

*Full Length Research Paper*

# Exogeneity of money supply evidence from Nigeria

<sup>1</sup>Chigbu, Emmanuel Ezeji (Ph.D) and <sup>\*2</sup>Okorontah, Chikeziem Fortunatus

<sup>1</sup>School of Management Technology, Federal University of Technology, Owerri, Imo State, Nigeria.

<sup>\*2</sup>Department of Economics, Rhema University, Aba, Abia State, Nigeria.

## Abstract

**This study investigates the exogeneity of the money supply using annual data from 1970-2008. The tests applied investigated the plausibility of the classical hypotheses. We employed the two stage least square method, the Johansen's cointegration procedures and the Granger causality approach. The findings show that there exists a long run relationship between money supply and the included variables. The real interest rate and real income Granger cause the growth of money. Moreover, Granger's causal relation between them was unidirectional from real interest rate, real income to money supply. Our main contribution is having demonstrated that money supply was endogenous with respect to the value of money, real income and real interest rate meaning that the monetary policy had influence to some extent on money supply but economic activities had greater influence in determining the rate of money growth. This study, therefore, recommends that the government and monetary authorities should undertake regulated/guided policies that would enhance economic activities for steady growth of money supply.**

**Keywords:** Exogeneity, Money supply, Causality, Endogeneity.

## INTRODUCTION

The issue of endogeneity or exogeneity of money is one that runs through the history of monetary theory, with prominent authors appearing to hold views on either side. Narrowly put, those who plug for the exogeneity view take one or all among the cluster of variables-price level, interest and or real output as being determined by movement in the stock of money. Those who hold endogeneity view consider that the stock of money in circulation is determined by one or all of the variables mentioned above.

It is also understandable that exogeneity or endogeneity of money depends on the type of money in question – commodity money (gold), fiat (paper) money, bank deposit or a large measure of liquidity that is to stand for the money stock. Also the basic issue is about the direction of causality-money to other variables or other variable to money (Hendry et al., 1983).

However, many scholars consider money supply as a policy-determined phenomenon. Nonetheless, the widespread use of foreign currency and foreign currency

deposits in private portfolios has at least two related implication for monetary control. First, the availability of a ready substitute for domestic money increases the sensitivity of domestic money demand to interest rates and inflation. Other things equal, the response of inflation and capital flow, to money supply shocks will be quantitatively larger and may be less predictable than in the absence of dollarization. (O'Connell et al., 2007).

With modernization and globalization the modern theory of money supply maintains that, the money supply is jointly determined by the central bank, the commercial banks and the public. Buffie et al., (2008), argue that the currency substitution now prevalent in many African countries, including Nigeria, increased the inflation elasticity of money demand and tightens the link between portfolio behavior and private sector expectations of future seigniorage. The fiscal managing of foreign aid then plays a key role not just in determining the path of the equilibrium real exchange rate but also, via portfolio adjustment, in determining the short-run response of the nominal exchange rate and the degree of overshooting which in turn affects money supply.

The purpose of this research is to investigate the exogeneity and or the endogeneity of money supply.

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\*Corresponding Author E-mail: [chizim4teens@yahoo.com](mailto:chizim4teens@yahoo.com)

## Conceptual issues and literature review

An exogenous variable is a factor that is outside of an economic model; it has impact on the outcome of the model, and changes in the model do not affect it. Put simply, an exogenous variable is something that affects a particular outcome without being controlled by that outcome in return. Exogenous variables are sometimes referred to as independent variables, as opposed to dependent – or endogenous – variables, which are explained by the mathematics relationship in the model. While endogenous variables can be manipulated within the economic model, exogenous variables are generally uncontrollable. (Miriam, 98).

The best way to consider the issue of exogeneity of money is to specify the type of money economy envisaged – commodity money, paper money, credit money and look at the variables likely to influence the supply of money and its relation with other variables.

Historically, the argument about exogeneity is constructed around the quantity theory of money, which states that the amount of money in circulation at any time determined the volume of trade and if the amount went on increasing it would lead sooner or later to an increase in price. In the context of commodity money, the proposition concerned attempts by coining authorities to debase coinage by clipping or alloying it with inferior metal. These were ways in which the amount of money could be altered by policy manipulation and the exogenously act upon prices.

The first statement of the quantity theory of money by David Hume starts with an illustration of an influx of gold from outside and traces its effect first on real economic activities and eventually on prices. In Hume's quality theory, money is exogenous but not subject to policy manipulation. The opposite view (argued by Jarnen Steuart for instance) was that it was the volume of activity that elicited the matching supply of money. It could also be altered if banks were willing to accommodate a larger volume of bills (Desai, 1981).

It is the case of fiat money printed as the state's liability, i.e. as outside money, that provides the best illustration of exogenous money not subject to any constraint. In a world where only paper currency was used and it was printed by the monetary authorities, the stock of money could be exogenously determined. This would be additionally so even if there was inside money as long as the monetary authorities could insist that banks obeyed a strict cash to deposit ratio and there were no substitute for cash available beyond the control of the monetary authorities. It is this view of money that most closely corresponds to Keynes's assumption in the general theory, and it is also in the monetarist theory of Milton Friedman (Paul, 2002).

In an economy with inside and outside money and with a sophisticated banking system as well as a non-banking financial sector, the question of exogeneity is the

most complex. Banks will expand their loan portfolio as long as the cost of replenishing their liquidity does not exceed the interest rate they can earn on loans. The relation between broad money ( $M_3$ ) and narrow money ( $M_1$ ) becomes a function of the funding policy concerning the budget deficit and the structure of interest rates. Thus the stock of narrow money can be exogenous and policy determined. But the stock of broad money is endogenous. A crucial element has been the financial revolution of some decade ago (De cecco, 1987). A variety of financial instruments – credit cards, charge cards, money market funds, interest-bearing demand deposits; electronic cash transfer-has made the ratio of cash to volume of financial transactions variable though with a steep downward trend.

An empirical test carried out by Luiz Fernards Cerqueira (2009) also sported money exogeneity. These empirical findings differ greatly from many other results. The main contribution demonstrated by Luiz is that the monetary supply was exogenous with respect to the inflation rate and that monetary authority had enough independence to execute an active monetary policy. This test was carried out in Brazil using Kalman filter procedure, and Johnson cointegration procedure.

However, the effectiveness of monetary policy, and the credibility of any regime will depend on how reliably and how quickly observable policy actions influence inflation and other real variables. In other words, effectiveness depends on the nature of the transmission mechanism and critically on how well it is understood since creditability of the monetary regime will be undermined if observed policy actions are perceived to be ineffective or even have persistently perverse outcomes. Chris, (2008).

Whichever, policy regime a country adopts, a crucial issue is how the policy actions and or decisions are transmitted to the economy to achieve the so called transmission mechanism of monetary policy. This describes the various routes through which a central bank monetary policy, including quantity of money affects output and prices, Okafor, (2009).

## The money supply model

Money supply is generally considered as a policy determine phenomenon. Nevertheless the modern theory of money supply maintain that money supply is jointly determined by the central bank, the commercial banks and the public (Paul 2002).

In the modern theory, it is assumed that money supply ( $M_s$ ) is the product of monetary base ( $B$ ) and the money multiplier ( $m$ ). Thus,  $MS = mB$ .....(1)  
Equation (1) implies that for explaining the changes in the money supply, the analysis of the factors determining the monetary base and the money multiplier is necessary.

At this point, it is explicit to define some variables and

ratios found in the money supply function.

(i) Money supply (Ms) has been defined to include currency in circulation (c) and the demand deposits (DD) with commercial banks.

Thus,  $MS = C + DD$ ..... (2)

(ii) The monetary base (B) refers to the supply of funds available for use either as cash or reserves of the central bank. The monetary base or the high – powered money (B) include gold stock, reserve assets and amount of the central bank credit outstanding.

Let  $B =$  (the sum of paper currency and coins in the hand of the public (C) plus the actual bank reserves@.

Thus  $B = C + R$  .....(3)

(iii) Public's demand for currency (C)

Let  $C = c_c \cdot DD$  .....(4)

Where  $c_c$  is a positive proportion function ( $c_c$ ) of DD. In other words,  $c_c$ , which is known as the currency ratio, is the ratio of C to DD.

Or  $C = \frac{C}{DD}$

(iv) Banks demand for cash reserve (R) is a positive function (r) of the total deposits of the bank (D). Thus r, known as the reserve ratio, represents the ratio of R to D. Thus,  $R = r \cdot D$ .....(5)

Or  $r = R/D$ .

(v) Total bank deposits (D). We may divide this into two (a) demand deposits (DD) and time deposits (TD). It is further assumed that time deposit (TD) are an increasing proportion function (t) of demand deposit (DD), so that t, known as time deposits ratio, indicates the ratio of TD to DD.

Thus,  $D = DD + TD$ .....(6)

$TD = t \cdot DD$ .....(7)

Or  $t = TD/DD$ .

Derivation of money multiplier:

The definitions and ratios above can be used to find out the nature of constituents and the size of the money multiplier.

To start with:

Substitute (5) into (3).

$B = C + r \cdot D$ .....(8)

Substitute (6) into (8)

$B = r(DD + TD) + C$  .....(9)

Then substitute (4) and (7) into (9)

$B = r(DD + t \cdot DD) + c_c \cdot DD$ .

or  $B = (r(1 + t) + c) DD$  .....(10)

from equation (10) we get DD to be

$DD = \frac{1}{r(1+t)+c} B$ .....(11)

In most literature on money supply, the expression  $1/r(1+t)+c$  is known as the demand deposit multiplier.

To get the money supply, substitute equation (11) and (4) into equation (2)

$MS = \frac{1+c}{r(1+t)+c} B$ .....(12)

The expression  $1+c/r(1+t)+c$  in equation (12) gives the value of the money multiplier (m).

Thus  $m = \frac{1+c}{r(1+t)+c}$  .....(13)

The money supply equation:  $MS = mB$  can now be represented as

$MS = \frac{1+c}{r(1+t)+c} B$ .....(14)

(refer to equation (1) and (13))

From equation (14), we can derive a money supply function if we are able to factor out the factors determining the variables like c, r, t ad B. The factors that affect these variables will directly or indirectly influence changes in money supply.

Paul, (2002), in trying to isolate the factors that determine the variables included in the money multiplier equation observed the following.

- Money supply (MS) is the product of the monetary base (B) and the money multiplier (m).

- Monetary base (B) is directly controlled by the government regulation (A) and is also influence by the value of money (1/p).

Where P is the general price level.

- The currency ratio (c) is affected by real economic activities (y) and seasonal factors.

- The reserve ratio (r) is determined by the interest rate (i), real economic activities and government regulation (A).

- The time-deposit ratio (t) is determined by the decision of the public as to how much time deposit to hold in relation to demand deposits and is influenced by the economic activities and the rate of interest (i).

On the bases of the above extractions, the money supply function can be written as:

$MS = f(1/p, i, y, A, )$ .

### Econometric Analysis

In econometric analysis, a causal relationship between the dependent variable and the explanatory variables is often assumed. In this sense a function that explains the relationship between the regressand (dependent variable) and few most important repressors (the independent variables) is introduced. The influence of other factors not included in the function is accounted for by the stochastic variable, U.

We begin with the specification of the model and using the Philips Peron unit root test to determine the order of integration of the variables. Variables are said to be co-integrated if they are affected by the same long run influence. Cointegration implies that  $y_t$  and  $x_t$  share similar stochastic trends, and since the difference  $e_t$  is stationary, they never diverge too far from each other (Carter, 2007). Because the existence of a relationship between variables does not ascertain causality or the direction of influence (Gujarati, 2004), the test for causality was also carried out. In order to undertake this exercise, we use e-view computer package (2003).

### Specification of the model

$$MS = f(VM, BR, RI, LR)$$

Where MS = Money supply (MS)

VM = Value of money (1/p)

BR = Bank rate (rate of interest) (i)

R1 = Real income (y)

LR = liquidity ratio (A)

The above relation can be rewritten as

$$MS_t = \alpha_0 + \alpha_1 \frac{1}{p}_t + \alpha_2 i_t + \alpha_3 y_t + \alpha_4 A_t + U_t.$$

and  $\alpha_1 > 0$ ,  $\alpha_2 < 0$ ,  $\alpha_3 > 0$ ,  $\alpha_4 > 0$  or  $< 0$

$\alpha_0$  is the constant term;  $\alpha_1 - \alpha_4$  are the parameters to be estimated.  $U_t$  = the disturbance term which is presumed to satisfy the least square assumption of homosidasticity, serial independence and nominal distribution.

### EMPIRICAL RESULT

We begin our empirical analysis by showing the degree of association between value of money (1/p), bank rate (i), real income (y), Liquidity ratio (LR) and money supply (MS) through the multiple regression analysis. Table I depicts the result of the OLS, and it shows that statistically, significant positive relationship exist between the value of money, real income and money supply. But there is a negative relationship between bank rate, liquidity ratio and money supply. It is observed that most of the explanatory variables were significant at the 5% level from the probability test.

The coefficient of determination  $R^2$  indicates that about 84 percent of the changes in money supply are explained by variable as represented by the explanatory variable. The joint significance of the model, F – statistic, which is 43.608 shows that the model is statistically significant and can really explain the reason for the changes in the level of money supply.

Given the results, it is necessary to test its reliability that is whether it is not a spurious regression.

This we did through the Augmented Dickey – fuller unit root test.

The results in (Table 2) indicate that some of the variables are non-stationary at levels and some are stationary at level, but were all stationary at first difference that is 1(1). It should be noted that the presence of 1(0) and 1(1) variables does not constitute any hindrance as it is not necessary for all the variables in a multivariate regression to have the same order of integrability (Akpan 2008). We need to know whether using the variables together in the model would yield reliable result through the cointegration test.

Table 3 shows the result of the Johnson cointegration test. It shows that the value of trace statistic is more than the critical value at 5% in two of the five null hypotheses, which indicates two cointegrating vectors or two cointegrating equations at the 0.05 level. Since the

variables are cointegrated, then there would be no loss of information, implying that there exist a long run relationship between money supply and the included variables.

All the variables except liquidity ratio (LR), are statistically significant at 5% level. The non-significance of LR may be due to modernization and globalization of the financial sector.

Note: The 5% critical value for ADF statistic at level is -2.941147, while -2.963927 is for 1<sup>st</sup> difference. We proceeded to 1<sup>st</sup> difference because the dependent variable was not stationary at level. Hence all the variables are stationary at 1<sup>st</sup> level, they are all worthy to be included in the model.

Trace test indicates 2 cointegrating equations at the 0.05 level.

\* Denotes rejection of the hypothesis at the 0.05 level.

\* Mackinnon – Hang-Michelis (1999) P – values.

The pairwise granger causality test represented in “Table 4” shows that there are independent causality among VM and MS, LR and MS. This indicates that as VM and LR do not grangers cause MS so also MS neither granger cause VM nor LR.

The third and fifth hypothesis tests show that BR and R1 granger cause MS, while MS does not granger cause any of them that is; BR → MS and R1 → MS. This implies the there is unidirectional causality from BR, R1 to MS.

The interesting thing to note from these results is that the two variable BR and R1 that granger cause MS are significant in the model even at less than 1%, though BR has a negative relationship with MS, while VM that has positive relationship with MS does not granger cause it.

The overall result of this analysis especially the granger causality test shows that economic activities have influence on money supply which suggests that money supply is also endogenously determined.

### CONCLUSION AND POLICY IMPLICATION

This paper examined the exogeneity and, or the endogeneity of money supply for the period 1970 to 2008 using annual data. We chose this period to enable use capture the years Nigeria experienced high valued currency and now she is battling with currency depreciation. It also covers the era of regulated interest rate and this time of deregulation.

The result supports the assertion of Moore, (1989), “that the expansion of money supply is governed by the interest rate charged on loans and paid on bank deposits”. It is also in line with the horizontalist approach which concludes that, “the rate of interest is exogenous”; the monetary authorities set it and therefore the money supply is endogenous (Rochon and Vernengo, 2001).

However, the result differ from luiz, (2001) conclusion

**Table 1.** Multiple regression result.

Variable	Coefficient	Std. error	t-statistic	Prob.	
C	-487924.7	74347.3	-0.656212	0.5161	$R^2 = 0.836878$
VM	484988.3	209937.4	2.310156	0.0271	Adj $R^2 = 0.817688$
BR	-130018.2	34331.10	-3.782184	0.0006	F. Stat = 43.60836
R1	12.22562	1.042324	11.72919	0.0000	Pro. (F. stat) 0.00000
LR	-11441.94	13479.19	-0.818498	0.4188	D. Waston stat. = 1.159932

Source: Author's computation.

**Table 2.** Unit root test.

Variable	Level	Prob.	1 <sup>st</sup> difference	Prob.	Order of integration
MS	4.586097	1.0000	-4.586099	0.0007	1(1)
VM	-5.535544	0.0000	-4.156988	0.0030	1(0)
BR	-2.070385	0.2572	-6.66261	0.0000	1(1)
R1	0.932801	0.9949	06.24344	0.0000	1(1)
LR	-4.172289	0.0000	-6.099204	0.0000	1(0)

Source: Author's computation.

**Table 3.** Johanson's cointegration test.

Hypothesized no of CE(s)	Trace statistic	0.05 critical value	Prob**
None*	76.45309	60.06141	0.0011
At most 1*	44.99983	40.17493	0.0151
At most 2	22.72876	24.27596	0.0774
At most 3	7.475883	12.32090	0.2802
At most 4	2.464798	4.129906	0.1375

Source: Author's computation.

**Table 4.** Pairwise Granger causality test.

Null hypothesis	Obs	F-stat	Prob	Decision	Direction
VM does not granger cause MS	38	1.24123	0.2728	Accept	No causality
MS does not granger cause VM		0.25001	0.6200	Accept	No causality
BR does not granger cause MS	38	4.01226	0.0500	Reject	causality
MS does not granger cause BR		0.1464	0.6460	Accept	No causality
R1 does not granger cause MS	38	5.93841	0.0200	Reject	causality
MS does not granger cause R1		2.25323	0.1423	Accept	No causality
LR does not granger cause MS	38	0.00681	0.9347	Accept	No causality
MS does not granger cause LR		0.03234	0.8583	Accept	No causality

Source: Author's computation.

that money growth was strongly exogenous with respect to the inflection rate. It was observed from the result that money supply was weakly exogenous in respect to the value of money. The overall result supports the post-Keynesian Economists, who maintain that money supply is endogeneity in nature: Instead of the unidirectional causality that run from money supply to aggregate spending until equilibrium between the demand and

supply of money is restored through income and interest rate adjustment, the post-Keynesians advocate unidirectional causality which run from aggregate spending to the money supply, (Wary,1992b) and (Nayan and Chik, 2010).

Rejecting the causality from real interest rate to money supply does not mean to propose there was a rigid monetary control, for this depends on the monetary

regime, rather it confirms, the endogeneity of money supply in respect to real interest rate.

The policy implication of our results is that, economic activities greatly influence money supply through the money multiplier principle; therefore monetary authorities or the government should create enabling environment for economic activities to function adequately. Secondly monetary authorities should put into consideration the effect of financial liberalization before embarking on any policy especially those that affect money supply through the banking activities.

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