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FINANCIAL DEVELOPMENT AND THE VELOCITY OF MONEY IN NIGERIA: AN EMPIRICAL ANALYSIS

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Abstract. The paper investigates the impact of financial development on the velocity of money in Nigeria, over the time horizon 1986:1 – 2010:4. The paper confirms the existence of a unique and statistically significant relationship between velocity of money (narrow and broad) and measures of financial development. The error-correction results show that current exchange rate has statistically significant negative effect on velocity of money in Nigeria. Per capita income has statistically significant relation with velocity of money (narrow and broad), which clearly supports the quantity theory. The results show that money issuing authorities cannot obtain additional leverage by issuing more money without generating high inflationary pressure. The results also show the importance of financial sector innovations for velocity.

1. Introduction

The study of the behaviour of the velocity of money has intrigued many researchers. The increasing research works on behaviour of money velocity is as a result of its importance in setting credible monetary policy programmes. The volume of money supply and its speed of circulation link money to the economic activity in a country. Therefore, the velocity of money is very crucial in the design and implementation of monetary policy. Indeed, the numerical value of velocity of money and its determining factors play a major role in ensuring the effectiveness of monetary policy for purpose of ensuring price stability and rapid economic growth in any country.

In mid 80s, several developing countries embarked on far reaching financial reforms. The basic objectives of these reforms are to enhance the efficiency of the financial sector and promote the development of the economy as a whole. However, the introduction of the financial reforms and innovation would have implications for instability or stability of the money demand and therefore the velocity of money function (Judd and Scadding, 1982). Financial reforms could alter or cause shifts in money velocity; and in particular, where the velocity is variable, the relationship between money and income becomes uncertain and less predictable. The variability in velocity breaks the rigid link between money and income, since changes in money supply, however induced, may result in pushing velocity up or down rather than produce the desired effects on spending and income[1].

Given the importance of money velocity in the setting up of credible monetary policy, the rapid development of the financial sector and the concerns on the nature of the relationship between money velocity and financial development, the aim of this paper is to investigate empirically the determinants of money velocity in Nigeria with emphasis on the role on financial

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[1]The details of this argument could be found in the works of Garvey and Blyn, 1970, and Irungu, 2003 among others)

development. We confine our empirical tests within the cointegration and error-correction framework so as to derive both long run and short run relationships.

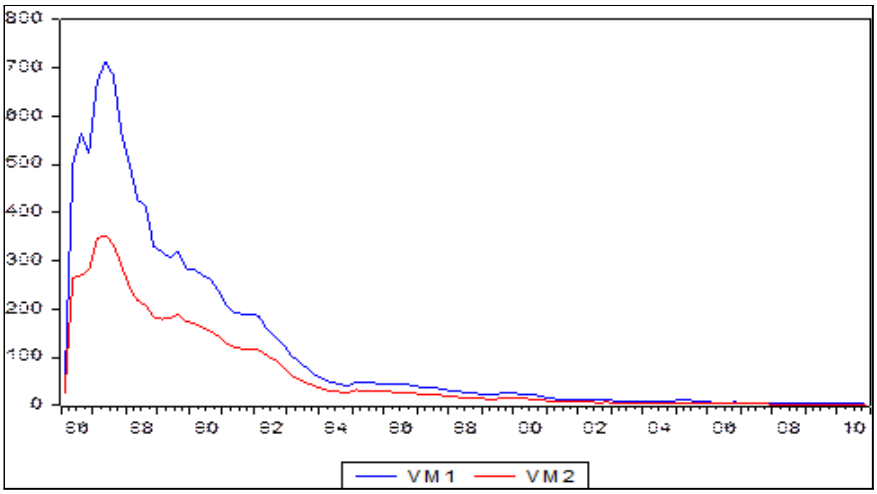
Our study differs from the many existing literature on the determinants or behaviour of money velocity by incorporating the role of financial sector development into the equation. Also, we ascertain the time series properties of the relevant variables using unit root tests. In addition, we employ multivariate cointegration test to determine whether the variables share a common trend while error correction approach is adopted to obtain the short run and the speed of adjustment of the money velocity to changes in the regressors. Finally, we check for the stability of the long run money velocity function which has important implications for the effectiveness of the monetary policy in the place country-region Nigeria.

The paper is organized as follows. In section 2 that follows, we provide a capsule summary of development of the financial sector over the study period. Section 3 provides the theoretical and empirical issues on determinants of money velocity and the role of financial development. Section 4 provides the methodology. In section 5, we discuss the results. The last section contains the concluding remarks.

2. Financial Development and Velocity of Money in Nigeria 1980- 2010

The Nigerian financial system has undergone some remarkable changes as a result of the reforms and policies implemented by the monetary authorities since mid 80s[2]. The effects of these reforms are evidenced in the rapid growth of financial variables such as saving, deposit, lending and borrowing, and money supply[3]. The interest rate and other key rates experienced upward movement following the financial sector reforms in the 80s[4].

Figure 1: Plots of income velocity of narrow money (MV1) and velocity of broad money (MV2)



The money velocity measured as money-GDP ratio as shown in fig. 1 shows that the ratios of M1 to GDP and M2 to GDP increased sharply up to the late 80s. However, velocity decreased

[2]Some of these reforms included liberalization of interest and exchange rates, bank consolidation and rationalization. Details of the various reforms and policies in the financial sector of the Nigerian economy and the performance of the sector have been exhaustively detailed and discussed in the literature (for details of the reforms and policies and they affect the sector, one may consult Ikhide (1997), Ogun (2006) and Poyi, (2006).

[3]Evidence of these can be found in the Central Bank of Nigeria, Statistical Bulletin 2009 Special Edition.

[4]However, following the intervention of the monetary authorities coupled with sound macroeconomic management by the CBN, many of the rates experienced significant positive trends in 2006.

steadily from 1987 until 2010. Essentially, with the growth in financial transactions, advancement in loans distribution techniques, financial innovation and service automation among others, the velocity of money would have undergone significant changes[5]. More specifically, how has the financial sector development affected behaviour of velocity of money in Nigeria? This, of course, constitutes the rationale for the study.

3. Theoretical and Empirical Issues

3.1. **Theoretical Issues.** The velocity of money concept is rooted in the Quantity Theory of Money which is based on the Fisher's (1911) equation of exchange (MV = PY). The Quantity Theory of Money postulates a direct relationship between price (P) (unknown variable) and the money supply (M) (determined by the monetary authority that is, Central bank and/or Ministry of Finance)[6]. The classical economists argued that velocity of money (VM) is more or less constant[7]. However, the Keynesian economists believed that VM is unstable and changes rapidly and offset changes in the money stock while the monetarists led by Friedman argued against treating velocity of money as a parameter and examined those variables that could affect the size of velocity of money[8]. Indeed, the work of the monetarist economists on velocity of money has led to resurgence of empirical research works worldwide. Some of these empirical works are reviewed below.

3.2. **Review of Related Empirical Studies.** In this section, we provide a summary of previous empirical studies on the behaviour and determination of velocity of money with special attention on the role of financial development. Many attempts have been made to examine the behaviour and determinants of velocity in different countries. Among the earliest papers in this field of applied research are: Ezekiel and Adekunle (1969), Khan (1973), Short (1973), Kharadia (1988), Anyanwu (1994), among others. Ezekiel and Adekunle (1969) examined the behavior of three alternative definitions of income velocity, that is, income velocity of currency; income velocity of narrow money (currency plus demand deposits), and income velocity of broad money (currency, demand deposits and quasi money) for 37 countries with different levels of economic growth. They found that income level and velocity of money are inversely related for the three money definitions. However, for the developed countries the velocity of currency later increased as income increased. The results showed an inverse relationship between the per capita income for both the narrow and broad money velocities when countries were treated in isolation. When the authors incorporated inflation rate, the results showed that the rate of decrease in money velocity slowed down as the level of per capita income expanded. This simply suggests that as per capita income increases, velocity of money either decreases or remains constant.

Short (1973) study for West Malaysia and placecountry-regionSingapore showed that the negative impact of per capita income on velocity was overpowered by the changes in monetary habits. The study revealed that a rise in either interest rate or anticipated rate of change of prices led to a rising velocity and vice versa. The study equally showed that an increase in the number of bank branches caused the velocity of money to increase.

Similar study by Khan (1973) for placecountry-regionPakistan showed that per capita income was inversely related to velocity of money. However, this was reversed when extra explanatory

[5]Moreover, the reforms in the sector would have led to significant psychological, social and institutional changes in the lending-borrowing behaviours of individuals and businesses in the economy thereby making the assumption of constant velocity of money rather unrealistic.

[6]Several studies have discussed extensively the Quantity Theory of Money to warrant detailed discussion here (see Akhtaruzzaman, 2008 and Anyanwu 1994 and Irungu 2003).. Therefore, we only highlight the main issue of controversy which is the role of the velocity of money.

[7]This view is based on the belief that factors that affect VM are essentially exogenous and, as such, not much susceptible to change in the short and long run. These factors include psychology of individuals regarding lending and borrowing, social and institutional factors determining the mode of payment and people saving behaviours and customs and conventions prevailing in society.

[8]This is what is called the Modern Quantity Theory of Money.

variables were introduced into the function. The results showed that there was an inverse relationship between the number of bank branches and money velocity. This by implications means that growth in banking caused the velocity of money to slow down because of the increasing savings in the form of time deposits compared with other forms of liquid wealth. Two other variables namely the rate of change of prices and the size of the monetized sector had positive impact on velocity of money.

The study by Kharadia (1988) examined the behaviour of income velocity of money in placecountry-regionIndia. The study could not find evidence in support of constant income velocity as per capita income and money supply varied. The income velocity had a secular downward trend with significant short-term variations. The study revealed that administrative controls that maintained interest rates within a narrow range sterilized their impact to the velocity money. The various measures of changing financial conditions including currency–demand deposit ratio, bank assets–national income ratio, and the household financial assets-national income ratio were all significant in the estimated model.

Bordo and Jonung (1987, 1990) studied the behaviour of velocity for a number of countries. Specifically, the paper looked into the nature and causes of a U-shaped secular trend in velocity on a century-long scale for the selected countries. It laid importance of interpreting the effects of financial innovations in the past 15-20 years as possible symptoms of the instability of velocity function in longer run content. According to them, the observed secular pattern of velocity can be interpreted more effectively in terms of the evolutionary technical progress taking place in the financial sector of the economy over the long run rather than a few episodic changes on which others have focused. They found that these institutional changes in the financial sector proceed in roughly two phases. In the first phase, increasing monetization of the economy takes place such that velocity is expected to decline as demand for money (transaction balances) grows faster than income[9]. Bordo and Jonung (1987) used currency-to-money as a measure of degree of monetization. The second phase is characterized by growing financial sophistication during which the number of substitutes for bank notes and deposits grows. They measure the degree of financial development as the ratio of total non-bank financial assets to total financial assets[10].

In sub Saharan Africa, few studies have been conducted on velocity of money. Among these are Anyanwu (1994), Ndanshau (1996), Mukisa (1998) and Killick and Mwega (1993) among others. Killick and Nwega (1993) examined money velocity in placecountry-regionKenya. They found past demand for money and lagged adjustment term as major factors affecting velocity. Other variables found significant were expected inflation and interest rate. These results were consistent with findings from earlier studies by Darrat (1985) and Kanga (1985).

Anyanwu (1994) study for Nigeria over the period 1960-1992 examined the income velocity of money narrowly defined. The paper showed that interest rate, inflation rate, real gross national product, exchange rate, and financial deregulation had significant impact on 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.

Ndanshau (1996) study for Tanzania for the period 1967-1994 showed that expected rate of inflation influenced income velocity negatively, though weakly. The currency to money ratio and lagged real money were found insignificant while real interest rate was found to be significant.

Mukisa (1998) study empirically investigated the determinants and behaviour of income velocity of money for Uganda over the period 1980-1997, incorporating financial innovation. The results revealed that both currency in circulation and narrow money showed insignificant influence by financial innovation and had unstable function. The velocity of broad money was stable and financial innovation significantly influenced the velocity. The results based on broad

[9]Bordo and Jonung (1987) defined the process of monetization as the proliferation of commercial banking and the spread of a money economy.

[10]Several other studies have been conducted on the institutionalist explanation of velocity of money. These include Siklos (1993), placecountry-regionIreland (1991), Hallman, Porter and Small (1991) among others.

money velocity showed that income elasticity is negative. Lagged nominal interest rates and inflation rates were equally found to be significant.

4. Methodology

4.1. **Model Specification.** The model used for estimation is as given below[11]:

$$\log V_t = \psi_0 + \psi_1 \log Y_t + \psi_2 \log r_t + \psi_3 \log e_t + \psi_4 \log \theta_t + \varepsilon \tag{4.1}$$

where V is the velocity of money, Y is per capita income, r is a measure of opportunity cost of holding money i.e. interest rate or expected inflation, e is exchange rate and θ is a measure of financial innovation.

In the study, we employed two measures of velocity namely: velocity of narrow money (Vm1) and velocity of broad money (Vm2). The theoretical rationale for the traditional variable 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's (1959) luxury good hypothesis, there are two possible reasons for the negative relationship between income and 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 (Short, 1973). However, as pointed out by Fry (1998), the relationship between velocity and per capita income could be positive for developed countries.

Interest rate is incorporated as a measure of 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 so that velocity should increase. However, we experiment with the alternative measures of opportunity costs of assets substitution, in particular expected rate of inflation. This is based on the argument that in the 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[12].

The exchange rate variable is expected to have 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 read just their portfolios in favour of foreign assets. Depreciation causes a higher cost of holding local currency so that velocity should increase.

As earlier discussed in section 2, the rapid growth of institutions, especially the banking system, 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 indeterminate. It could either be positive or negative. Indeed, several alternatives can be considered as proxy for financial development. However, for the study we experiment with four measures namely: total non-bank financial assets to total financial assets ratio (rna), time deposit-currency ratio (rtm), currency-money ratio (rcm) and the demand deposit-time deposit ratio (rdt)). Increase in the ratio of non bank financial assets to total financial assets is expected to reduce the demand for money by increasing the number of close substitutes and thereby raising velocity. The expected sign of the remaining three measures of financial developments namely rtm, rcm and rdt could either be positive or negative[13].

[11]The model is a variant of the earlier one by Irungu (2003). The detailed derivation can be found in appendix 1.

[12]The theoretical plausible sign of expected inflation rate is positive implying inverse relationship with holding domestic money, and thus, a direct relationship with velocity.

[13]The theoretical arguments on the relationship between velocity of money and each of time deposit-currency ratio (rtm), currency-money ratio (rcm) and the demand deposit-time deposit ratio (rdt) have been properly articulated in the work of Akhtaruzzaman (2008).

4.2. **Data Source and Description.** All data sets used in the analysis cover the period 1986:1 to 2010:4. They were obtained from International Monetary Fund, International Financial Statistics CD-ROM (2009) and Central Bank of Nigeria, Statistical Bulletin 2010 Edition. The variables are as defined: Velocity of narrow money (Vm1) is calculated as the ratio of GDP to narrow money; velocity of broad money (Vm2) is calculated as the ratio of GDP to broad money; pci is real per capita income and this is obtained by dividing GDP by the population. GDP is gross domestic product quarterly series and exc is the real exchange rate. The real exchange rate (exc) is calculated as P*E/P, where P* is the United States CPI (1980=100), P is the Nigeria CPI (1980=100) and E is the official market exchange rate (i.e. number of naira per US dollar). int is the domestic interest rate. Inf is the expected rate of inflation. The expected rate of inflation in period t is assumed based on adaptive expectation: $\pi_t = d_1(\Delta log\Phi_{t-1})+(1-d_1)\pi_{t-1}$, where $\Delta log\Phi_{t-1}$ represents actual inflation in period t-1 and π_{t-1} is the expected rate of inflation in period t-1. We assume that $d_1 = 1$, leading to the following reduced form inflation equation $\pi_t = \Delta log\Phi_{t-1}$. rdt is the ratio of demand deposit to time deposit. rcm is the currency - money ratio; rtm is the ratio of time deposit to currency and rna ratio of total non-financial assets to total non-financial assets.

5. Empirical Results

5.1. **The Estimation and Presentation of Estimation.** In general, macro time series data such as the ones used in this study tend to exhibit either a determistic and/or stochastic trend and are therefore non-stationary; that is, the variables under consideration have means, variances and covariances that are not time invariant. Direct application of OLS and GLS to non stationary data produces regressions that are misspecified or spurious in nature (Enle and Granger, 1987) . Consequently, all the variables used in the study were tested for a unit root using the Augmented Dickey – Fuller test (ADF) [Dickey and Fuller, 1981] and KPSS (Kwiatkowski-Phillips-Schmidt-Shin (1992) tests both with a constant and a deterministic trend[14].

Table 1 presents the results of the ADF and KPSS tests with and without trend. Table 1 shows that all the variables are integrated of order one, I(1)[15]. Having established that all the variables are I(1), we applied that Johansen–Juselius (1990) technique to determine whether there is at least one linear combination of these variables that is I(0)[16].

The results of the$\lambda - max$ and trace tests for velocity of money (Vm1 and Vm2) are shown in panel A of tables 2 to 5. The co-integrating equations (normalized on velocity variable) are as shown in panel B of tables 2 to 5. Tables 2 and 3 are $\lambda - max$ and trace tests for velocity of narrow (Vm1) and broad (Vm2) money respectively when demand deposit-time deposit ratio (rdt) is used as measure of financial development. Tables 4 and 5 on the other hand, are $\lambda - max$ and trace tests for velocity of money (narrow and broad) respectively when time deposit-currency ratio (rtm) is used as a measure of financial development[17]. The results in panel A of tables 2 to 5 show that the null hypothesis of no co-integration can be rejected either using $\lambda - max$ on the trace tests statistics.

[14]The use of KPSS as an additional test helps to provide remedy to the limitation of the ADF statistic in deciding whether $\Theta = 1$ or $\Theta = 0.98$, in a model like $X_t = \mu + \Theta X_t - 1 + \varepsilon_t$.

[15]We equally used the Phillips-Perron (1988) test for stationarity. The results showed that all the variables were integrated of order one, l(1).

[16]If there is a co-integrating relationship among the selected variables in level, an error correction (EC) model can be estimated that is, a model that combines both the short run and the long run properties of the economic relationships in the first difference form as equation 10 as well as the long run information provided by the data in level form.

[17]The results for the cointegrating equation normalized on the two other measures of financial development (currency-money ratio and total non-financial assets-total financial assets ratio) were quite similar to the one reported here.

Table 1: Unit root tests for stationarity with constant and linear trend 1986 - 2010

Variables	ADF		KPSS	
	Level	1st difference	level	1st difference
Vm1(constant)	-2.608	-3.825	1.998	0.191
(constant & linear)	-1.800	-4.156	0.239	0.137
Vm2 (constant)	-1.864	-3.966	2.019	0.232
(onstant & linear)	-2.091	-4.082	0.151	0.139
pci (constant)	-1.443	-4.392	0.897	0.251
(constant & linear)	-2.622	-4.669	0.118	0.137
exv (constant)	-1.629	-4.662	1.957	0.386
(constant & linear)	-1.559	-4.859	0.299	0.057
int (constant)	-1.554	-5.319	0.659	0.143
(constant & linear)	-2.551	-5.495	0.144	0.038
inf (constant)	-2.220	-3.561	1.936	0.475
(constant & linear)	-1.057	-4.143	0.476	0.076
rna (constant)	-1.853	-5.457	1.803	0.037
(constant & linear)	-4.147	-5.443	0.118	0.031
rtna (constant)	-0.329	-4.351	0.855	0.289
(constant & linear)	-1.120	-4.841	0.475	0.061
rtd (constant)	-0.977	-4.420	0.564	0.187
(constant & linear)	-1.269	-4.664	0.455	0.072
rcm (constant)	-0.077	-4.732	-1.597	0.175
(constant & linear)	-2.358	-4.849	0.463	0.066

Note: Critical values for ADF are: -3.501, -2.892 and -2.583 respectively (constant only); -4.051, -3.458 and -3.155 (constant and linear) at 1%, 5% and 10% level respectively. However, the critical values for the KPSS tests are 0.739, 0.463 and 0.347 (constant only), 0.216, 0.146 and 0.119 (constant and linear) at 99%, 95% and 90% level of significance respectively.

Table 2: Co-integration results (within a linear trend) where r is the number of co-integrating vectors

Pane (A): Estimates of $\lambda - max$ and trace tests					
Null	Alternative r	$\lambda - max$	C.V. 95%	Trace	C.V. 5%
0	1	48.53	40.08	107.71	95.75
1	2	31.01	33.88	59.19	69.82
2	3	12.75	27.58	28.18	47.86
3	4	09.24	21.13	15.43	29.80
4	5	5.68	14.26	6.18	15.49
5	6	0.51	3.84	0.51	3.84
Panel (B): Estimates of co-integrating vector					
Vm1	pci	exr	int	inf	rdt
-1.000	0.368	0.006	-0.443	-1.329	0.665
	(0.97)	(0.047)	(2.14)**	(-10.54)***	(8.63)***

Notes: ratios are in parenthesis; *** and ** denote significant at 1% and 5% respectively

Table 3: Co-integration results (with a linear trend) where r is the number of co integrating vectors

Pane (A): Estimates of $\lambda - max$ and trace tests					
Null	Alternative r	$\lambda - max$	C.V. 95%	Trace	C.V. 95%
0	1	47.40	40.08	102.67	95.75
1	2	27.81	33.88	55.27	69.82
2	3	12.78	27.58	27.45	47.86
3	4	9.03	21.13	14.67	29.79
4	5	5.58	14.26	5.65	15.49
5	6	0.07	3.84	0.07	3.84
Panel (B): Estimates of co-integrating vector					
Vm2	pci	exr	int	inf	rdt
-1.000	0.15	-0.08	-0.19	-1.26	0.72
	(0.34)	(-0.59)	(-0.77)	(8.66)***	(7.97)***

Notes: t ratios are in parenthesis; *** and ** denote significant at 1% and 5% respectively.

Table 4: Co-integration results (with a linear trend) where r is the number of co-integrating vectors

Pane (A): Estimates of $\lambda - max$ and trace tests					
Null	Alternative r	$\lambda - max$	C.V. 5%	Trace	C.V. 5%
0	1	49.93	40.08	107.83	95.75
1	2	29.18	33.88	57.90	69.82
2	3	12.11	27.58	28.72	47.86
3	4	9.16	21.13	16.62	29.80
4	5	7.29	14.26	7.45	15.49
5	6	0.17	3.84	0.17	3.84
Panel (B): Estimates of co-integrating vector					
Vm1	pci	exr	int	inf	rdt
-1.000	0.364	0.240	-1.009	-1.524	-0.647
	(0.87)	(1.76)*	(-4.20)***	(-11.04)***	(-8.99)***

Notes: t ratios are in parenthesis; *** and ** denote significant at 1% and 5% respectively.

In both cases, they are greater than their critical values. The co-integrating equation (normalized on velocity variable) shown in panel B of tables 2 to 5 indicate that per capita income is positively related to velocity though not significant.

Table 5: Co- integration results (with a linear trend) where r is the number of co-integrating vectors

Pane (A): Estimates of $\lambda - max$ and trace tests					
Null	Alternative r	$\lambda - max$	C.V. 95%	Trace	C.V. 95%
0	1	47.85	40.08	103.65	95.75
1	2	27.03	33.88	55.79	69.82
2	3	12.48	27.58	28.77	47.86
3	4	10.01	21.13	16.28	29.80
4	5	6.26	14.26	6.28	15.49
5	6	0.01	3.84	0.01	3.84
Panel (B): Estimates of co-integrating vector					
Vm2	pci	exr	int	inf	rdt
-1.000	0.221	0.229	-0.651	-1.395	-0.669
	(0.49)	(0.76)	(-2.57)**	(-9.69)***	(-8.85)***

Notes: t ratios are in parenthesis; *** and ** denote significant at 1% and 5% respectively.

Interest rate and expected inflation have significant negative effect on velocity of money. Exchange rate has a significant positive effect on the velocity of narrow money. The first

measure of financial development, demand deposit-time deposit ratio (rdt) has a positive sign while the second measure time deposit-currency ratio (rtm) has a significant negative sign[18].

Next we use the information provided by the L.R. tests to generate a set of EC models that captures the short run and long run behaviour of the velocity of money relationship. The changes in the relevant variables represent short run elasticities, while the coefficient of the EC term represents the speed of adjustment back to the long run relationship among variables. Table 6 provides the results for the velocities-financial development relationship for the period 1986:1 – 2010:4. Specifically, models (1) and (2) in table 6 show the results for velocity-financial development relationship when time deposit-currency ratio is used as measure of financial development. Models (3) and (4) in table 7 provide the results of velocity-financial development when demand deposit-time deposit ratio is used as measure of financial development.

Table 6: Nigeria: OLS Estimation of Error Correction Model (dependent variables Δln Vm1 and Δln Vm2

Variables	**ΔlnVm1 (1)**	**ΔlnVm2 (2)**	**ΔlnVm1 (3)**	**ΔlnVm2 (4)**
Constant	0.18 (1.74)*	0.12 (1.40)	0.18 (1.73)*	0.12 (1.44)
Δlnpci	1.00 (11.64)***	1.06 (15.22)***	1.00 (11.65)***	1.05 (15.12)***
ΔlnExc	-0.04 (-2.15)**	-0.03 (-2.08)**	-0.04 (-2.11)**	-0.03 (-2.14)**
Δlninf	-0.05 (-0.38)	-0.01 (-0.23)	-0.05 (-0.52)	-0.01 (-0.17)
ΔlnVm1-1	-0.01 (-0.35)		-0.01 (-0.39)	
ΔlnVm2-1		-0.03 (-1.05)		-0.03 (-1.14)
Δlnint	0.03 (0.57)	-0.01 (-0.33)	0.03 (0.61)	-0.01 (-0.37)
Δlnrdt			-0.05 (-1.40)	-0.02 (-0.81)
Δlnrtm	0.06 (1.88)*	0.003 (0.10)		
Ec-1	-0.03 (-2.47)**	-0.02 (-2.10)**	-0.03 (-2.46)***	-0.02 (-2.14)**
R-2	0.63	0.72	0.63	0.73
D.W.	2.30	2.14	2.29	2.13
SSE	0.075	0.061	0.076	0.059
F-statistics	24.96	37.30	24.28	37.67

Note: *** , ** and * denote significance at 1%, 5% and 10% level respectively.

The estimated results reported in tables 6 performed reasonably well[19]. The value of the adjusted R-2 is reasonably high. The respective individual F-statistic which is against the null that all coefficients are equal to zero, is significant and standard error of the estimates (SEE) relatively small. The Durbin-Watson (DW) statistics are also satisfactory, although they should be treated with caution due to the inclusion of lagged dependent variable among the explicative variables.

[18]The reported results here are without constants. However, when we included a constant term, the results obtained were not significantly different.

[19]To conserve space we only report here the results of diagnostic statistical tests for models 1 and 2 in table 6.

When the error correction models (1) and (2) in table 6 were fitted against historical velocity data (Vm1 and Vm2), they performed well in terms of tracking the cyclical nature of the velocity of money (Vm1 and Vm2) movement in Nigeria (see figs 2 and 3). The presence of serial correlation or more general forms of autocorrelation was rejected based on Breusch-Godfrey and Box-Pierce Q statistics. The Jarque-Bera statistic indeed confirmed normality and the Arch test reject heteroscedacity in the disturbance term. The presence of general specification error was rejected based on the result of Ramsey RESET (1). Moreover, the cumulative sum of recursive residuals (CUSUM) test (figs. 8 and 9, Appendix B), confirmed structural stability[20].

Figure 2: Plot of the Actual and Fitted Velocity of Narrow Money (Vm1)

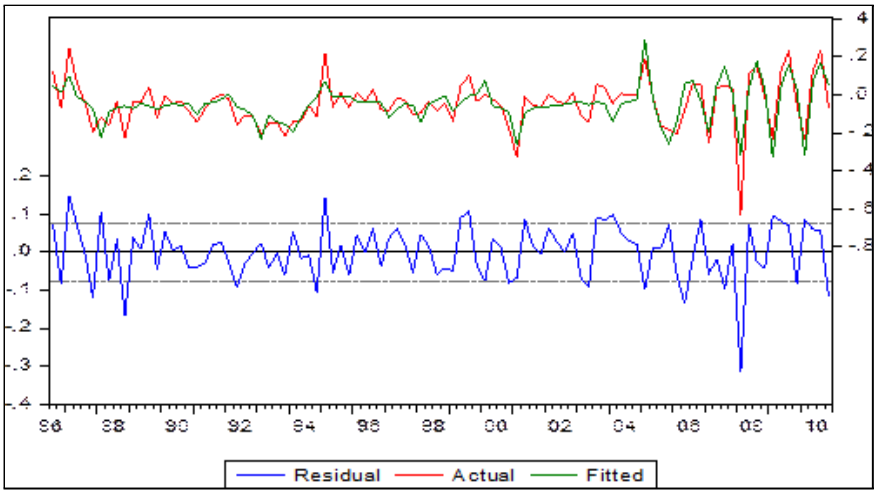
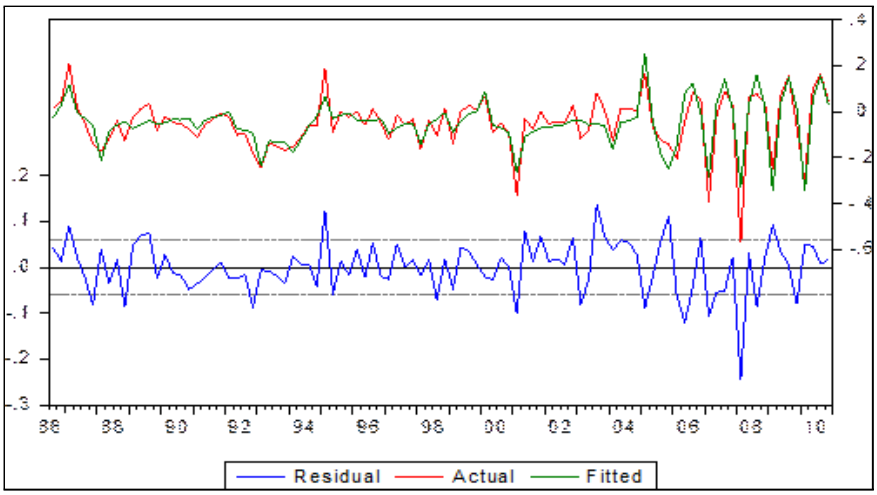


Figure 3: Plot of the Actual and Fitted Velocity of Broad Money (Vm2)



Having provided evidence supporting the adequacy of the estimated relationship between velocity of money and financial development (measured as time deposit-currency ratio and demand deposit-time deposit ratio), we analyze the results of the estimated coefficients. The results in table 6 show that per capita income has significant positive impact on velocities

[20]Although Cusum of Squares test and recursive residuals show some degree of instability, the residuals in both cases do not exceed the confidence bands that much to jeopardized the predictive power of the models.

of narrow and broad money (vm1 and vm2) thus supporting the quantity theory. Thus result seems to contradict earlier ones by Short (1973) for West Malaysia and country-regionSingapore, Akhtamzzaman (2008) for placecountry-regionBangladesh among others. However, as pointed out by Fry (1998), the sign of correlation between velocity of money (vm1 and vm2) and per capita income (negative or positive) 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 (Howlader and Khan 1990).

The exchange rate proved to be a significant determinant of income velocity of money. The variable has a negative sign in the short run model. 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[21]. The result is consistent with the finding of Irungu (2003) for Kenya.

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.

The ratio time deposit to domestic currency (rtm) affects velocity of money positively but significant only in the case of velocity of narrow money. This positive effect 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. The demand deposit-time deposit ratio (rdt) shows up negatively in equations 3 and 4. This suggests that with increasing financial maturity, people hold more money in time deposit which slows the speed of velocity via lowering the value of credit and money multiplies and thus explaining the inverse relationship between velocity of money and demand-time deposit ratio. However, this is only suggestive as the coefficient of (rdt) is not significant.

Finally, the one–lagged error correction term, ECt-1 appears with a statistically significant coefficient and displays the appropriate negative (sign). The finding supports the validity of an equilibrium relationship among the variables in the co-integrating equation. This simply means that overlooking the co-integratedness of the variables would have introduced mis-specification in the underlying dynamic structures and it should also be pointed out that literature on co-integrated systems supports that only ECt-1 is needed to represent the co-integrating scheme[22].

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 on the error correction term of each equation. The speed of adjustments to the last period's disequilibrium for the four equations in table 6 remains almost the same. This implies that the adjustment of velocity of money to changes in the regressors may take a considerable long term. The result shows that a deviation from long run equilibrium in level this period is corrected by about 3 per cent in the next quarter.

6. Concluding Remarks

The paper examined the impact of financial development on velocity of money by using the multivariate co-integration and error correction modeling approach. Velocity of money functions (narrow and broad) in which per capita income , exchange rate, interest rate, expected rate of inflation and measure of financial development were used as argument were estimated using quarterly data 1986:1– 2010:4. The estimated models satisfy several econometrics tests in

[21]The major outcome of the deregulation process was the removal of the major obstacles in portfolio decision making thereby facilitating households and firms' access to foreign market. As noted by one the referees, risk aversion of the investors made them to diversify their portfolio in favour of foreign assets so as to hedge against loss arising from the depreciation of the exchange rate.

[22]As pointed out by Muscatelli and Papi (1990) the reason for the inclusion of non linear error-correction terms is to allow for the possibility that economic agents react more strongly to large equilibrium error terms through some type of non-linear relationship (one might also consult Hendry and Ericsson (1991) for more details on this issue).

the analysis of time series for such issues as co-integration, stationarity, specification errors, residual correlation, residual normality and structural stability. Our empirical results suggest the following conclusions.

First, the estimated parameters of the financial development variables are significant in the long run model but not in the short run dynamics except in the velocity of narrow money (Vm1) when financial development is measured as time deposit-currency ratio. Second, exchange rate has significant negative effect on velocity of money while per capita income has significant positive effect on velocity of money.

Several policy implications can be derived from these findings. Firstly, the significant positive relationship between per capita income and the velocity of money means that the money issuing authorities cannot obtain additional leverage by issuing more money. This means 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.

Secondly, policy makers must take into consideration the stability and level of the real exchange rate. There is need to properly coordinate the monetary and exchange, rate policies. Suitable and sustainable monetary and fiscal policies that reduce the level of money supply into the economy, stem the hide of inflationary pressure and enhance output would help to stabilize the exchange rate. Finally, government should fashion and implement appropriate policies that will enhance the development of the financial system as developments in the sector seem to have impact on the velocity of money especially in the long run. Thus, confidence and positive expectation building by the Central Bank of country-regionplaceNigeria will assist significantly in this respect.

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Appendix

Appendix A

The velocity of money function is specified as:

$$V_t = f(Y_t, r_t, e_t, \theta_t, \mu_t) \tag{7.1}$$

such that $f_y < 0; f_e, f_r, f_\theta > 0$

where Vt is the velocity, Y is real income, r is the real interest rate, e is the real exchange rate, θ is the measure of financial development and μ is the error term.

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

$$\left[M^d/P\right]_t = f(Y_t, r_t, e_t, \theta_t, \mu_t) \tag{7.2}$$

where Md is money demand, P is the price level,

$$\left[M^d/P\right]_t = k\, Y_t^{\beta_1}\, r_t^{\beta_2}\, e_t^{\beta_3}\, \theta_t^{\beta_4}\, \mu_t \tag{7.3}$$

If we assume money market equilibrium:

$$M^d = M^s \tag{7.4}$$

where *Ms* is money supply,
then from the equation of exchange (Fisher, 1911)

$$M^s\, V = PY \tag{7.5}$$

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

$$M_t^d = P(k_t\, Y_t^{\beta_1}\, r_t^{\beta_2}\, e_t^{\beta_3}\, \theta_t^{\beta_4}\, \mu_t) = M^s \tag{7.6}$$

From equation 5 we obtain:

$$V = \frac{PY}{M^s} \tag{7.7}$$

$$V = \frac{PY}{P(k^1\, Y_t^{\beta_1}\, r_t^{\beta_2}\, e_t^{\beta_3}\, \theta_t^{\beta_4}\, \mu_t)} \tag{7.8}$$

$$V = k^{-1}\, Y_t^{1-\beta_1}\, r_t^{-\beta_2}\, e_t^{-\beta_3}\, \theta_t^{-\beta_4}\, \mu_t^{-1} \tag{7.9}$$

The log linear form of equation (1.10) is given thus:

$$\log V_t = -\log K + (1-\beta_1)\log Y_t - \beta_2 \log r_t - \beta_3 \log e_t - \beta_4 \log \theta_t - \log \mu_t \tag{7.10}$$

let $\psi_0 = -\log K, \psi_1 = (1-\beta_1), \psi_2 = -\beta_2, \psi_3 = -\beta_3, \psi_4 = -\beta_4, -\log \mu_t = \varepsilon$
Then equation (1.10) becomes :

$$\log V_t = \psi_0 + \psi_1 \log Y_t + \psi_2 \log r_t + \psi_3 \log e_t + \psi_4 \log \theta_t + \varepsilon \tag{7.11}$$

Equation (1.12) constitutes the estimated equation of this work.

Appendix B

Fig. 4 : Recursive residuals for narrow money (Vm1)

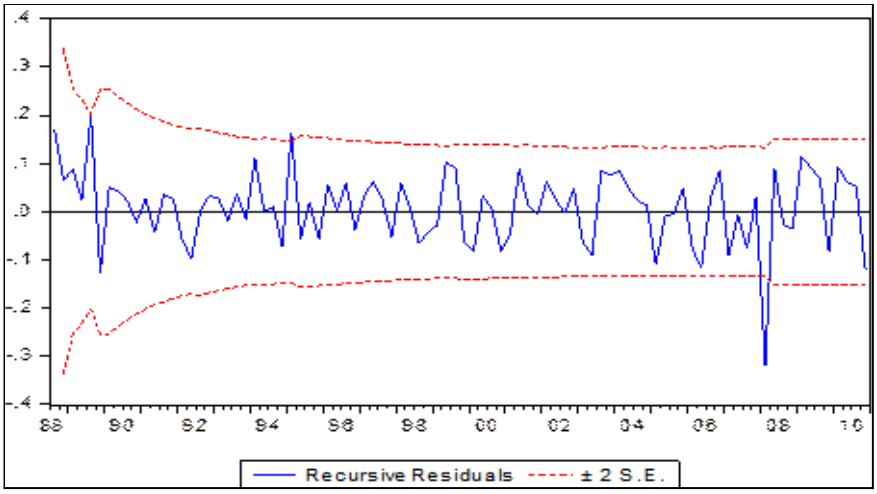

Fig. 5: Recursive residuals for broad money (Vm2)

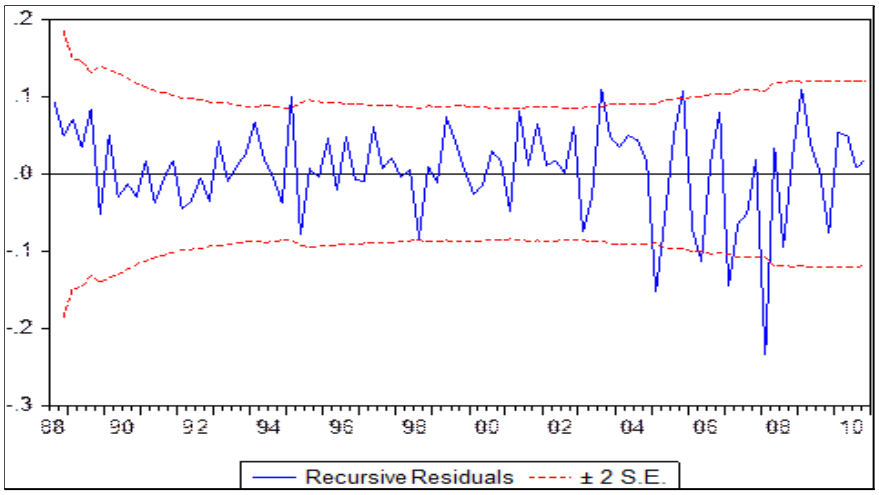

Fig.6: Plot of sum of square of recursive residuals for narrow money

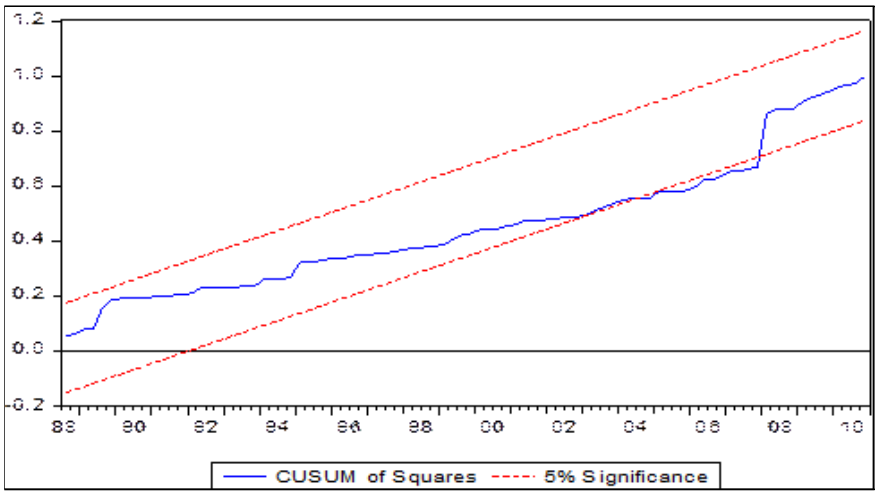

Fig.7: Plot of sum of square of recursive residuals for broad money

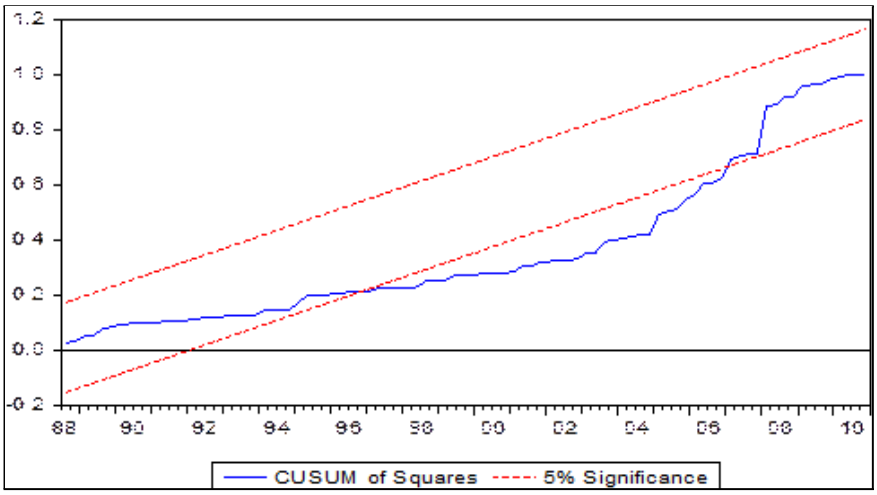

Fig. 8: Plot of the cumulative sum of recursive residuals for narrow money

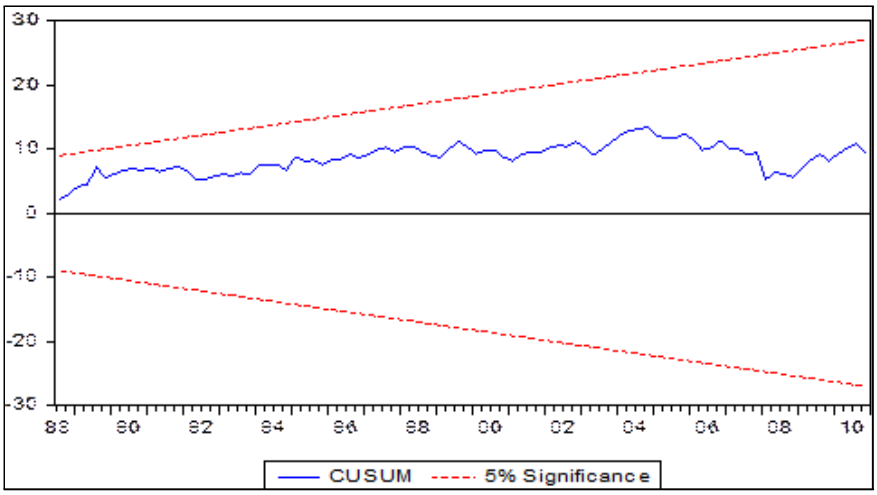

Fig. 9: Plot of the cumulative sum of recursive residuals for broad money