

## Effects of Exchange Rate Movements On Economic Growth in Nigeria

Eme O. Akpan<sup>1</sup> and Johnson A. Atan<sup>2</sup>

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*This study investigates the effect of exchange rate movements on real output growth in Nigeria. Based on quarterly series for the period 1986 to 2010, the paper examines the possible direct and indirect relationship between exchange rates and GDP growth. The relationship is derived in two ways using a simultaneous equations model within a fully specified (but small) macroeconomic model. A Generalised Method of Moments (GMM) technique was explored. The estimation results suggest that there is no evidence of a strong direct relationship between changes in exchange rate and output growth. Rather, Nigeria's economic growth has been directly affected by monetary variables. These factors have tended to sustain a pattern of real exchange rate, which has been unfavourable for growth. The conclusion is that improvements in exchange rate management are necessary but not adequate to revive the Nigerian economy. A broad program of economic reform is required to complement the exchange rate policy adopted.*

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**JEL Classification:** E5; E6

### 1.0 Introduction

Exchange rate policies in developing countries are often sensitive and controversial, mainly because of the kind of structural transformation required, such as reducing imports or expanding non-oil exports, which invariably imply a depreciation of the nominal exchange rate. Such domestic adjustments, due to their short-run impact on prices and demand, are perceived as damaging to the economy. Ironically, the distortions inherent in an overvalued exchange rate regime are hardly a subject of debate in developing economies that are dependent on imports for production and consumption.

The debate rather focuses on the degree of fluctuations in the exchange rate in the face of internal and external shocks. There appears a consensus view on the fact that devaluation or depreciation could boost domestic production through stimulating the net export component. This is evident through the increase in international competitiveness of domestic industries leading to the diversion of spending from foreign goods whose prices become high, to domestic goods. As illustrated by Guitan (1976) and Dornbusch (1988), the success of currency depreciation in promoting trade balance largely depends on switching demand in proper direction and amount as well as on the capacity of the home economy to meet the additional demand by supplying more goods. On the whole, exchange rate fluctuations are likely, in turn, to determine economic performance. It is therefore necessary to evaluate the effects of exchange rate fluctuations on output growth and price inflation.

In Nigeria, the exchange rate policy has undergone substantial transformation from the immediate post-independence period when the country maintained a fixed parity with the British

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<sup>1</sup>Department of Economics, University of Ibadan, Ibadan (emyakpan@yahoo.com)

<sup>2</sup>Department of Economics, University of Uyo, Uyo, Nigeria.

pound, through the oil boom of the 1970s, to the floating of the currency in 1986, following the near collapse of the economy between 1982 and 1985 period. In each of these epochs, the economic and political considerations underpinning the exchange rate policy had important repercussions for the structural evolution of the economy, inflation, the balance of payments and real income.

Hence, the focus of this research is to examine the effect of exchange rate movements on economic growth in Nigeria. Specifically, the possible direct and indirect relationships are investigated. Some previous attempts have been made to conduct econometric studies on exchange rate determination and the movements in output in Nigeria, Egwaikhide et al (1994), Ekpo (2004); Akinlo and Odusola (2001), among others. However, these earlier works were based on single equation regression approach. This study deviates from the previous ones in Nigeria by employing a simultaneous equation modeling approach and its structural variant in which movements in output are driven by several fundamental disturbances - monetary, exchange rates (official and parallel), and income.

The rest of the paper is presented in four sections. In section 2, exchange rate policies in Nigeria are discussed. Section 3 reviews related literature. The empirical model and estimation is presented in section 4, while section 5 summarizes, and concludes the paper.

## **2.0 Developments in Exchange Rate Policy in Nigeria**

The objectives of an exchange rate policy include determining an appropriate exchange rate and ensuring its stability. Over the years, efforts have been made to achieve these objectives through the applications of various techniques and options to attain efficiency in the foreign exchange market. Exchange rate arrangements in Nigeria have transited from a fixed regime in the 1960s to a pegged regime between the 1970s and the mid-1980s and finally, to the various variants of the floating regime from 1986 with the deregulation and adoption of the structural adjustment programme (SAP). A managed floating exchange rate regime, without any strong commitment to defending any particular parity, has been the most predominant of the floating system in Nigeria since the SAP.

Following the failures of the variants of the flexible exchange rate mechanism (the AFEM introduced in 1995 and the IFEM in 1999) to ensure exchange rate stability, the Dutch Auction System (DAS) was re-introduced on July 22, 2002. The DAS was to serve the triple purposes of reducing the parallel market premium, conserve the dwindling external reserves and achieve a realistic exchange rate for the naira. The DAS helped to stabilize the naira exchange rate, reduce the widening premium, conserve external reserves, and minimize speculative tendencies of authorized dealers. The foreign exchange market has been relatively stabilized since 2003.

As indicated by Mordi (2006), The conditions that facilitated the re-introduction of DAS in 2002 included, the external reserve position which could guarantee adequate funding of the market by the CBN; reduce inflationary pressures; instrument autonomy of the CBN and its prompt deployment of monetary control instruments in support of the DAS as well as the bi-weekly

auctions as against the previous fortnightly auctions, thus assuring a steady supply of foreign exchange.

In order to further liberalize the market, narrow the arbitrage premium between the official inter-bank and bureau de change segments of the markets and achieve convergence, the CBN introduces the Wholesale Dutch Auction System (WDAS) on February 20, 2006. This was meant to consolidate the gains of the retail Dutch Auction System as well as deepen the foreign exchange market in order to evolve a realistic exchange rate of the naira. Under this arrangement, the authorized dealers were permitted to deal in foreign exchange on their own accounts for onward sale to their customers. These exchange rate regimes have had some implication for economic performance. This is discussed in the ensuing section.

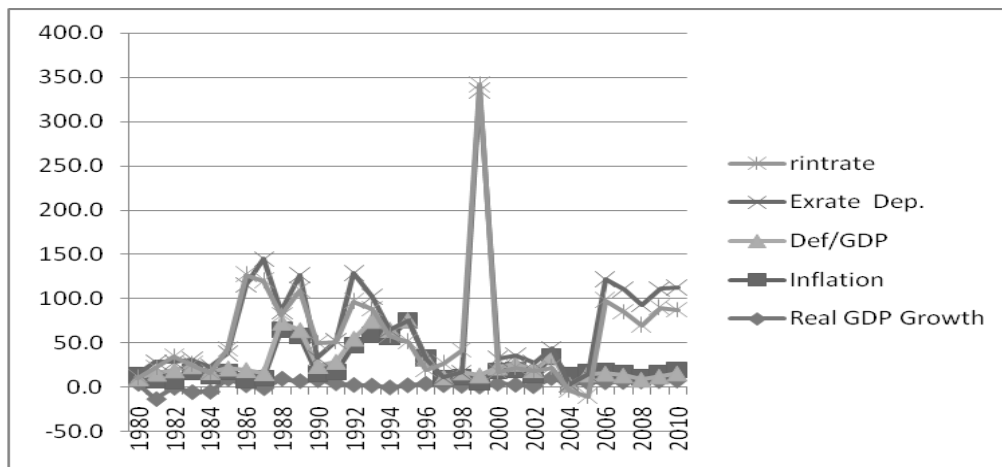
### **2.1 Exchange Rate Movement and Macroeconomic Performance**

Contained in Figure 1 is a graphical illustration of exchange rate movements and selected macroeconomic variables. Analysis of Nigeria's exchange rate movement from 1970-2010 suggests a causal relationship between the exchange rate movements and macroeconomic aggregates such as inflation, fiscal deficits and economic growth. Evidently, the persistent depreciation of the exchange rate trended with major economic variables such as inflation, GDP growth, and fiscal deficit/GDP ratio. In this context, the exchange rate movement in the 1990's trended with inflation rate. A close observation of Figure 1 indicates that during periods of high inflation rate, volatility in the exchange rate was high, which was also reversed in a period of relative stability. For instance, while the inflation rate moved from 7.5 per cent in 1990 to 57.2 per cent and 72.8 per cent in 1993 and 1995 respectively, the exchange rate moved from ₦8.04 to \$1 in 1990 to ₦22.05 and ₦81.65 to a dollar in the same period. When the inflation rate dropped from 72.8 per cent in 1995 to 29.3 per cent and 8.5 per cent, in 1996 and 1997 respectively, and rose thereafter to 10.0 per cent in 1998 and averaged 12.5 per cent in 2000-2009, the exchange rate trended in the same direction. A similar trend was observed for fiscal deficit/GDP ratio and GDP growth rate as shown in Figure 1.

In summary, a tentative conclusion emerging from the trend analysis is that exchange rate movements engender inflation and there is some association between exchange rate movements and economic growth. However, an empirical analysis is required to determine the exact relationship existing between the variables.

### **3.0 Theoretical Literature**

The earliest and leading theoretical foundation for the choice of exchange rate regimes rests on the optimal currency area (OCA) theory, developed by Mundell (1961) and McKinnon (1963). This literature focuses on trade, and stabilization of the business cycle. It is based on concepts of the symmetry of shocks, the degree of openness, and labor market mobility. According to the theory, a fixed exchange rate regime can increase trade and output growth by reducing exchange rate uncertainty and thus the cost of hedging, and also encourage investment by lowering currency premium from interest rates. However, on the other hand it can also reduce trade and output growth by stopping, delaying or slowing the necessary relative price adjustment process.



**Figure 1: Trend of Exchange Rate and Selected Macroeconomic Indicators in Nigeria (1980-2010)**

*Source: Underlying data from Central Bank of Nigeria Statistical Bulletin Various Years*

Later theories focused on financial market stabilization of speculative financial behaviour as it relates particularly to emerging economies. According to the theory, a fixed regime can increase trade and output growth by providing a nominal anchor and the often needed credibility for monetary policy by avoiding competitive depreciation, and enhancing the development of financial markets (see Barro and Gordon (1983), Calvo and Vegh (2004), Edwards and Savastano (2000), Eichengreen et al (1999), and Frankel (2003) among others).

On the other hand, however, the theory also suggests that a fixed regime can also delay the necessary relative price adjustments and often lead to speculative attacks. Therefore, many developing and emerging economies suffer from a “fear of floating,” in the words of Calvo and Reinhart (2002), but their fixed regimes also often end in crashes when there is a “sudden stop” of foreign investment (Calvo, 2003) and capital flight follows, as was evident in the East Asian and Latin American crises and some sub-Saharan African countries.

Not surprisingly, there is little theoretical consensus on this question of regime choice and subsequent economic growth in the development economics literature as well. While the role of a nominal anchor is often emphasized, factors ranging from market depth (or the lack of it), political economy, institutions and so on often lead to inclusive suggestions as to which exchange rate regime is appropriate for a developing country (Frankel et al (2001), Montiel (2003), Montiel and Ostry (1991)). The literature in development economics acknowledges the importance of the effects of the level of development to the relationship between regime and growth (see Berg et al (2002), Borensztein and Lee (2002), Lin (2001), McKinnon and Schnabel (2003), and Mussa et al (2000) among others).

### 3.1 Empirical Literature

There is a vast body of empirical literature on the impacts of exchange rate devaluation on output and prices. In many of the existing studies, it has been recognized that the possible effects of devaluation on output could be contractionary. To this extent, several channels through which devaluation could be contractionary have been identified.

First, Diaz-Alejandro (1965) examined the impacts of devaluation on some macroeconomic variables in Argentina for the period 1955–61. He observed that devaluation was contractionary for Argentina because it induces a shift in income distribution towards savers, which in turn depresses consumption and real absorption. He equally observed that current account improved because of the fall in absorption relative to output.

Cooper (1971) also reviewed twenty-four devaluation experiences involving nineteen different developing countries during the period 1959–66. The study showed that devaluation improved the trade balance of the devaluing country but that the economic activity often decreased in addition to an increase in inflation in the short term.

In a similar study, Gylfson and Schmidt (1983) also constructed a log-linear macro model of an open economy for a sample of ten countries, using different estimates of the key parameters of the model. Their results showed that devaluation was expansionary in eight out of ten countries investigated. Devaluation was found to be contractionary in two countries (the United Kingdom and Brazil). The main feature of the studies reviewed above is that they were based on simulation analyses.

The few studies on contractionary devaluation based on regression analysis include those of Edwards (1989), Agénor (1991), and Morley (1992). In a pool-time series/ cross-country sample, Edwards (1989) regressed the real GDP on nominal and real exchange rates, government spending, the terms of trade, and measures of money growth. He found that devaluation tended to reduce the output in the short term even where other factors remained constant. His results for the long-term effect of a real devaluation were more mixed; but as a whole it was suggested that the initial contractionary effect was not reversed subsequently. In the same way, Agénor (1995) using a sample of twenty-three developing countries, regressed output growth on contemporaneous and lagged levels of the real exchange rate and on deviations of actual changes from expected ones in the real exchange rate, government spending, the money supply, and foreign income. The results showed that surprises in real exchange rate depreciation actually boosted output growth, but that depreciations of the level of the real exchange rate exerted a contractionary effect.

Another study by Mireille (2007) argues that overvaluation of exchange rates have constituted a major setback in the recovery process of Nigeria and Benin Republic. In addition, the author suggests that devaluation accompanied with well-targeted measures alongside an upward adjustment in the domestic price of tradable goods, could restore exchange rate equilibrium and improve economic performance.

In a related study, Aliyu et al (2009) examined exchange rate pass-through in Nigeria for the period 1986 to 2007. Quarterly series was employed and a vector Error Correction Model estimation was used in the estimation process. The authors found that exchange rate pass-through in Nigeria during the period under consideration was low and declined along the price chain, which partly overturns the conventional wisdom in the literature that exchange rate pass-through is always considerably higher in developing countries than developed countries. The authors conclude that in the long run, pass through would likely increase and monetary policy should be designed to accommodate the effect.

### **3.2 Empirical Issues on Exchange Rate and Output**

Morley (1992) analyzed the effect of real exchange rates on output for twenty eight developing countries that have devalued their currencies using a regression framework. After the introduction of controls for factors that could simultaneously induce devaluation and reduce output including terms of trade, import growth, the money supply, and the fiscal balance, he discovered that depreciation of the level of the real exchange rate reduced the output.

Kamin and Klau (1998) using an error correction technique estimated a regression equation linking the output to the real exchange rate for a group of twenty seven countries. They did not find that devaluations were contractionary in the long term. Additionally, through the control of the sources of spurious correlation, reverse causality appeared to alternate the measured contractionary effect of devaluation in the short term although the effect persisted even after the introduction of controls. Apart from the findings from simulation and regression analyses, results from VAR models, though not focused mainly on the effects of the exchange rate on the output per se, are equally informative.

Ndung'u (1993) estimated a six-variable VAR—money supply, domestic price level, exchange rate index, foreign price index, real output, and the rate of interest—in an attempt to explain the inflation movement in Kenya. He observed that the rate of inflation and exchange rate explained each other. A similar conclusion was also reached in the extended version of this study (Ndung'u 1997).

Rodriguez and Diaz (1995) estimated a six-variable VAR—output growth, real wage growth, exchange rate depreciation, inflation, monetary growth, and the Solow residuals—in an attempt to decompose the movements of Peruvian output. They found that output growth could mainly be explained by “own” shocks but was negatively affected by increases in exchange rate depreciation as well.

Rogers and Wang (1995) obtained similar results for Mexico. In a five-variable VAR model—output, government spending, inflation, the real exchange rate, and money growth—most variations in the Mexican output resulted from “own” shocks. They however noted that exchange rate depreciations led to a decline in output. Adopting the same methodology, though with slightly different variables, Copelman and Wermer (1996) reported that positive shocks to the rate of exchange rate depreciation, significantly reduced credit availability, with a negative impact on the output. Surprisingly, they found that shocks to the level of the real exchange rate

had no effects on the output, indicating that the contractionary effects of devaluation are more associated with the rate of change of the nominal exchange rate than with the level of the change of the real exchange rate. They equally found that “own” shocks to real credit did not affect the output, implying that depreciation depressed the output through mechanisms other than the reduction of credit availability.

It is important to mention the work of Odusola and Akinlo (2001) who examined the linkage among exchange rate, inflation and output in Nigeria. A structural VAR model was employed which captured the interactions between exchange rate and output. Evidence from the contemporaneous models showed a contractionary impact of the parallel exchange rate on output only in the short term. Prices, parallel exchange rate and lending rate were found to be important sources of perturbations in the official exchange rate. In addition, output and parallel exchange rate were significant determinants of inflation dynamics in Nigeria. The authors concluded by suggesting more concerted efforts by the Central Bank towards taming the parallel exchange rate behavior and formulating monetary policies that enhance income growth. Largely the findings were informative. Batini (2004) and Mordi (2006) present similar arguments in different studies on Nigeria. On the contrary, Aliyu et al (2009) find that prices react less proportionately to exchange rate shock in Nigeria.

In conclusion, most of the econometric analyses indicated that devaluations (either increases in the level of the real exchange rate or in the rate of depreciation) were associated with a reduction in output and increase in inflation. The studies reviewed above equally supported the existence of a contractionary devaluation in the sampled countries. However, most cases of contractionary devaluations had been focused on Latin America and other developed nations. Only few studies had been conducted on the issue in sub-Saharan Africa, particularly Nigeria, thus, warranting research on the subject.

#### 4.0 Methodology

For the purpose of the analysis, Nigeria is treated as a small open developing economy, which is affected by world market fluctuations. The model employed in the research draws on the structural macroeconomic model of Edwards and Sebastein (2000)<sup>3</sup>. It includes all the basic elements of the financial programming framework used by the international Monetary Fund. This work enhances the original Sebastein (2000) model by adding exchange rate as an open economy indicator. The basic idea is to determine the relation between growth and exchange rate while allowing for other key influences on both variables. These are presented accordingly.

#### Output Equation

The output equation expresses real GDP as a function of monetary and fiscal variables such that;

$$\ln Yr_t = \beta_0 + \beta_1 \ln Ms_t + \beta_2 \ln ex_t + \beta_3 \ln ex_{t-1} + \beta_4 \ln inf_t + \beta_5 \ln yr_{t-1} + \varepsilon_t \quad (1)$$

where

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<sup>3</sup>See Edwards and Sebastein (2000) for detailed specification of the model.

$\ln inf_t$	rate of inflation (this is the Nigerian Consumer Price Index)
$\ln inf_{t-1}$	a proxy for the expected inflation rate at time t
$\ln Yr_t$	growth rate of real GDP
$\ln Yr_{t-1}$	Lag of real GDP
$\ln exr_t$	nominal exchange rate
$\ln Ms_t$	Growth rate of Money Supply ( $M_2$ )
$\ln$	Natural Logarithm
$t$	time subscript

$Yr$  is real output proxied by real GDP, and  $inf_t$  is inflation rate,  $ex$  is exchange rate, while  $yr_{t-1}$  represents the lag of real output and  $\varepsilon$  is the error term.

### Exchange Rate Equation

$$\ln EX_t = \mu_0 + \mu_1 \ln Yr_t + \mu_2 \ln inf_t + \mu_3 \ln ex_{t-1} + \mu_4 \ln Ms_t + \varepsilon_t \quad (2)$$

where  $Ms$  is money supply while other variables are as previously defined

$\ln inf_t$	rate of inflation (this is the Nigerian Consumer Price Index)
$\ln inf_{t-1}$	a proxy for the expected inflation rate at time t
$\ln Yr_t$	growth rate of real GDP
$\ln Yr_{t-1}$	Lag of real GDP
$\ln exr_t$	nominal exchange rate
$\ln Ms_t$	Growth rate of Money Supply ( $M_2$ )
$\ln$	Natural Logarithm
$t$	time subscript

### The Inflation Equation

The specification considers the monetarist perspective and expresses inflation as functionally related to money supply, real output, expected inflation and exchange rate, such that;

$$\ln inf_t = \alpha_0 + \alpha_1 \ln MS_t + \alpha_2 \ln Yr + \alpha_3 inf_{t-1} + \alpha_4 ex_t + \varepsilon_t \quad (3)$$

Where  $inf$  indicates inflation rate,  $MS$  is money supply (broadly defined);  $Yr$  is real output proxied by real GDP, and  $inf_{t-1}$  is a proxy for expected inflation while  $ex$  is exchange rate and  $\varepsilon$  is the error term.

$\ln inf_t$	rate of inflation (this is the Nigerian Consumer Price Index)
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$\ln Yr_t$	growth rate of real GDP
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$\ln exr_t$	nominal exchange rate
$\ln Ms_t$	Growth rate of Money Supply ( $M_2$ )
$\ln$	Natural Logarithm
$t$	time subscript



## 4.2 Data and Sources

The study employs quarterly series covering the period 1986-2010. This period is chosen as it corresponds to the period where uniform and consistent data on the relevant variables are available. More importantly, this period witnessed several exchange rate regimes. Data for the work are drawn from the International Monetary Fund (IMF) Financial Statistics and the Central Bank of Nigeria (CBN) statistical Bulletins. As a working definition of the real exchange rate, the nominal exchange rate is nominal exchange rate adjusted with the ratio of the foreign price level (US CPI, as a proxy for the price of tradables) and the domestic price level (Nigerian CPI as a proxy for price of non-tradables). This definition follows the purchasing power parity condition.

## 5.0 Estimation Technique

The estimation technique begins with determining the time series properties of the data and followed by cointegration tests. Thereafter, the system estimation was performed using the Generalised Method of Moments (GMM) procedure. The GMM estimation technique is preferred given its inherent ability to produce unbiased estimators even with lagged dependent variables acting as instruments. It is capable of avoiding biased results due to correlation between the error term and the lagged endogenous variables. In addition it has the potential of obtaining consistent parameter estimates even in the presence of measurement error and endogenous right-hand side variables in a system equation estimation procedure.

### 5.1 Time Series Properties of the Variables

Prior to the estimations, unit root tests were performed on the series to determine their level of stationarity. The result of the stationarity test using the Augmented Dickey-Fuller (ADF) test is reported in Table 1. Evidently, all the variables were stationary after first differencing, indicating that they are I(1) variables. Specifically, the ADF statistic for Inflation rate (INF) is 2.945047 (in absolute terms) and is less than the critical value of the ADF statistic (3.540328). Similarly, the ADF statistic for real exchange rate (REXRA) is 2.627754 which is less than the critical value of the ADF statistic (3.202445) in absolute terms. This implies that all the variables were characterized by the presence of unit root at level but were found stationary at their first difference. The same trend is observed for all the series. However, for the first differences of the variables, the ADF test statistic of each of the series is greater than the 5 per cent critical value of the ADF statistic in absolute terms. This implies that all the variables are 1(1). Since most of the variables follow an I(1) process, the next step is to test if a long run relationship (cointegration) exists among the variables.

### 5.2 Co-integration Test Results

The existence of cointegration between the regressand and regressors were assessed. This required running a Johansen cointegration test based on VAR model of the equations. The Johansen Maximum Likelihood procedure is preceded by an estimation of a vector autoregressive (VAR) model at its optimal lag length since the procedure is very sensitive to the appropriate lag length. In the selection of appropriate lag length, VAR lag order selection criteria include:

**Table 1: Results of Unit Root Tests Based on Augmented Dickey-Fuller (constant, time trend included).**

Variable	Lags	ADF-Statistic	ADF-Critical Value	Conclusion
Inf	0	-2.945047	-3.540328	Unit Root
D(inf)	1	-6.014894	-3.548490	No Unit Root
exr	0	-2.627754	-3.202445	Unit Root
D(exr)	1	-4.687903	-3.204699	No Unit Root
yt	5	-1.926870	-3.562882	Unit Root
D(yt)	1	-5.157989	-3.548490	No Unit Root
Ms	0	-1.422362	-3.540328	Unit Root
D(Ms)	1	-4.865157	-3.548490	No Unit Root

*Note: The  $H_0$  is that a series is non-stationary against alternative hypothesis  $H_1$  of a series being stationary. The rejection of  $H_0$  for the ADF test is based on the MacKinnon critical values. The lag lengths were determined in accordance with the SIC.*

**Source:** Underlying data from unit root test

sequential modified Likelihood Ratio test (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) and Hannan-Quinn Information Criterion (HQ). The appropriate lag length is the one supported by more of the five criteria. As a result of the small number of observations and the need to save the degrees of freedom, the highest and optimal lag length adopted was two for each of the equations.

As the result of the test statistics show, the hypothesis of no cointegration among the variables can be rejected and at least two cointegrating vectors exist among the variables of interest. Evidently, the max-Eigen value reveals two co-integrating equations in the analysis. The PT-matrix of the beta coefficients from the Johansen cointegrating analysis and the preferred cointegrating equations of the model are presented in Table 2.

**Table 2: Cointegration Test Results Using Johansen's Maximum Likelihood**

Model	Optimal lag length Selected	Trace Statistic		Maximum Eigen value		Conclusion
		Cointegration Rank	level of Significance	Cointegration Rank	level of Significance	
Output equation	2	1	1%	2	1%	Cointegrated
Exchange Rate Equation	1	2	1%	1	1%	Not Cointegrated
Inflation Equation	1	1	1%	1	1%	Cointegrated

### 5.3 System Estimation Results

Following the existence of cointegrating relations among the equations, the system was estimated using a Generalised Method of Moments (GMM) technique. The results are contained in Table 3. The results for each equation are presented below.

**Table 3: Estimation Results**

<p><b>1. Output-Equation</b></p> $\text{LnYr}_t = 1.746 + 1.209\text{yr}_{(t-1)} + 0.575\text{inf}_t + 0.4750\text{Ms}_t + 0.200 \text{Lnex}_t$ <p>T-Statistic: (2.667)* (3.2092)* (2.683)* (1.923)** (1.627)</p> <p><math>\bar{R}^2 = 0.6258</math>, DW= 2.078</p> <p>Instruments: <math>\text{Y}_t</math>; <math>\text{y}_{t-1}</math>; <math>\text{inf}(t-1)</math>; <math>\text{ex}(t-1)</math>; Constant</p>
<p><b>2. Exchange Rate Equation</b></p> $\text{Lnex}_t = 2.1196 - 0.3312\text{LnYr}_t - 0.2888\text{Inf}_t + 0.8153 \text{Lnex}(t-1) - 1.6906\text{Ms}_t$ <p>T-Statistic: (2.7785)* (1.4826) (1.9115)** (2.6603)* (2.5800)*</p> <p><math>\bar{R}^2 = 0.5379</math>; DW= 1.90</p> <p>Instruments: <math>\text{Y}_t(t-1)</math>; <math>\text{ex}</math>; <math>\text{inf}(t-1)</math>; <math>\text{MS}</math>; Constant</p>
<p><b>3. Inflation Equation</b></p> $\text{Ln Inf}_t = 3.2531 + 0.852\text{Ms}_t - 0.5521\text{LnYr}_t + 0.4253\text{LnInf}(t-1) + 0.3420 \text{Lnex}_t$ <p>T-Statistic: (4.1372)* (2.7298)** (2.5760)** (3.9112)* (2.3400)**</p> <p><math>\bar{R}^2 = 0.6143</math>; DW= 1.801</p> <p>Instruments: <math>\text{Inf}</math>; <math>\text{Inf}(t-1)</math>; <math>\text{Yr}(t-1)</math>; Constant</p>

Note: \*, \*\*, represent significance at 1% and 5% respectively

Source: From system estimations.

The interpretation begins with the result of the output equation. The result demonstrates that real output, is determined by the lag of real GDP, inflation and money supply, with a positive relationship existing among the variables. With an explanatory power of 62.6 per cent, it can be said that the exogenous variables fit reasonably well, while the D.W statistic of 2.01, indicates absence of first order serial correlation. This demonstrates that Nigeria's economic growth has been directly affected by monetary variables.

A striking feature of the finding is the relationship between exchange rate and output. Exchange rate is significant in determining output in Nigeria. It is interesting to note that growth and real exchange rate were positively related, and the estimated coefficient was statistically significant. The result confirms what is normally expected, i.e. real exchange rate depreciation associated with an increase in growth. This outcome is repeated in the exchange rate equation. This suggests that slower income growth can put pressure on the exchange rate. Thus, within the context of the model, the direct relation between the real exchange rate and real income growth is negative. Money supply and lag of real exchange rate are significant in explaining variations

in real exchange rate and conform to the expected signs. Theoretically, increased supply of foreign exchange should lead to increased money growth, however, when the demand for foreign exchange exceeds its supply a depreciation of the local currency results.

From the result of the inflation equation it is evident that growth in money supply and real output have the expected signs and are significant at 5% level. The coefficient of lagged exchange rate is highly significant, indicating that depreciation of exchange rate exerts upward pressure on inflation.

Largely, some of the results confirmed theoretical expectations while others did not and not all coefficients were statistically significant. However, an interesting feature of the model is the use of lags and natural logarithms which made the model dynamic. A more disaggregated formation is suggested for further research to provide an alternative means of examining the issues.

## 6.0 Conclusions and Recommendations

Certain policy implications arise from the findings. Principal among them is that exchange rate depreciation affects both output and money supply. It demonstrates the need for a monetary policy framework that complements the existing exchange rate policy.

On the whole, this paper has provided empirical estimates of the relation between exchange rate and economic growth in Nigeria. The results suggest that there is a statistically significant direct relationship between the two variables. The vector auto regression results also demonstrate that real exchange rate and real income are significantly cointegrated. In the long run, the exchange rate and income may drift apart, but in a short run their relationship is strong and direct. Given this, there is need to improve on the existing exchange rate management framework in Nigeria. This can influence the rate of income growth, but only in the context of a broad based economic reform involving a complementary monetary policy.

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