$
…….....(5)

The results in table 5 shows that there is causality running from the independent variables for equations (1) to (3) where lnms, lnbc and lnbd are dependent variables. This is deduced from highly significant error correction terms coefficients of -7.47, -7.58 and -7.45 respectively. The R^2 for the three equations are all high and over 68%. Taking the first equation, the results implies that bank credit, bank deposits and cpi causes money supply. The coefficient for the cpi error correction term is positive and statistically insignificant, meaning that money supply, bank credit and bank deposits do not cause cpi.

Table 5: Estimates of VECM

Variable	Δlnms	Δlnbc	Δlntd	Δlncpi
ECT	-7.47 (0,000)	-7.580 (0,000)	-7.450 (0,000)	0.530 (0,599)
lnms(-1)	0.27 (0,784)	-0.940 (0,35)	0.180 (0,857)	-0.850 (0,397)
lnbc(-1)	-0.99 (0,322)	0.980 (0,327)	0.950 (0,341)	2.190 (0,029)
lnbd(-1)	-0.63 (0,531)	0.850 (0,393)	-0.530 (0,599)	0.720 (0,473)
lncpi(-1)	1.28 (0,200)	1.050 (0,296)	1.340 (0,179)	5.940 (0,000)
R2	69.14%	68.75%	77.15%	42.53%
Log Likelihood	**AIC**	**HQIC**	**SBIC**	
1270.306	-25.11729	-24.83092	-24.40953	

4.4.1 Endogeneity and Exogeneity Tests

To determine whether money supply is endogenous or not, VECM long run causality tests were conducted between lnms and lnbc, lnbc and lnmb , lnbc and lnbd, lnbc and lnmm. The system of equations for the tests are given below.

$$\Delta lnMS_t = \alpha_0 + \alpha_1 e_{t-1} + \sum_{i=1}^{m} \alpha_i ln\Delta MS_{t-i} + \sum_{j=1}^{n} \alpha_j \Delta lnBC_{t-j} + \varepsilon_t \quad \text{…….……..} \quad (6)$$

$$\Delta lnBC_t = \beta_0 + \beta_1 e_{t-1} + \sum_{i=1}^{m} \beta_i \Delta lnBC_{t-i} + \sum_{j=1}^{n} \beta_j \Delta lnMS_{t-j} + \varepsilon_t \quad \text{……..…..…..(7)}$$

$$\Delta lnBC_t = \rho_0 + \rho_1 e_{t-1} + \sum_{i=1}^{m} \rho_i \Delta lnBC_{t-i} + \sum_{j=1}^{n} \rho_j \Delta lnMB_{t-j} + \varepsilon_t \quad \text{……..……..…..(8)}$$

$$\Delta lnMB_t = \varphi_0 + \varphi e_{t-1} + \sum_{i=1}^{m} \varphi_i \Delta lnMB_{t-i} + \sum_{j=1}^{n} \varphi_j \Delta lnBC_{t-j} + \varepsilon_t \text{……..…..} \quad \text{.....(9)}$$

$$\Delta lnBC_t = \gamma_0 + \gamma_1 e_{t-1} + \sum_{i=1}^{m} \gamma_i \Delta lnBC_{t-i} + \sum_{j=1}^{n} \gamma_j \Delta lnBD_{t-j} + \varepsilon_t \text{……..……(10)}$$

$$\Delta lnBD_t = \delta_0 + \delta_1 e_{t-1} + \sum_{i=1}^{m} \delta_i \Delta lnBD_{t-i} + \sum_{j=1}^{n} \delta_j \Delta lnBC_{t-j} + \varepsilon_t \text{……..…..(11)}$$

$$\Delta lnBC_t = \theta_0 + \theta_1 e_{t-1} + \sum_{i=1}^{m} \theta_i \Delta lnBC_{t-i} + \sum_{j=1}^{n} \theta_j \Delta lnMM_{t-j} + \varepsilon_t \text{……..(12)}$$

$$\Delta lnMM_t = \vartheta_0 + \vartheta_1 e_{t-1} + \sum_{i=1}^{m} \vartheta_i \Delta lnMM_{t-i} + \sum_{j=1}^{n} \vartheta_j \Delta lnBC_{t-j} + \varepsilon_t \text{……} \quad \text{.....(13)}$$

$\gamma_1,\ \delta_1, \theta_1, \vartheta_1$ are additional coefficients of the error correction terms. Other variables are defined as before.The VECM estimates for the causality tests of equation (6) to (13) are summarised in Table 6 below.

Table 4: VECM Causality Tests

Equation	ECT	t statistic	Conclusion
lnms-lnbc	-0.0547672	-6.920	MS causes BC
lnbc-lnms	-0.0557121	-8.090	BC causes MS
lntd-lnbc	-0.068085	-7.630	TD causes BC
lnbc-lntd	-0.0503657	-7.960	BC causes TD
lnmb-lnbc	-0.0659651	-7.560	MB causes BC
lnbc-lnmb	-0.0794698	-2.150	BC causes MB
lnmm-lnbc	-0.068085	-7.630	MM causes BC
lnbc-lnmm	-0.0000773	0.001	BC do not cause MM

Source: Author's compilation from STATA 14 output

The table above shows VECM long run causality tests for four regression equations; (1) money supply and bank credit (2) bank credit and deposits (3) bank credit and monetary base and (4) bank credit and money multiplier. The first 3 regressions show strong evidence of bi-directional causality running from bank credit to money supply, deposits and monetary base. Bidirectional causality between bank credit and money supply and bank credit and deposits confirms the position that money supply under the multiple currency regime is endogenous. Causality running from bank credit to monetary base supports the accommodationist hypothesis. However, there is only unidirectional long run causality from money multiplier to bank credit. The absence of reverse causality between bank credit and money multiplier implies that there is no statistical evidence of structuralist endogeneity. The liquidity preferences endogeneity is also accepted because there is bidirectional causality between bank credit and money supply. The findings of the present study echoes those of Haghighati (2011), Chigbu and Okorontah (2013) and Elhendawy (2016) but contradicts that of Aquidair (ud).

The heading finding of this study is that money supply under the multiple regime is being determined endogenously. In the words of (Howell, 2010) it follows that traditional monetary policy instruments are ineffective in finetuning fundamental real sector variables. This is in tandem with theoretical expectations given that the RBZ has lost ultimate control over primary monetary policy instruments such as monetary aggregates and open market operations. This should not be mistaken to imply impotency of the central bank's policy measures. It simply means that the central bank should focus more on measures meant to appetise the private sector's quest for credit to support and enhance their productivity. According to Terra & Arestis (2010), endogenous money supply calls for policy measures that stimulates investments and production. The finding therefore is in support of intervention programmes such as the Afreximbank Nostro Stabilisation and Export Finance Facility which gives up to 5% bonus on exports. To complement the facility, it is recommended that production for the domestic market also be incentivized. In as much as exports are critical in bringing in foreign currency, domestic production oriented measures are equally important in reducing the import bill, hence reducing foreign currency leaks.

The incentive should be targeted at producers who are producing goods which are topping the growing imports bill. The central bank can facilitate loan schemes for such producers in which a certain percentage of the firm's income/revenue from local sales is credited to the loan repayment amount. By so doing, beneficiaries would be motivated to produce more import substituting goods and services. The import substitution production incentive facility will go a long way in improving liquidity as well as reducing Non-Performing Loans (NPL) which have discouraged banks to extent credit.

Given endogenous money supply, post Keynesian monetary policy should be anchored on three pillars namely interest rate, regulation and debt management (Palley, 2008; Terra & Arestis, 2017). Incorporation of debt management as a monetary policy tool was traditionally proposed by Keynes (1930) and rekindled by Tily (2006, 2010). The rationale is that conventional instruments like open market operations only affect short-term interest rates making short term lending more visible. However, short term lending is pro-consumption but anti-production. In this respect, the RBZ should focus on encouraging firms to issue medium - long term investment bonds. Taking a leaf from the Federal Reserve Bank's Maturity Extension Programme, the RBZ can sell short term bonds and use the proceeds to buy long-term bonds. Bank lending has been dominated by short assets, which are not only dearer, but could not sustain long term investment. Given that the growing importation bill is a result of surging domestic demand relative to actual, not potential production, availability of long term credit lines will take local production to the frontier which will reduce 'exportation' of domestic demand.

5.0 Conclusion

The study brings new evidence on money supply determination by inviting the exogeneity and endogeneity debate to a rare monetary system - the multiple currency regime currently used in Zimbabwe. Using monthly data from January 2009 to May 2017, the Unit root-Johansen Cointegration -VECM approach was used test long run causality between money supply, bank credit, bank deposits, monetary base and money multiplier. The key finding is that money supply under the multiple currency regime is strongly endogenous. This does not imply monetary policy impotency. However, it suggests that policy measures should focus more on stimulating demand for credit and places interest rate and debt management as pillars. In addition to export incentives currently in place, the central bank is encouraged to incentivize producers of import substituting goods through a medium-long term import substitution credit facility.

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