

# **The Quantity Theory of Money in a Developing Economy: Empirical Evidence from Nigeria**

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## **Abstract**

This paper investigates the quantity theory of money via Keynesian liquidity preference theory in a developing economy of Nigeria from 1986Q3 to 2005Q4. The study applies the ADF unit root and Johansen-Juselius cointegration tests and found a long run relationship among aggregate demand for money (seasonally adjusted M2), real income, real interest rate, and expected inflation rate. In essence, the stability of M2 is deemed necessary as a monetary policy tool to effect economic activity in Nigeria.

## **Introduction**

This paper is motivated by the inefficacy of fiscal authorities and the resultant ineffectiveness of fiscal policy to significantly stimulate economic growth in Nigeria. Consequently, the main burden of economic stimulus in Nigeria is borne by the monetary authorities via monetary policy. The Central Bank of Nigeria (CBN) is the sole authority in charge of monetary policy in Nigeria and thus issues and distributes currency in the Nigerian economy. In line with maintaining price stability, the CBN strives to promote and maintain a viable monetary stability through the management of debt and foreign exchange rate. In essence, appropriate demand and supply management policies by the CBN necessary for economic development requires money to be stable and functional. As such, since early 1990s, the CBN has employed a market-oriented monetary policy through financial instruments like open market operations, discount rates,

and reserve requirements. In this context, this study focuses on testing the factors affecting the quantity theory of money in a developing economy, namely, Nigeria.

Although, there have been several studies generally dealing with the quantity theory of money as it relates to developed nations; for example, Emerson (2006), Moosa (1997), Miyao (1996), Moazami and Gupta (1996), Duck (1993), and Karfakis (2002). Few studies delved into the issue with respect to sub-Saharan Africa and Nigeria in particular. Such papers include Anoruo (2002), Nwaobi (2002), and Fielding (1994). In Anoruo, the stability of the M2 money demand function in Nigeria during the structural adjustment program period was investigated using the Johansen and Juselius cointegration method. The finding suggests that there is a long run relationship existing between M2, and real discount rate, and economic activity. He also applied the Hansen (1992) CUSUM and CUSUMQ stability test results and concluded that the M2 money demand is stable during the study period and thus a viable monetary policy instrument to stimulate economic activity in Nigeria. In addition, Nwaobi applying the Johansen cointegration technique with data from 1960-95, found that money supply, real GDP, inflation, and interest rate are cointegrated in the Nigerian case.

Deviating from Anoruo and Nwaobi, respectively, this paper postulates the Keynesian liquidity preference theory in a reduced form of two propositions to test for the quantity theory of money demand in Nigeria from 1986Q3 to 2005Q4. The rest of the paper is arranged as follows: section 2 discusses the theoretical formulations, while sections 3, 4, and 5 capture the methodological framework, empirical analysis and conclusion, respectively.

### Theoretical Formulations

The liquidity preference theory (LPT) as developed by John Maynard Keynes proposes three motives of why people demand money: the transactions motive, the precautionary motive, and the speculative motive. Thus, following

Keynes, proposition I asserts that both transactions and precautionary motives of aggregate money demand are proportional to income, respectively; while proposition II posits that aggregate demand for money is a function of interest rate. Similarly, Macesich and Tsai (1982) noted that the LPT separates the demand for money into two parts:

$$M = y + i \quad (1)$$

That is, proposition I is captured by income ( $y$ ) in equation (1), whereas, proposition II is indicated by nominal interest rate ( $i$ ) in equation (1). Proposition II implies that since interest rate is the cost of holding money or borrowing capital, the interest rate becomes vital to the transmission mechanism of money in the society. Assume in equation (1) that nominal interest rate consists of two components, notably, the real interest rate ( $r$ ), and the expected inflation rate ( $z$ ), thus:

$$i = r + z \quad (2)$$

Substituting (2) in (1) yields an aggregate money demand function of the form:

$$M = b(y + r + z) \quad (3)$$

Which could be rewritten as a testable hypothetical money demand equation in form of:

$$M_t = b_0 + b_1 y_t + b_2 r_t + b_3 z_t + u_t \quad (4)$$

Where M is money demand, y is real income (also a measure of economic activity), r is real interest rate, z is expected inflation, and u is error term, while t is time.

### Methodological Framework

#### Unit Root Test for Nonstationarity

In line with Gujarati (1999), regression models involving time series data sometimes give results that are spurious, or of dubious value, in the sense that superficially the results look good but on further investigation they look suspect. This implies that the series might be nonstationary or contain unit root; a highly persistent time series process where the current value equals last period's value, plus a weakly dependent disturbance (Wooldridge 2006). Noting Greene (2003), the Augmented Dickey Fuller (ADF) test is employed to test for unit root based on an equation of the following forms:

$$q_t = \mu + \gamma q_{t-1} + \sum_{i=1}^n \gamma_i \Delta q_{t-i} + u_t \quad (5)$$

$$q_t = \mu + \beta t + \gamma q_{t-1} + \sum_{i=1}^n \gamma_i \Delta q_{t-i} + u_t \quad (6)$$

where equations (5) and (6) indicate ADF tests without trend and with trend, respectively. Thus, the ADF unit root test posits a null hypothesis  $\gamma = 0$  versus an alternative hypothesis  $\gamma < 0$ . Hence, implying that if the series have unit root, one can conclude that cointegration is necessary.

#### Cointegration

Since the cointegration test procedures of Johansen and Juselius (1990) can distinguish between the existence of one or more cointegrating vectors and

also generate test statistics with exact distributions; it is hereby appropriate to utilize. Thus, assuming a vector autoregressive (VAR) model:

$$\Delta x_t = \sum \Gamma_i \Delta x_{t-i} + \Omega x_{t-1} + \mu + \varepsilon_t \quad (7)$$

Where  $x_t$  is a vector of nonstationary variables  $p \times 1$  and  $(i = 1, \dots, k)$ .

In essence, the Johansen and Juselius (JJ) method tests whether the coefficient matrix  $\Omega$  reflects the fundamentals of long run equilibrium among the non-stationary variables. As a result, if  $0 < \text{rank } \Omega = r < p$ , then there are matrices  $\alpha$  and  $\beta$  of dimension  $p \times r$  where  $\Omega = \alpha\beta'$  and  $r$  cointegrating relations among elements of  $x_t$ ; where  $\alpha$  and  $\beta$  are cointegration vectors and error correction parameters, respectively.

#### Empirical Analysis

First, all data variables were taken from the International Monetary Fund's (IMF) International Financial Statistics (IFS) CD-rom version based on quarterly series from 1986Q3 to 2005Q4. Second, unit root tests (see ADF unit root test: Table 1) were performed on the time series variables of the aggregate money demand respectively using the augmented Dickey-Fuller (1981) unit root test procedure. The results indicate that the unit root hypothesis cannot be rejected; hence, cointegration is required. Third, the cointegration test results in Table 2 supports the money demand equation as stated in (4) in accordance with LPT. Specifically, the Trace and Max-Eigenvalue tests were conducted, and each test finds at least one cointegrating vector at the 1 percent level and two cointegrating vectors at the 5 percent level; implying a long-run relationship among seasonally adjusted M2, real income, real interest rate, and expected inflation rate.

Table 1: Augmented Dickey-Fuller (ADF) test-Statistics for Unit Roots Based on modified AIC (Akaike Information Criterion) with Max-lag length = 11.

Variable	t-Statistic	Probability*
Real M2	-1.54	0.51
Real income	-2.05	0.26
Real interest rate	-0.50	0.88
Expected inflation rate	-2.35	0.16

\*Mackinnon (1996) one-sided p-values. In terms of rejecting the null of nonstationarity, the ADF critical values are -3.52, -2.90, and -2.59 for 1, 5, and 10 percent (%)levels of significance, respectively.

Table 2: Johansen and Juselius Multivariate Cointegration Test Results

NH CV 5%	TT 1%	CV 5%	CV 1%	NH 1%	$\lambda$ MAX	CV
$r = 0^{**}$ 32.42	70.18	47.21	54.46	$r = 0^{**}$	39.02	27.07
$r \leq 1^*$ 25.52	31.16	29.68	35.65	$r \leq 1^*$	23.79	20.97
$r \leq 2$ 18.63	7.38	15.41	20.04	$r \leq 2$	6.86	14.07
$r \leq 3$ 6.65	0.51	3.76	6.65	$r \leq 3$	0.51	3.76

Notes: NH = Null hypothesis, TT = Trace test, CV = Critical values, r = number of cointegrating vectors in the system indicated by asterisk (\*),  $\lambda$ MAX = Maximum Eigenvalue test. The Critical values (CV) are at the 5 and 1 percent levels of significance. <sup>(\*\*)</sup> denotes rejection of the hypothesis at the 5% (1%)level.

Finally, following McNown and Wallace (1992), the cointegrating vectors for **M2** (money demand), **y** (real income), **r** (real interest rate), and **z** (expected

inflation rate) with time  $t$  have been normalized; by dividing by the coefficient on money demand to approximately yield a restricted money demand equation of the form:

$$M2_t = \begin{matrix} 5.43y_t & + & 0.48r_t & + & 6.98z_t & & (8) \\ (1.64) & & (0.78) & & (1.27) & & \end{matrix}$$

Thus, the quantity demand for money  $M2$  in the Nigerian experience is positively related to real income, real interest rate, and expected inflation rate, respectively. Standard errors are noted in parentheses below the coefficients in equation (8) and all coefficients appear to have the correct signs and consistent with the LPT. That is, as real income increases, the demand for money increases. Also, the demand for money is reported to be proportional to real interest rate and inflation rate as well. Implying, an increase in interest rate vis-à-vis money demand, plus a direct relation between anticipated inflation and money demand. In contrast, all coefficients are statistically significant, except for the real interest rate. This could be explained by the dominance of the open market operations as the preferred monetary policy instrument of the CBN to effect economic activity in Nigeria.

### Conclusion

The time series on the quantity theory of money based on the ADF unit root tests and the Johansen Juselius cointegration procedures show support (given at least one cointegrating vector) for the long run aggregate money demand in Nigeria in accordance with the Keynesian liquidity preference theory (LPT). This result is consistent with those obtained by Anoruo (2002) and Nwaobi (2002) in the sense that the  $M2$  is a stable function of money demand and hence a viable monetary policy tool to effect economic activity in the Nigerian case.

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