Determinants of Income Velocity of Money in Nigeria

Peter N. Okafor, Tersoo S. Shitile, Danladi Osude, Chidi C. Ihediwa, Olamide H. Owolabi, Verse C. Shom and Emmanuel T. Agbadaola*

Abstract

In this paper, we set out to empirically investigate the determinants of income velocity of money in Nigeria, using quarterly time series from 1985:1 to 2012:4. The paper confirms a positive and statistically significant relationship between the growth of income and the velocity of money, which supports the quantity theory of money. Interest rate also has a positive and significant relationship with the income velocity of money. The financial sector development variable adopted, growth rate of stock market capitalization, has a negative relationship with the income velocity of money. The variance decomposition and impulse response results identified inflation rate as the most significant variable to innovations in the income velocity. The results show that the monetary authority cannot obtain additional leverage by issuing more money without generating high inflationary pressure.

Keywords: Central Bank of Nigeria, Income velocity, Money, Monetary Targeting, Nigeria

JEL Classification: C5, C58, N27

Author's E-mail: pnokafor@cbn.gov.ng; tsshitile@cbn.gov.ng; dosude@cbn.gov.ng; ccihediwa@cbn.gov.ng; ohowolabi@cbn.gov.ng

I. Introduction

The Central Bank of Nigeria currently uses the monetary targeting framework in the conduct of monetary policy, with the broad money (M_2) as the intermediate target. The monetary targeting framework is premised on the assumption that portfolio equilibrium induces a reasonable predictive relationship between money and prices. The strength of this approach is the capacity to accurately estimate the demand for money function given that if money demand function is accurately estimated, a policy that targets the growth of nominal money has the prospect of stabilising inflation at desired levels and at reasonable cost. However, if it is becoming increasingly difficult to estimate the demand for money function, an approach that places less emphasis on money

* *Peter Okafor is an Assistant Director; Tersoo Shitile is an Economist, Danlodi Osude, Chris Ihediwa, Olamide Owolabi and Verse Shom are Assistant Economists, while Emmanuel Agbadaola is an NYSC Corp Member in the Monetary Policy Department of the Central Bank of Nigeria. The usual disclaimer applies.*

growth may produce better macroeconomic outcomes. The difficulty encountered in accurately estimating the demand for money function is considered to have contributed to the demise of monetary targeting frameworks among the industrial and emerging market economies and their replacement, since the early 1990s, with variants of inflation targeting.

While the estimation of demand for money function has received considerable attention from economists in the country, such as Anoruo (2002) and Douglason and Patience (2010), the velocity of money, which is a major variable towards accurate estimation of demand for money has not received much attention. The importance of the velocity of money in monetary policy could be better captured by the statement of Selden (1956) "the importance of the concept (of monetary velocity) can scarcely be denied. A given change in the quantity of money will have widely varying effects on the level of prices and income, depending on the behavior of monetary velocity". Friedman (1959) restated the quantity theory and retrieved the importance of money to nominal output by pointing at the relevance of velocity behavior. He argued that successful estimation of velocity would imply monetary changes to be generating predictable changes in aggregate spending. Velocity is not only important in determining to what extent monetary policy is effective, but rather crucial in determining whether short term monetary policy is effective at all (Van den Ingh, 2009)

In spite of the crucial nature of the velocity of money, there are many issues about its behavior which in practical terms remained unsolved. Within the framework of the original quantity theory of money, velocity was treated as a constant with the implication that an expansionary monetary policy need not be questioned because it would certainly affect nominal output levels. Variability in the velocity values has, however, proved this theory to be erroneous. Available data from the Central Bank of Nigeria revealed that the trend in the velocity of money in Nigeria has shown a seemingly V-shape between 2002 and 2010. It increased consistently from 4.87 in 2002 to peak at 5.15 by 2005 when it commenced a gradual decline which reached the lowest value of 2.52 by 2010. One of the major problems in the developed countries is the increased difficulty in distinguishing between money and money substitutes; In the developing economy is, however, issues such as financial innovations, deepening of the financial sector, monetisation policy, growth of GDP, among others, have contributed to the fluctuating behavior of velocity. The variation in velocity has implications for monetary policy particularly for central banks that use the monetary targeting framework. An unstable velocity makes the forecast of optimal monetary aggregates difficult; thereby affecting the basis of monetary policy decisions.

In the light of the foregoing, it has been stressed that for practical policy purposes, the focus is not about the constancy or stability of velocity but how predictable it is. As a result, this paper intends to develop a forecasting model for income velocity which is used for the Monetary Programme of Central Bank on Nigeria.

Currently, econometric models do not play a prominent role in the estimation of velocity of money in Nigeria. Forecasts of velocity are required to determine the programme targets for nominal money growth, but this generally come down to judgmental extrapolations of trends in velocity. This approach is valid when velocity appears to follow a relatively slow-moving trend, otherwise it could cost serious misallocation of resources in the economy. For instance, during the 1980s in the US, the Federal Reserve relied on the upward trend of velocity and was able to pursue monetary targeting accurately. However, there was a break in the trend, leading to overestimation of velocity with the implication of a temporary shortage of money. Consequently, Poole (1988), among others, considered it unwise just to rely on a 30-year old trend, instead of carefully examining the underlying determinants.

In the current economic context in Nigeria with huge public debt and reliance on monetary policy to stabilise the economic environment, the velocity of money should be brought under intense scrutiny. In view of the foregoing, this paper empirically investigates the key determinants of income velocity in order to improve the efficiency of estimating the demand for money and by extension the level of money supply that would be consistent with the optimal growth in the monetary programme of the Central Bank of Nigeria.

The paper differs from many existing literature on the determinants or behaviour of the income velocity of money by incorporating the role of financial sector development into the equation. The most neglected area of financial sector which is incorporated in this paper is the stock market. An investment in stock can be seen in this direction as an opportunity cost of holding money especially when the stock market is booming. This in turn may have the tendency of reducing the amount of physical cash held by individual and, hence, a reduction in the velocity of money.

Following the introduction, section two reviews the literature while section three focuses on the model specification and methodology. Section four presents the analysis and discussion of findings while section five concludes the paper with policy recommendations.

II. Literature Review

II.1 Theoretical Review

The debates about the behavior of the income velocity are far from being settled. The classical school, comprising the neoclassical and classical schools, is of the view that the income velocity is independent from government active policies; hence it is a function of real as well as institutional variables with negligible fluctuations in the short-run. However, the Keynesian school argues that velocity is a highly fluctuating variable which is significantly affected by economic policies. As a result, changes in velocity could nullify the effects of monetary policy.

The classical school, championed by economists such as Stewart Mill, David Ricardo and Irving Fisher analyzed the relationship between the volume of money and inflation in terms of the velocity of money. From the perspective of the classical school, velocity is a function of choice and preferences of people, real factors and structures of the society. Hence, it is independent of government policies and especially from the demand management policies. Therefore, as a result of negligible changes in these factors, velocity is regarded as a stationary variable in both the short-run and long-run.

The Chicago school led by Milton Friedman based its arguments on the assumption of the inherent stability of the private sector and flexibility of prices. They argued that due to the dependency of velocity or economic policies, it has high fluctuations in the long-run; hence its behavior is less predictable. In the long-run, due to fluctuations of real factors and structures of the society, the changes maintain a smooth path, which increases its stability and predictability. They concluded that velocity could be regarded as a stable function of rates on different financial and physical assets. The main thrust of their argument is that the equilibrium associated with full employment in the labor market, under the neoclassical school, does not exist, due to rigidity of wages. They stressed that the velocity of money is severely affected by demand management policies; hence, it is a non-stationary variable. Furthermore, they argued that the movements of velocity are opposite to the movement of money-supply. Interest rate is also regarded as one of the variables influencing velocity.

Lucas (1973), Sargent and Wallace (1975) and Barro (1997) however based their arguments on the axiom of complex flexibility of wages and prices and rational expectations. They argued that monetary policy could have a temporary impact on the output level, if the public has not properly anticipated it. As a result, the New Classical is of the opinion that the velocity of money (due to the stability of money demand function) is a stationary variable in the long run.

Income velocity is a measure of the rate of the use of money or the average number of transactions per unit of money. It is a flow concept which is measurable but not visible. The concept was developed by Fisher in 1956.

The original equation is of the form:

$$MV = PT \quad (1)$$

where
M= money stock
V= velocity of circulation
P= price level
T= number of transactions

Since T represents final transactions, it could be replaced by Y which represents some version of real income or output.

Then equation 1 could be written as

$$MV = PY \quad (2)$$

Since P is the average price level and Y is the level of real income, then equation 2 could be written as follows:

$$MV = NY \quad (3)$$

Where NY= nominal GDP

The Cambridge School modified equation 3 by placing emphasis on cash balance holdings used in facilitating expenditures. Therefore, equation (3) was modified as follows:

$$M = kY \quad (4)$$

Where k=1/v which represents average cash balances as a fraction of nominal income. Equation 4 shifted emphasis to the determinants of the demand for money rather than the effects of changes in the supply of money. In essence, the

Cambridge equation relates average cash balances during s period to the level of income in the same period.

Furthermore, the income velocity could be defined in terms of demand deposits turnover which is debit divided by total demand deposits. Prior to 1930, the quantity theory regarded "V" and "Y" as constants at least in the short term. This was based on the assumption that the potential output was not affected by the changes in the supply of money because output depends on land, labor, and capital. Velocity was assumed constant because the economic and social activities which affect the factor of production do not change in the short term. As a result, velocity was not affected by the quantity of money. Invariably with V and Y held constant, a direct relationship was established between the stock of money and the level of prices.

Keynes argued against the thesis that economic agents hold a constant fraction of their incomes in cash balances. He argued that the medium of exchange role was only one of the motives of holding money, stressing that liquidity preference could be influenced by yields or alternative financial assets. As a result of this, velocity could change due to expectations about future interest rates or risk. Also, changes in money stock alone could also affect the velocity of money through the medium of interest rate.

II.2 Empirical Review

The issue of the velocity of money has continued to attract the attention of authors in both developed and developing economies. Garvy (1956) examined the structural aspect of the money velocity focusing attention to factors determining fluctuations in the velocity of money other than interest rates. He extended his analysis of transactional velocity to include the structural and institutional aspects and constraints determining the efficiency of money. Garvy concluded that the long-run developments that increase the transaction velocity of money are mostly confined to the corporate sector, and include efforts to reduce the mail float as well as to economise on balances by centralising cash holdings, by a better synchronization of payments flows, and by temporary investment of excess cash and reserves.

In a study by Andersen (1975), where he observed that movements in velocity, if taking alone, would provide little useful evidence in the debate regarding the predictability of the response of income to a change in money. Another conclusion is that misunderstanding of the factors causing changes in observed velocity, and the inability to observe changes in desired money balances, could result in monetary policy actions which are unintentionally procyclical. In other words, the lack of reliable information regarding the utilization of money balances suggests that the growth in the stock of money should not be sharply expanded or contracted as a result of observations or expectations regarding short-run fluctuations in the income velocity of money. He also concluded that changes in the behavior of the money stock have been closely associated with changes in economic activity, money income, and prices.

Bordo and Jonung (1987) found that since the late 19th century until World War II, velocity has kept a downward trend in five industrialized countries namely the USA, England, Canada, Sweden and Norway. It, however, experienced an upward trend in the post-war period, hence, contradicting the conventional theories of stationarity. They attributed their findings to development in the money and capital markets, particularly the broader-based banking system expansion, technical progress in the financial sector of different countries and changes in fiscal and monetary policy decision making.

Anyanwu (1994) examined the determinants of income velocity of money in Nigeria over the period 1960-1992. The paper showed that interest rate, inflation rate, real gross national product, exchange rate, and financial deregulation had significant impact on the velocity of money. Moreover, velocity was found to feedback into interest rate and economies of scale were revealed by the long-run income elasticity of velocity which was marginally less than unity.

Gill (2000) examined the determinants of the income velocity of money in Pakistan for the period 1973/4 to 2005/6 (33 years) using the Johansen co-integration technique. The study found that real income (per capita real GDP), financial development (91 day Treasury bill ratio), consumer price index (inflation) and interest rate (call money rate) all had a positive relationship with the velocity of money. Accordingly, it concluded that the constancy of the velocity of money does not hold in the changing economic situation of Pakistan and should be taken into account in formulating an effective and credible monetary policy in the economy.

Komijani and Nazarian (2004) reviewed the pattern of velocity of money in Iran during the period 1968 to 1979. They pointed out that velocity displayed three general trends during the period. It was shown that velocity registered a decreasing trend from its initial amount of 5.7 in 1968 until 1979, which coincided with the Iraq war, during which it reached its lowest level of 1.47. The second period synchronized with the war era in which velocity maintained an almost linear trend of 1.47 to 1.42. The third period was the post-war era in which velocity experienced an upward trend, rising with a smooth slope of 1.48. They attributed the upward trend to technical efficiency of the payments system and steps taken by the country's capital market. Their study further indicated that the velocity of liquidity was unstable during the period.

Wang and Shi (2006) studied the variability of the velocity of money in a search model by constructing a search model where there is costly search in both the goods and the labour market. Their results showed that money growth shocks can affect velocity and output persistently and also that shocks to monetary policy may also have persistent effects on real activities. The changes in the income velocity of money due to precautionary money demand, as studied by Hromcova (2004), found that the precautionary money demand does not introduce significant changes into the volatility of the income velocity; however, its presence can alter the relationship between the growth rate of money supply and the income velocity.

Leão (2005) attempted to provide an alternative explanation to the pro-cyclical behavior of velocity by using data over the period 1982 to 2003. He distinguished between expenditures related to durable consumption, export and investment goods on the one hand (DGEI), and expenditures related to non-durable goods and services (NDGS) on the other. The result showed that money involved in expenditures related to NDGS because agents usually synchronize their expenditures on the former category the moment that liquid capital has become available. Following this, he explained the pro-cyclical behavior of velocity in terms of the increasing share of the DGEI in total expenditures during expansions and decreasing during downturns.

The finding of Leão (2005) was further confirmed by Barros etal (2007). They used a VAR model to analyze the determinants of the velocity of both M1 and M2 in the USA during the period 1964 to 2005 and found evidence in support of expenditure composition hypothesis. They showed that increases in the weight of investment and durable consumption in total expenditure raise the velocity of both narrow and broad money. As a result, they stressed that the more a central bank's interest decision responds to money growth, the more volatile economic growth will be. In other words, a monetary policy which puts emphasis on money growth is de-stabilising.

Akhtaruzzaman (2008) investigated the income velocity of money for Bangladesh using data for the period 1973 – 2007. Based on co-integration analysis, he found that the velocity for both M1 and M2 was negatively related to real GDP (growth) and financial development (demand deposit – time deposit ratio) reflecting the early stages of economic and financial development in the country; and that the two variables jointly account for about half of the variance of the speed of income velocity.

Another study was performed by Sitikantha and Subhandhra (2011) on the determinants of the income velocity of money using a reduced from VAR model. They reported that conventional determinants of velocity such as GDP, interest rate and financial deepening (credit to GDP ratio) were statistically significant for the Indian data, but the parameters alone may not be sufficient in undertaking a forward looking assessment of velocity, particularly during periods of major uncertainty that could cause velocity to deviate significantly from its medium-term trend.

Adam et. *al* (2010) attempted to forecast the velocity of income in Tanzania in view of the importance of the variable for a central bank that uses monetary targeting framework. They employed four different models namely: rolling trend estimator, moving average growth estimator, a simple random walk with drift; and a reduced form VAR model. Their results showed that the vector autoregressive model, based on structural money demand equation, outperformed the various univariate approaches both within sample and over a short period out - of - sample horizon. Consequently, they concluded that the existence of a stable cointegrating relationship between velocity and the determinants of money demand suggests that VAR-based forecast may have substantial value in monetary programme formulation. Gordon et al (1997) investigated the trend in velocity with quarterly data for a period covering 1960 – 1997 using a general equilibrium model. They found that expansive fiscal policy through the creation of nominal liability pulled agents into real assets that are to become relatively less taxed, whereas contractionary policy would increase real taxes and, consequently, induce agents to shift into nominal assets including money. As a result, a shift into real assets generates lower short-term money demand, and hence would imply higher velocity values. Expansive monetary policy, on the other hand, produces increases in real money balances, thereby heightening the opportunity cost of holding money, leading agents to substitute out of money into real assets with the implication that short term velocity is also increased as well.

In a recent study by Akinlo (2012) on financial development and income velocity in Nigeria; using co-integration and error correction mechanism, the result showed a positive relationship between velocity and income growth which suggests that Nigeria might possibly be at later stages of economic growth. However, exchange rate has a negative relationship with income velocity in the short run model. The opportunity cost variables namely interest rate and expected rate of inflation were not significant in the short run model, thus conclusive inference cannot be drawn from them. This positive effect of financial development variable (demand deposit-time deposit ratio) possibly arises from the fact that financial innovation encourages the use of money substitutes or quasi—money that reduces the demand for money and, thus, brings the speed of velocity of money up. He, therefore, concluded that any attempt by government or monetary authorities in the country to exercise greater command over resources by printing more money would precipitate inflationary pressure.

It could be concluded from the above empirical review that most studies neglected the stock market which is also an important determinant of financial sector development. This paper, therefore, incorporated this by looking into how investment in stock could affect the velocity of money. Also, many studies did not capture the short- run deviations that might have occurred in estimating the long-run cointegrating equations. Therefore, a dynamic vector error correction model (VECM) is formulated in this paper.

III. Model Specification and Methodology

On the basis of the literature, the velocity of broad money (V2) was employed as a measure of velocity. The theoretical rationale for the traditional variable growth of income (Y) is well known. The variable Y is a measure of income and can have a positive or negative effect on velocity. As postulated by Friedman (1959), there are two possible reasons for the negative relationship between income and the velocity of money. First, money to income ratio increases in response to an increase in savings to income ratio during economic development. Second, the cause may be associated with empirical studies on velocity where the income elasticity of the demand for money exceeds one. Interest rate is incorporated as a measure of the opportunity cost of holding money and it is expected to be positive. Since substitution can occur between money and alternative financial assets, a rise in the rate of interest leads to a higher cost of holding money, and therefore, velocity increases (Akinlo, 2012). However, exchange rate was used here as the alternative measures of opportunity costs of assets substitution. This is based on the argument that in developing countries, the asset choice of wealth holders is largely limited between money and real assets, and not so much between money and financial assets. The exchange rate variable is expected to have a positive effect on the velocity function due to increased international

trade occasioned by economic reforms. If the domestic currency is expected to depreciate, the domestic portfolio holders would readjust their portfolios in favour of foreign assets. Depreciation causes a higher cost of holding local currency so that velocity should increase. The rapid growth of institutions, especially the stock market, affects the way people conduct their economic transactions. This is why it is important to include a measure of financial development. The sign of the measure of financial development is either positive or negative as the case may be, and for this paper, growth of stock market capitalization (MC) was adopted.
Quarterly data were sourced from the various editions of the Central Bank of Nigeria (CBN) statistical bulletin from 1985:1 to 2012:4. The dependent variable used is the velocity of broad money (V2).

To model the determinants of the income velocity of money, the paper employed the vector autoregression (VAR) and Engle-Granger cointegration approaches. The approaches adopted benefited from the empirical expositions of Adam et al (2010) and Akinlo (2012). The procedure provides the opportunity to specify both long-run and short- run behaviour of the velocity of money in Nigeria.

Based on the equation of exchange, velocity is defined as follows:

$$\mathbf{V_t = GDP / M_2} \quad (5)$$

The specification of the velocity function is given as:

$$V_t = f(Y_y, E_t, R_t, \pi^e, \mu_t) \quad (6)$$

Where,
V_t = velocity of broad money
Y_t = growth rate of income at time t
E_t = exchange rate at time t
R_t = interest rate at time t
π^e_t = inflation rate at time t
μ_t = error term

The velocity function is derived from the specified money demand as follows:

$$\left[M^{dt}/P\right] = f\left(Y_t, R_t, E_t, \pi_t^e, \mu_t\right) \quad (7)$$

Where:
M^{dt} is money demand and p is the price level.

$$\frac{M^{dt}}{P} = K * (Y_t R_t E_t \pi^e \mu_t) \quad (8)$$

while k is a constant fraction of the transactions conducted in the economy. Assuming money market equilibrium:

$$M^{dd} = M^{ss} \quad (9)$$

Where M^{ss} is money supply
From the equation of exchange,

$$M^{ss}V = PY \quad (10)$$

With the equilibrium condition, the model is therefore derived as follows:

$$M^{dd} = P\left(K, Y_t, R_t, E_t, \pi_t^e\right) \quad (11)$$

From equation (10) we get

$$V = PY/M^{ss} : M^{dd} = M^{ss} \quad (12)$$

$$V = PY_t/P\left(K, Y_t, R_t, E_t, \pi_t^e\right) \quad (13)$$

$$V = f\left(K, Y_t, R_t, E_t, \pi_t^e\right) \quad (14)$$

By incorporating the effect of financial sector development, equation (14) is modified as follow:

$$V = f\left(K, Y_t, R_t, E_t, \pi_t^e, \lambda\right) \quad (15)$$

Where λ is the growth of stock market capitalization
The linear form of equation (15) is as follows:

$$v_t = k + a_1 y_1 + a_2 r_t + a_3 e_t + a_4 \pi_t^e + a_5 \lambda + \mu_t \quad (16)$$

If we let $k = \beta_0$, $a_1 = \beta_1$, $a_2 = \beta_2$, $a_3 = \beta_3$, $a_4 = \beta_4$, $a_5 = \beta_5$
Where the a's are the slopes, then equation (16) becomes

$$v_t = \beta_0 + \beta_1 y_1 + \beta_2 r_t + \beta_3 e_t + \beta_4 \pi_t^e + \beta_5 \lambda + \mu_t \quad (17)$$

where
$\beta_0, \beta_1, \beta_2 > 0$; $\beta_3, \beta_4, \beta_5 < 0$

III.1 Testing Series Properties

Before estimating the income velocity function specified in equation 17, it is necessary to examine the statistical characteristics of the variables included in the function in order to verify their stationarity. The verification is crucial because Granger (1986) and Hendry (1986) have shown that econometric estimations on non-stationary variables are not statistically valid because the conventional tests, t-test and F-test, are biased. Such results actually lead to spurious regression. The test of stationary on the variables would be done using the Augmented Dickey-Fuller (ADF) test ((Dickey and Fuller, 1979) and the Phillips-Perron test (1988) in order to detect the presence of the unit root in the series and to determine the order of integration of the variables.

The cointegration technique makes it possible to test the existence of a relationship of long term equilibrium relationship among non-stationary economic variables. Following Engle and Granger (1987), it has been shown that even if individual variables are non-stationary, there can be linear combinations among them so that they can form a new series, which in the course of time will converge to equilibrium; that is, they will cointegrate.

The multivariable system cointegration test developed by Johansen (1988) will be used in the study. The technique uses the maximum likelihood estimator to determine the coefficients, the coefficients, the number and the significance of the cointegration vectors in the series.

Based on the Johansen and Juselius (1990), a general vector autoregressive model is specified as follows:

$$X_t = \Pi_1 X_{t-1} + \ldots + \Pi_k X_{t-k} + m + \psi D_t + \varepsilon_t \qquad (t= 1 \ldots T) \qquad (18)$$

where,
X_t =vector (nx1) of endogenous variables,
Π_i = matrix (nxn) of the model's parameters,
m = constant,
D_t = vector of deterministic variables including seasonal variables,
ε_t = random error term.

The model is then formulated into an error correction model as follows:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1} \Delta X_{t-k+1} - \Pi X_{t-k} + m + \psi D_t + \varepsilon_t \qquad (19)$$

where,

$$\Gamma_i = -\left(1-\Pi_1-\Pi_2...-\Pi_i\right) \text{(i=1...k-1) and } \Pi = -\left(1-\Pi_1-...-\Pi_k\right) \quad (20)$$

As specified in equation 19, the model contains information relating to the short and long term adjustments that occur as a result of the variables in X_t, through the parameters of the matrices Γ and Π, respectively.

The rank of matrix Π determines the number of cointegrating vectors; however, it must be a limited such that r cannot be ≤ n (0 ≤ r ≥ n).

The number of cointegrating vectors and the corresponding parameters are determined by the two likelihood-ratio tests, the trace test (λ_{trace}) and the maximum eigenvalue test (λ_{max}) statistics.

III.2 Vector Error Correction Model

In order to capture the short-run deviations that might have occurred in estimating the long-run cointegrating equations, a dynamic vector error correction model (VECM) is formulated. The error correction term depicts the speed of adjustment to equilibrium once the equation is shocked. The dynamic error correction formulation is specified below.

$$\Delta Y_t = \Phi_0 + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_t + \Pi Y_{t-1} + \varepsilon_t \quad (21)$$

where, $\Pi = +\sum_{i=1}^{p} \Phi_{i-1}$ and $\Gamma_i = -\sum_{j=i+1}^{p} \Phi_j$ (22)

where y_t is a 6x1 matrix of income velocity of money, growth of income, interest rate, exchange rate, inflation rate and growth of stock market capitalization. Φ_0 is the 6x1 intercept vector and ε_t is a vector of white noise process and Π conveys the long-run information contained in the data.

IV. Empirical Results and Discussion

The estimation and analysis of the model involves a multi-stage procedure. As shown in Figure 1 below, V_2 displays the classical pattern for an AR (1) series.

Table 1: Correlogram of Residuals

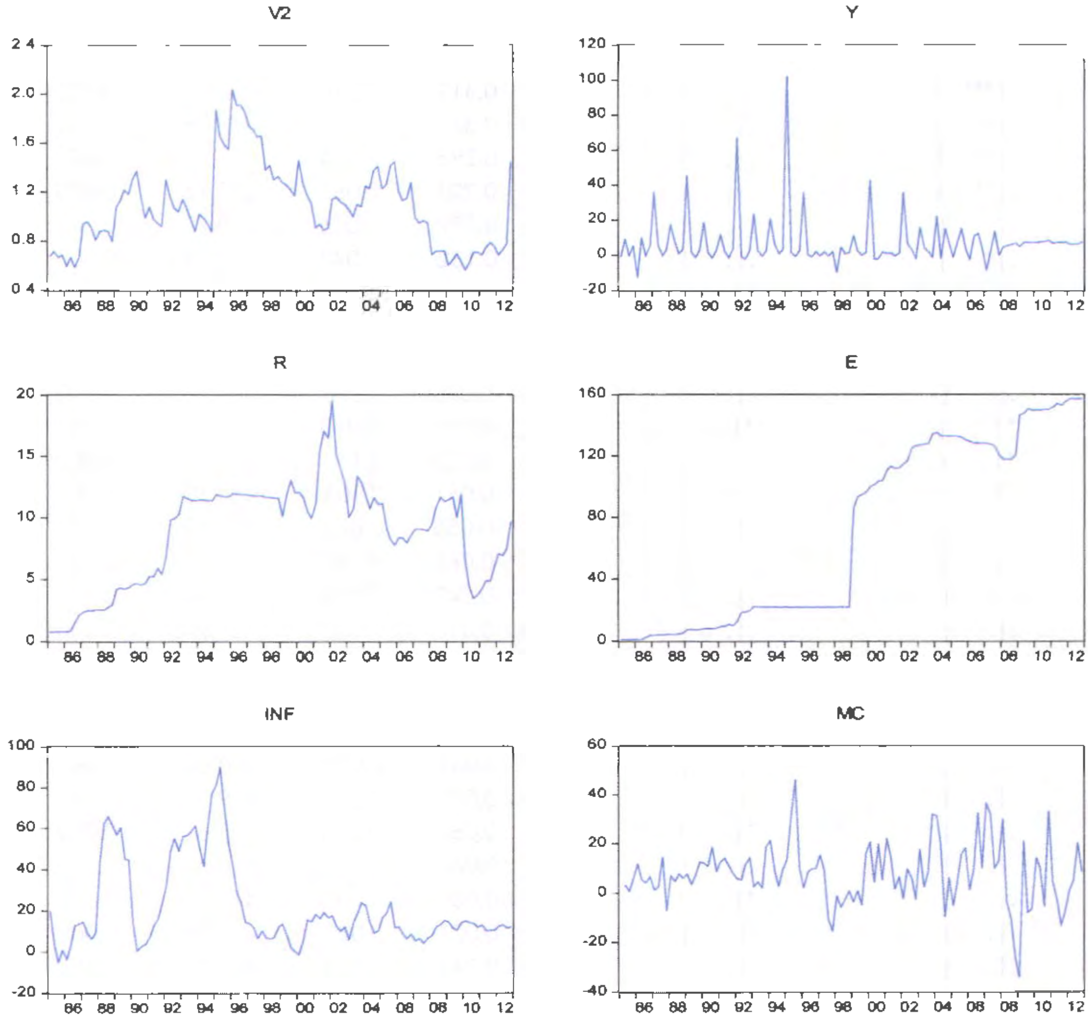
<table>
<tr><th>Autocorrelation</th><th>Partial Correlation</th><th></th><th>AC</th><th>PAC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>.|******|</td><td>.|******|</td><td>1</td><td>0.864</td><td>0.864</td><td>85.861</td><td>0.000</td></tr>
<tr><td>.|******|</td><td>.|* |</td><td>2</td><td>0.783</td><td>0.146</td><td>157.10</td><td>0.000</td></tr>
<tr><td>.|***** |</td><td>.|* |</td><td>3</td><td>0.723</td><td>0.078</td><td>218.41</td><td>0.000</td></tr>
<tr><td>.|***** |</td><td>.|* |</td><td>4</td><td>0.689</td><td>0.107</td><td>274.47</td><td>0.000</td></tr>
<tr><td>.|**** |</td><td>**|. |</td><td>5</td><td>0.568</td><td>-0.311</td><td>313.02</td><td>0.000</td></tr>
<tr><td>.|*** |</td><td>.|. |</td><td>6</td><td>0.477</td><td>-0.057</td><td>340.44</td><td>0.000</td></tr>
<tr><td>.|*** |</td><td>.|. |</td><td>7</td><td>0.419</td><td>0.057</td><td>361.82</td><td>0.000</td></tr>
<tr><td>.|*** |</td><td>.|. |</td><td>8</td><td>0.371</td><td>0.001</td><td>378.69</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|. |</td><td>9</td><td>0.295</td><td>-0.014</td><td>389.51</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|. |</td><td>10</td><td>0.223</td><td>-0.065</td><td>395.73</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>.|. |</td><td>11</td><td>0.179</td><td>-0.006</td><td>399.78</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>.|. |</td><td>12</td><td>0.132</td><td>-0.042</td><td>402.02</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>*|. |</td><td>13</td><td>0.059</td><td>-0.113</td><td>402.48</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>14</td><td>-0.002</td><td>-0.023</td><td>402.48</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>15</td><td>-0.034</td><td>0.028</td><td>402.63</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|* |</td><td>16</td><td>-0.048</td><td>0.076</td><td>402.93</td><td>0.000</td></tr>
<tr><td>*|. |</td><td>*|. |</td><td>17</td><td>-0.098</td><td>-0.078</td><td>404.21</td><td>0.000</td></tr>
<tr><td>*|. |</td><td>.|* |</td><td>18</td><td>-0.105</td><td>0.110</td><td>405.70</td><td>0.000</td></tr>
<tr><td>*|. |</td><td>.|* |</td><td>19</td><td>-0.081</td><td>0.105</td><td>406.60</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>20</td><td>-0.055</td><td>0.020</td><td>407.02</td><td>0.000</td></tr>
<tr><td>*|. |</td><td>.|. |</td><td>21</td><td>-0.066</td><td>-0.031</td><td>407.63</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>22</td><td>-0.047</td><td>0.026</td><td>407.94</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>23</td><td>-0.016</td><td>-0.002</td><td>407.97</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>24</td><td>0.006</td><td>-0.006</td><td>407.98</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>25</td><td>0.006</td><td>0.010</td><td>407.98</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>26</td><td>0.016</td><td>-0.013</td><td>408.02</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>27</td><td>0.046</td><td>0.029</td><td>408.34</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>28</td><td>0.072</td><td>0.041</td><td>409.12</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>*|. |</td><td>29</td><td>0.067</td><td>-0.070</td><td>409.81</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>30</td><td>0.062</td><td>-0.055</td><td>410.41</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>*|. |</td><td>31</td><td>0.060</td><td>-0.080</td><td>410.98</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>32</td><td>0.071</td><td>0.039</td><td>411.79</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>33</td><td>0.041</td><td>-0.051</td><td>412.05</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>34</td><td>0.013</td><td>-0.046</td><td>412.08</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>35</td><td>-0.012</td><td>-0.029</td><td>412.10</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>*|. |</td><td>36</td><td>-0.052</td><td>-0.134</td><td>412.56</td><td>0.000</td></tr>
</table>

From table (1), the auto-correlation value not exceeds the graphic interval, thus, there is no serial correlation of errors. This is also confirmed by the test Q-statistic and associated probability.

IV.1 Time Series Properties of Variables

We proceed by determining the underlying properties of the processes that generate our time series variables; that is whether the variables in our model are stationary or non-stationary. To proceed with the test, graph of each series is first visually examined to see whether a trend is present or not as shown in Figure 1.

Figure 1: Trend graph of the variables



From Figure 1, only the exchange rate exhibited a trend. We thereafter employed the Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) test, to test the order of integration of the variables. The results of the ADF and PP tests are presented in Table 2.

Table 2: Unit Root Test Result using ADF and PP

Variables	ADF Test				PP Test			
	At level	At 1st difference	5% level	Order of Integration	At level	At 1st difference	5% level	Order of Integration
V_2	-2.72	-3.90*	-2.89	I (1)	-2.67	-11.32*	-2.89	I (1)
Y	-4.45*	NA	-2.89	I (0)	-12.06*	NA	-2.89	I (0)
R	-2.14	-9.37*	-2.89	I (1)	-2.21	-9.39*	-2.89	I (1)
E	-0.30	-9.48*	-2.89	I (1)	-0.34	-9.48*	-2.89	I (1)
INF	-3.17*	NA	-2.89	I (0)	-2.37	-6.94*	-2.89	I (1)
MC	-7.22*	NA	-2.89	I (0)	-7.20*	NA	-2.89	I (0)

Source: Author's computation
*Significant at 5 per cent levels. NA = Not applicable

From Table 2, using both Augmented Dickey- Fuller (ADF) and Phillips – Perron (PP) unit root tests, V_2, R and E were not stationary at levels as with most macroeconomic variables and they were differenced once before they could be stationary. They are therefore integrated of order one. However, both Y and MC were integrated of order zero as they were stationary at levels. Finally, INF was stationary at level using ADF test but was stationary at first difference with PP test. These can be seen by comparing the observed values (in absolute terms) of both the ADF and PP test statistics with the critical values (also in absolute terms) of the test statistics at 5% levels. The hypothesis of non stationarity is therefore rejected.

IV.2 Pair-wise Granger Causality Test Result

The result of the pair-wise granger causality test is presented in Table 3. It reveals that inflation rate Granger causes the velocity of money growth of income and growth of stock market capitalization. Moreover, the growth of income Granger caused the growth of stock market capitalization while the growth of stock market capitalization Granger caused exchange rate based on the standard F-test. This result implies that changes in the past values of these variables can be used to predict the change in the present value of the variables they Granger caused.

Table 3: Pairwise Granger Causality Test Result

Null Hypothesis:	Obs	F-Statistic	Prob.
INF → V2	110	4.59233	0.0122
V2 → INF		1.76631	0.1760
INF → Y	110	8.05597	0.0006
Y → INF		2.29401	0.1059
MC → Y	109	0.17309	0.8413
Y → MC		2.69975	0.0719
MC → E	109	2.45841	0.0905
E → MC		0.07576	0.9271
MC → INF	109	0.73713	0.4810
INF → MC		2.39716	0.0960

Source: Authors' computation

IV.3 Johansen Cointegration Test Result

Cointegration regression measures the long-run relationship between the variables whose existence guarantees that the variables demonstrate no inherent tendency to drift apart. A vector of variables integrated of order one is cointegrated if there exists a linear combination of the variables, which are stationary. Following the approach of Johansen and Juselius (1990) two likelihood ratio test statistics, the maximal eigenvalue and the trace statistic, were utilized to determine the number of cointegrating vectors. The cointegration tests were performed allowing for the presence of linear deterministic trends. The result of the test is presented in Table 4.

Table 4: Cointegration Test Result

Trace test (λ_{trace})				Maximum eigenvalue test (λ_{max})			
H_0	H_1	statistic	95 % critical value	H_0	H_1	statistic	95 % critical value
r = 0	r = 1	129.71*	95.75	r = 0	r = 1	49.94*	40.08
r ≤ 1	r = 2	79.76*	69.82	r ≤ 1	r = 2	35.37*	33.88
r ≤ 2	r = 3	44.40	47.86	r ≤ 2	r = 3	21.90	27.58
r ≤ 3	r = 4	22.50	29.80	r ≤ 3	r = 4	13.33	21.13
r ≤ 4	r = 5	9.16	15.49	r ≤ 4	r = 5	8.70	14.26
r ≤ 5	r = 6	0.47	3.84	r ≤ 5	r = 6	0.47	3.84

Source: Author's computation

Note: The * indicates statistical significance at 5 per cent level.

Table 3 presents the summary of the result of the cointrgration tests using the Johansen Maximum Likelihood ratio tests based on the trace of the stochastic matrix and the maximal eigenvalue. Both the Trace test and Max-Eigen test indicate two cointegrating equations at the 0.05 level. Their values, as indicated in the table are greater than the critical values at the 0.05 level, thus confirming that there exists a long run relationship among the variables.

Having ascertained a long-run relationship among the variables, the long-run cointegrating equation is determined by the normalized cointegrating coefficient with the highest log likelihood in absolute term. The result is presented in Table 4 below.

Table 5: Normalized cointegration result

1 Cointegrating Equation(s):	Log likelihood	-1538.434			
Normalized cointegrating coefficients (standard error in parentheses)					
V2	Y	R	E	INF	MC
1.000000	0.384775	0.001916	-0.002272	-0.041872	-0.094389
	(0.06419)**	(0.04877)*	(0.00349)*	(0.01340)*	(0.02476)*

Source: Author's computation

*Significant at 5 per cent level ** Significant at 10 per cent level

The long-run equation is therefore specified as follows:

$$V_2 = 0.384775{*}Y + 0.001916{*}R - 0.002272{*}E - 0.041872{*}INF - 0.094389{*}MC \quad (23)$$

The cointegrating equation revealed that the growth rate of income (Y) has a positive long-run significant relationship with the velocity of money (V_2). This conforms to the a-priori expectation. A unit rise in Y leads to about 0.38 unit increase in V_2. The result is in accordance with the quantity theory of money. This result also depends on the stage of economic development, especially the stage of financial development. The positive relation between velocity and income growth shows that Nigeria might possibly be at later stages of economic growth.

Similarly, interest rate (R), proxied by 91- day Treasury bill rate, has a positive long-run relationship with the velocity of money. A unit increase in R leads to about 0.002 increase in V_2. The rising interest rates leads to a decrease in the demand for money and, thus, velocity increases. On the other hand, inflation rate was found having a significant long-run negative relationship with V_2. A unit change in INF leads to 0.04 decrease in V2. This result is as expected. When prices increase, velocity of money declines as the payment pattern and shopping habits change.

A long-run negative relationship also exists between exchange rate (R) and V_2. A unit change in exchange rate leads to about 0.002 decrease in V_2. The highly significant exchange rate variable simply means that the depreciation of the exchange rate causes the income velocity to decrease as the domestic portfolio holders readjust their portfolio in favour of foreign assets. This result is consistent with the finding of Akinlo (2012). Finally, market capitalization (MC) has a negative long-run significant relationship with V_2. A unit increase in MC would lead to a 0.09 increase in V_2. Since investment in stocks is another opportunity cost of holding money especially when return is high, an increase in this investment would reduce the volume of cash and hence reduce the velocity of money.

IV.4 Impulse Response Function

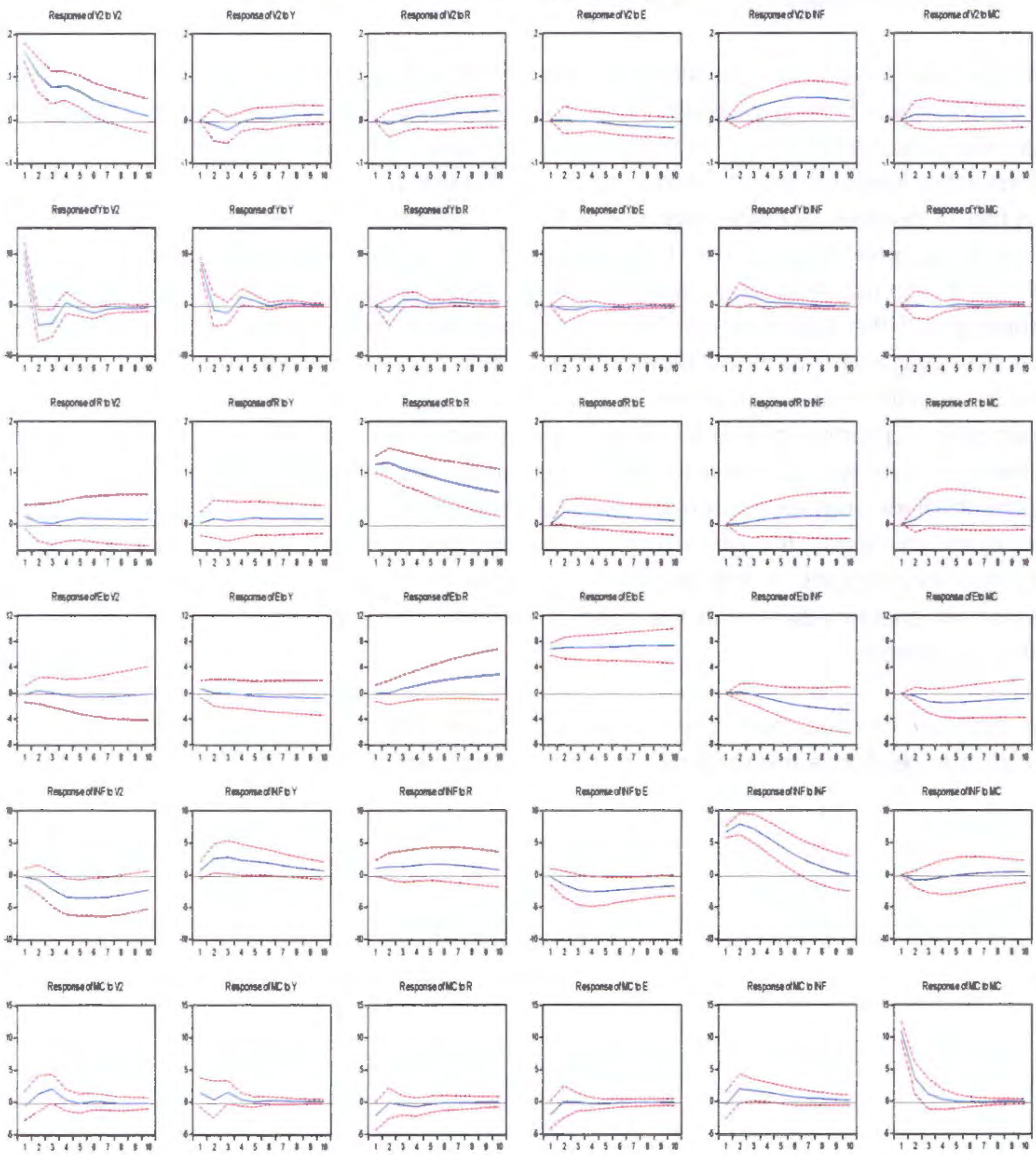
Figure 2 presents the impulse response functions which trace the long-run responses of the system variables to one standard deviation shocks to the system innovations spanning the ten (10) quarters. The result shows that each variable responded significantly to its own one standard deviation shock. For instance, V_2 responded positively to shock in itself throughout the forecast horizon at a decreasing rate. Similarly, V_2 responded positively to innovations on inflation rate and growth of market capitalization throughout the 10 quarters. However, a shock to exchange rate had positive impact on V_2 in the first two quarters and became negative in the remaining eight quarters. The response of V_2 to innovations in interest rate was negative only in the second quarter and was positive in the remaining quarters. More so, the shock due to growth of income had negative impact on V_2 in the forecast quarters except in the 2nd, 3rd and 4th quarters where the impacts were positive.

In the same vein, a one standard deviation shock in growth of stock market capitalization had a positive impact on the growth of income in the forecast quarters except in the 3rd and 4th quarters where the impacts were negative. The impact of innovations on interest rate was not significant on the growth of income in the 1st quarter but was negative in the 2nd quarter but later became positive in the 3rd quarter through the 10th quarter. It was also evident from the result that interest rate responded positively to innovations on all the endogenous variables throughout the ten quarters. These responses were also significant. The response of exchange rate to innovations in the growth of stock market capitalization and inflation rate were not significant in the 1st quarter but was negative in the remaining quarters of the forecast horizon except in the case of inflation where the response was positive in the 2nd quarter. The impact of innovations in the growth of income and interest rate on inflation rate were positive throughout the 10 quarters. Finally, the growth of stock market capitalization responded positively to the innovations in the growth of income and inflation rate throughout the forecast quarters except in the case of inflation where it responded negatively in the 1st quarter.

It can be inferred from these results that the responses of these endogenous variables reinforce the long-run co-integrating relationship.

Figure 2: Impulse Response Graph

Response to Cholesky One S.D. Innovations ± 2 S.E.



IV.5 Variance Decomposition Result

The variance decomposition typically shows the proportion of the forecast error variance of a variable which can be attributed to its own shocks and the innovations from the other variables. The result is presented in Table 8 in the appendix. From the result, it is discovered that the variables were largely driven by themselves except in the case of the growth of income which is mostly driven by the velocity of money. For example, 100 per cent of the variation in Velocity of money (V_2) are due to its own innovations in the 1st quarter and declined to about 72.54 per cent in the 10th quarter of the forecast horizon. Inflation rate contributed insignificantly to variation in V_2 in the 1st quarter and began to increase up to 21.02 per cent in the 10th quarter. Growth of income has no significant contribution to shock on V_2 in the 1st quarter but later rose to 1.55 per cent in the 10th quarter. More so, the shock due to interest rate, exchange rate and growth of stock market capitalization were not significant in the 1st quarter but rose to about 2.41, 1.49 and 0.99 per cent, respectively in the 10th quarter.

The variation in the growth of income is mostly driven by V_2 as it contributed about 59.64 and 60.08 per cent of the forecast variance in Y in the 1st and 10th quarters, respectively. The growth of income also contributed about 40.36 per cent of its variance in the 1st quarter and decline to 33.77 per cent in the 10th quarter.

It could be inferred from the foregoing that the major driver of income the velocity of money is inflation rate. During inflationary period, the velocity of circulation rises as the payment pattern and shopping habits change. This result reinforces the result of the co-integration test.

IV.6 Results from Vector Error Correction Model

The result of the VECM is presented in Table 5. From the result, the sign of the error-correction parameter in the VECM estimate above is as expected and statistically significant at 1, 5 and 10 per cent levels. Moreover, the change in velocity per quarter that is attributed to disequilibrium between the actual and equilibrium levels is measured by absolute value of the coefficient of the error correction term of each equation. The speed of adjustment implies that the adjustment of the velocity of money to changes in the regressors may take considerably long time. The result shows that one per cent deviation from the long run equilibrium in level this period is corrected by about 0.0036 per cent in the next quarter.

Table 6: VECM Estimate

Error Correction:	D(V2)	D(Y)	D(R)	D(E)	D(INF)	D(MC)
CointEq1	-0.003632	-0.499052	-0.008632	0.022710	0.093386	0.012620
	(0.00087)	(0.07116)	(0.00666)	(0.03923)	(0.03902)	(0.06970)
	[-4.19440]	[-7.01263]	[-1.29635]	[0.57896]	[2.39305]	[0.18108]

IV.7 Tests for Stability of the Model

To ensure the reliability of the coefficients of the normalized cointegrating model for the long-run and the vector error correction model for the short-run, we employed the Autoregressive (AR) root stability test. The estimated VAR is stable if all the characteristics roots have modulus less than one and lie inside the unit circle. The result of the AR root stability test in Table 7 satisfies the stability condition of the model. The stability of the model is achieved and the model is said to be good for the analysis.

Table 7: Stability Test Result

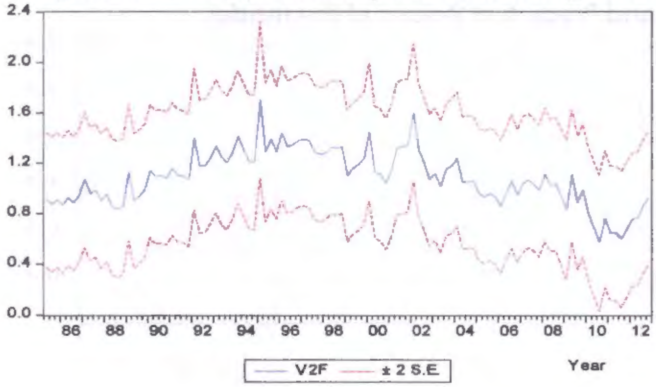
Root	Modulus
0.983337	0.983337
0.938147	0.938147
0.829985 - 0.154677i	0.844275
0.829985 + 0.154677i	0.844275
-0.141265 - 0.556114i	0.573776
-0.141265 + 0.556114i	0.573776
0.489247	0.489247
0.274093 - 0.185853i	0.331163
0.274093 + 0.185853i	0.331163
-0.015704 - 0.096470i	0.097740
-0.015704 + 0.096470i	0.097740
-0.079327	0.079327

No root lies outside the unit circle.
VAR satisfies the stability condition.

IV.8 Predictive and Forecast Test

The three common measures of predictive accuracy (root mean square error (RMSE), mean absolute error (MAE) and Theil's inequality coefficient (U)) are used to evaluate the model's predictive performance. The values of RMSE, MAE and U are reported in Figure 3. The result shows that the model is free from bias. These results are satisfactory and the model is therefore reasonably accurate in prediction.

Figure 3: Velocity of Money Function in Nigeria: Actual and Predicted Values

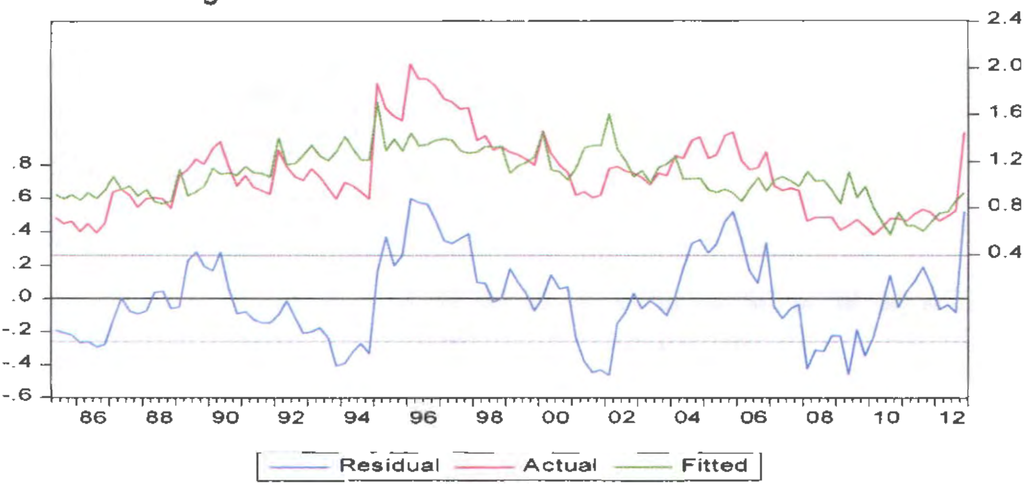


Forecast: V2F	
Actual: V2	
Forecast sample: 1985Q1 2012Q4	
Adjusted sample: 1985Q2 2012Q4	
Included observations: 111	
Root Mean Squared Error	0.252197
Mean Absolute Error	0.202797
Mean Abs. Percent Error	19.67122
Theil Inequality Coefficient	0.112579
Bias Proportion	0.000000
Variance Proportion	0.212348
Covariance Proportion	0.787652

IV.9 Velocity of Money Function in Nigeria: Actual and Predicted Values

An in-sample forecast of the endogenous variable (V_2) is made and the actual and forecast values are reported in Figure 4. As could be seen from the Figure, the model is capable of tracking the historical values of endogenous variable with reasonable accuracy. The fits were quite impressive and they did track the actual dates. The ability of the model to capture turning points was remarkable. The model does forecast the actual variable well. That is, the model has a good predictive ability.

Figure 4: Actual and Predicted Values of the model



V. Conclusion and Policy Recommendations

This paper empirically investigated the determinants of the income velocity of money in Nigeria using quarterly data spanning from the period 1985:1 through 2012:4. The velocity of money is one of the most narrowly watched variables by the monetary authorities to estimate the safe limit of monetary growth and to formulate a sound monetary policy. It is true that the change of velocity of money is rather a long-run occurrence, but it has a central place in monetary policy. It is, therefore, a matter of concern for monetary authorities to have reliable information about macroeconomic variables that have impact on the variation of velocity.

The positive sign of the growth of income shows that at the later stage of financial development, the velocity and income become positively correlated and real incomes has an important impact on the velocity. Inflation rate and exchange rate have negative influence on the velocity of money. It is the behaviour of V_2 that determines the degree of effectiveness to which the action of monetary authority contributes to economic growth, without fuelling inflation. The interest rate proxied by the 91-day Treasury bill rate has a positive relationship with the velocity of money. Since substitution can occur between money and alternative financial assets, a rise in the rate of interest leads to a higher cost of holding money so that velocity increases. The appreciation of the Naira would make the domestic portfolio holders readjust their portfolios against foreign assets. An appreciation causes a lower cost of holding local currency so that velocity decreases. This could be responsible for the negative relationship between the exchange rate and the velocity of money. The growth of stock market capitalisation had a negative relationship with the velocity of money. An increase in the investment in stocks would reduce the amount of cash held by individual in a stable economy and, thereby, reduce the velocity of money. The implication of this result is that the economy of Nigeria is operating at the later stage of financial development.

The result of the study shows that the determinants of income velocity in Nigeria include exchange rate, interest rate, inflation rate and assets prices (capital market). An increase in money supply between 2002Q1 – 2008Q1 led to an increase in capital market prices and all its indices.

It could also be inferred from the variance decomposition and impulse response function results that variation in the velocity of money is mostly affected by inflation rate. A high consumer price has often led to high volume of money used for transaction. The expansionary monetary policy which leads to more money in circulation may also be attributed to this phenomenon.

Based on the foregoing analysis, we can conclude that the velocity of money has a relationship with growth of income, interest rate, inflation rate and exchange rate and growth of stock market capitalization in Nigeria.

The traditional view of the stability of the velocity of money does not seem to hold in the changing economic situation of Nigeria and this should be taken into account in formulating an efficient and credible monetary policy in the country.

References

Abid, R. G. (2010): "Determinants of velocity of money in Pakistan". Proceeding of International Conference on Applied Economics, 2010 (**Athens, 26-28 August** 2010) pp.179-188

Adam, C., P. Kessy, J. J. Nyella, & S.A. O'Connell (2010): "The demand for money in Tanzania". International Growth Centre, London, UK. This version available at: http://eprints.lse.ac.uk/36393/

Akhtaruzzaman, Md. (2008) "Financial Development and Velocity of Money in Bangladesh: A Vector Auto-Regressive Analysis". *Bangladesh Bank Working* Paper Series 0806.

Akinlo, A. E. (2012): "Financial Development and the Velocity of Money in Nigeria: An Empirical Analysis". *The Review of Finance and Banking*, Vol. 4 (2), Pp.97-113

Anderson, D. L. (1975): "Accelerated plate tectonics". *Science* 187, 1077-1079

Anoruo, E. (2002): "Stability of the Nigerian M2 Money Demand Function in the SAP Period". *Economics Bulletin*, Vol. 14, No. 3 pp. 1−9

Anyanwu, J.C. (1994): "The Behaviour and Determinants of Income Velocity of Money: A Study of the Nigerian Experience, 1960-1992". African Economic Research Consortium (unpublished).

Barro, R. J. (1997): "Determinants of Economic Growth: A Cross-Country Empirical Study", Cambridge MA, *MIT Press*

Barros, C. P., L.A. Gil-Alana, and Leao, P. (2007): "The Expenditure Composition Hypothesis: Empirical Evidence and Implications for Monetary Policy" Working Papers No. WP 010/2007/DE/UECE, School of Economics and Management, Technical University of Libson, ISSN 0874-4548

Bordo, M.D. and L. Jonung (1987): "The Stochastic Properties of Velocity: A New Interpretation", *NBER Working Paper Series No. 2255*. National Bureau of Economic Research, Inc.

Bordo, M.D., L. Jonung and P.Siklos (1993): "The Common Development of Institutional Change as Measured by Income Velocity: A Century of Evidence from Industrialized Countries," *NBER Working Papers 4379*, National Bureau of Economic Research, Inc.

Bull, L. (2002): "Short run money demand, NBER working paper series, working paper 9235. National Bureau of Economic Research, Inc.

Broadbent, B. and R. Barro (1997): "Central Bank Preferences and Macroeconomic Equilibrium", *Journal of Monetary Economics* 39, 17-43

Dickey, D.A. and W.A. Fuller (1979): "Distribution of the estimators of autoregressive time series with a unit root". *Journal of the American Statistical Association*, 74(366), 427-31

Douglason, G. and E. Patience (2010): "Structural Breaks, Demand for Money and Monetary Policy in Nigeria". Department of Economics, Delta State University, Abraka, Nigeria (Unpublished)

Engle, R.F. and C.W.J. Granger (1987): "Co-integration and error correction, representation estimation and testing", *Econometrica* Vol.55, No.2, pp.251-276

Friedman, M.(1959): "The Demand for Money: Some Theoretical and Empirical Results". *Journal of Political Economy*, Vol. 67 *(August 1959), pp. 327-51*

Garvy, G. (1959): "Structural Aspect of Money Velocity", *The Quarterly Journal of Economics (Aug. 1979)*, Vol. 73, pp.429-447

Gill, K. G. (2000): "The Third Job: Employed Couples' Management of Household Work Contradictions", Aldershot, England: *Ashgate*. ISBN 1-84014-304-5

Gordon, R. J. (1984): "The 1981-82 Velocity Decline: A Structural Shift in Income or Money Demand?," *NBER Working Papers* 1343, National Bureau of Economic Research, Inc

Gordon, D.B., E. M. Leeper, and T. Zha (1997): "Trends in Velocity and Policy Expectations" *FED of Atlanta Working Paper 97-7*

Granger, C.W.J. (1986): "Developments in the study of co-integrated economic variables". *Oxford Bulletin of Economics and Statistics*, 48, 213-228

Henry, D.F. (1986): "Economic Modeling with Cointegrated Variables: An Overview," *Oxford Bulletin of Economics and Statistics*, 48, August, 1986, 201-212

Hromcová, J. (2004): "On the Income Velocity of Money in A Cash-In-Advance Economy with Capital," Working Papers. Serie AD 2004-21, *Instituto Valenciano de Investigaciones Económicas*, S.A. (Ivie)

Komijani, A. and R. Nazarian (2004): "Behavioral Pattern of Income Velocity of Money and Estimation of Its Function (The case of Iran)" *Iranian Economic Review*, Vol.9, No.11, Fall 2004

Leão, P. (2005), ''Why Does the Velocity of Money Move Pro-cyclically?,'' *International*
Review of Applied Economics, Vol. 19 (1), pp. 119-131

Lucas, R. E. Jr. (1973): "Some International Evidence on Output-Inflation Tradeoffs", *American Economic Review* (June 1973), pp 326-34

Johansen, S. (1988): "Statistical analysis of co-integration vectors". *Journal of Economic Dynamics and Control*, 12, 231-254

Johansen, S. and K. Juselies (1990): "Maximum likelihood estimation and inferences on co-integration". *Oxford Bulletin of Economics and Statistics*, 52, 169-210

MacKinnon, J. G., A. Haug and L. Michelis (1999): "Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration", *Journal of Applied Econometrics*, Vol. 14, No. 5, 1999, pp. 563-577.

Phillips, P.C.B. and P. Perron (1988): "Testing for a unit root in time series regression". *Biometrika*, 75, 335-346.

Poole, W. (1988), ''Monetary Policy Lessons of Recent Inflation and Disinflation,'' Journal of Economic Perspectives, Vol. 2, No. 3, pp. 73-100

Randa, J. (1999): "Economic reform and the stability of the demand for money in Tanzania", *Journal of African Economies*, Vol. 8 (3), October, pp. 307-344

Sargent, T.J. and N. Wallace (1975): "Rational expectations, the optimal monetary instrument, and the optimal money supply rule", *Journal of Political Economy* 83, 241-254.

Selden, R.T. (1956): ''Monetary Velocity in the United States,'' In: *Studies in the Quantity Theory of Money*, ed. Friedman, M., Chicago: *The University of Chicago Press*.

Sitikantha, P. and S. Subhadhra (2011): The Velocity Crowding-out Impact: Why High Money Growth is Not Always Inflationary. *Reserve Bank of India Working Paper series* (WPS (DEPR), May 2011.

Van den Ingh, H. (2009): "Velocity as an Indicator for Economic Policy"; Thesis, Erasmus School of Economics, Erasmus University Rotterdam

Wang, W. and S. Shi (2006): "The Variability of Velocity of Money in a Search Model," Working Papers tecipa-190, *University of Toronto*, Department of Economics.

APPENDIX

Table 8: Variance Decomposition Result

Variance Deconposition of V2							
Period	S.E.	V2	Y	R	E	INF	MC
1	0.159187	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.192623	98.82448	0.282314	0.215604	0.000381	0.274207	0.403010
3	0.210467	95.73318	1.390658	0.182037	0.015710	1.953884	0.724534
4	0.228717	93.28728	1.202101	0.315610	0.031037	4.369331	0.794641
5	0.243410	90.11636	1.103109	0.432955	0.099015	7.408689	0.839868
6	0.254130	86.26669	1.045394	0.632817	0.273113	10.89970	0.882287
7	0.263308	82.34502	1.076224	0.989521	0.513899	14.17162	0.903720
8	0.271241	78.67506	1.216548	1.424037	0.799679	16.95977	0.924906
9	0.277896	75.38377	1.379080	1.898805	1.130203	19.25253	0.955615
10	0.283559	72.54217	1.546535	2.411016	1.485823	21.02196	0.992500
Variance Decomposition of Y:							
Period	S.E.	V2	Y	R	E	INF	MC
1	13.29896	59.63565	40.36435	0.000000	0.000000	0.000000	0.000000
2	14.15674	60.66213	36.09267	0.986787	0.370582	1.887804	2.53E-05
3	14.84318	61.09371	34.01929	1.364092	0.649188	2.837305	0.036408
4	14.99993	59.92007	34.49263	1.915037	0.650919	2.935635	0.085704
5	15.05550	59.72937	34.55362	1.929747	0.695755	3.003946	0.087569
6	15.15903	60.05793	34.09133	1.969737	0.768939	3.019500	0.092555
7	15.19507	60.05241	33.95901	2.088490	0.800315	3.006805	0.092973
8	15.21501	60.02640	33.92009	2.132801	0.820099	3.004442	0.096169
9	15.23537	60.06743	33.83174	2.148620	0.840843	3.009470	0.101899
10	15.24920	60.07690	33.77069	2.162185	0.856125	3.028284	0.105812
Variance Decomposition of R:							
Period	S.E.	V2	Y	R	E	INF	MC
1	1.181802	1.763755	0.014236	98.22201	0.000000	0.000000	0.000000
2	1.714179	0.879390	0.418649	96.49032	1.953305	0.003097	0.255239
3	2.063268	0.610621	0.405226	94.60440	2.482987	0.081090	1.815676
4	2.333773	0.588222	0.486884	92.99897	2.674742	0.257017	2.994161
5	2.544366	0.714112	0.651931	91.64162	2.726563	0.477156	3.788614
6	2.709446	0.784166	0.752063	90.67902	2.698180	0.728185	4.358390
7	2.844175	0.836932	0.822468	89.96379	2.637689	0.980512	4.758613
8	2.956080	0.896918	0.894762	89.37349	2.568545	1.218414	5.047869
9	3.049260	0.944576	0.958495	88.88553	2.497194	1.444000	5.270209
10	3.127565	0.977475	1.011586	88.48276	2.426855	1.657021	5.444307
Variance Decomposition of E:							
Period	S.E.	V2	Y	R	E	INF	MC
1	6.851707	0.046983	1.064421	0.000133	98.88846	0.000000	0.000000
2	9.840961	0.146547	0.516071	0.004458	99.10540	0.036850	0.190673
3	12.21040	0.098495	0.341473	0.347811	97.89738	0.051394	1.263447
4	14.27820	0.113965	0.272849	0.981087	96.19118	0.358563	2.082351
5	16.18526	0.205755	0.274445	1.818925	94.26129	0.982064	2.457525
6	17.99195	0.267686	0.297756	2.763414	92.31828	1.801946	2.550918
7	19.71244	0.285729	0.326937	3.699310	90.50633	2.684792	2.496900
8	21.35134	0.278348	0.364730	4.580763	88.86461	3.534264	2.377280
9	22.91316	0.255256	0.405710	5.401019	87.40144	4.300890	2.235689
10	24.40078	0.227192	0.444730	6.157723	86.11570	4.962268	2.092390
Variance Decomposition of INF:							
Period	S.E.	V2	Y	R	E	INF	MC
1	6.802181	0.145619	1.121269	2.456129	0.168867	96.10812	0.000000
2	10.98193	0.462162	5.988949	2.426342	1.858799	88.75792	0.505830
3	13.87445	2.764608	7.814808	2.396869	3.943987	82.51379	0.565939
4	15.91074	6.549337	8.116465	2.746163	5.654295	76.43760	0.496138
5	17.29951	9.698219	8.442822	3.309416	6.879923	71.24326	0.426365
6	18.25245	12.32843	8.700877	3.807080	7.806615	66.97099	0.386011
7	18.92901	14.65103	8.750328	4.182160	8.551261	63.48542	0.379809
8	19.40798	16.48065	8.710714	4.448204	9.168649	60.79388	0.397905
9	19.74452	17.80239	8.643555	4.602272	9.698284	58.82291	0.430589
10	19.98437	18.72311	8.556852	4.661069	10.16709	57.42162	0.470259
Variance Decomposition of MC:							
Period	S.E.	V2	Y	R	E	INF	MC
1	11.55862	0.250352	1.690854	3.523335	3.096246	0.233930	91.20528
2	12.33455	1.391258	1.587394	3.109426	2.719859	2.843601	88.34846
3	12.78201	4.030891	2.933152	3.047940	2.533446	4.420516	83.03406
4	12.90693	4.042269	3.000645	3.311934	2.550751	5.585238	81.50916
5	12.96304	4.020652	2.975223	3.355515	2.593691	6.249831	80.80509
6	12.99137	4.014191	3.015321	3.354184	2.604984	6.551308	80.46001
7	13.00750	4.004345	3.044886	3.359210	2.611776	6.714935	80.26485
8	13.01773	4.023344	3.046802	3.358502	2.618124	6.811821	80.14141
9	13.02368	4.040344	3.051743	3.355684	2.621451	6.859986	80.07079
10	13.02731	4.056138	3.058429	3.353832	2.623198	6.880726	80.02768
Cholesky Ordering: V2 Y R E INF MC							