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Exchange Rate and Macroeconomic Aggregates in Nigeria

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Abstract
This study analyses the impact of exchange rate on macroeconomic aggregates in Nigeria. Based on the annual time series data for the period 1970 to 2009, the research examines the possible direct and indirect relationship between the real 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, and a vector-autoregressive model. The estimation results show that there is no evidence of a strong direct relationship between changes in the exchange rate and GDP growth. Rather, Nigeria's economic growth has been directly affected by fiscal and monetary policies and other economic variables particularly the growth of exports (oil). These factors have tended to sustain a pattern of real exchange rate over-valuation, 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, which includes among others, a complementary restrictive monetary policy. On the whole, the results are informative.

Keywords: Exchange rate, Macro-economy, Simultaneous equations, Nigeria.

1. Introduction

The issue of exchange rate management and macroeconomic performance in developing countries has received considerable attention and generated much debate. The debate 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.

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, 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.

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 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. 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.

Some attempts have been made to conduct econometric studies on exchange rate determination and the movements in output in Nigeria, Egwaikhde et al (1994); Odusola and Akinlo (2001); Ekpo (2003) among others. However, many of these earlier studies were based on single equation regression approach. This study deviates from the previous ones in Nigeria by the adoption of 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), interest rate, and income.

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

2. **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. However, since the links between the nominal exchange rate regime and macroeconomic performance both counterbalance and reinforce each other, the OCA theory is unable to present an unambiguous proposal for the optimal exchange rate regime. For example, 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.

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 (1994), 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), Frankel (1999), Lin (2001), McKinnon and Schnabl (2003), and Mussa et al (2000) among others).

2.1 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 Schmid (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-timeseries/ cross-country sample, Edwards (1989) regressed the real GDP on measures of the nominal and real exchange rates, government spending, the terms of trade, and measures of money growth. He observed 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 (1991) 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.

2.2 Exchange Rate and Output

Morley (1992) analyzed the effect of real exchange rates on output for twentyeight devaluation experiences in developing countries 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 observed 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 twentyseven 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 observed 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.

Output, inflation and exchange rate in Nigeria was the focus of the work by Odusola and Akinola (2001). Employing a structural VAR model, evidence from the estimations demonstrated the existence of mixed results on the impacts of exchange rate depreciation on output. Inflation was found to generate substantial destabilizing impacts on output, suggesting that monetary authorities should play a critical role in providing enabling environment for growth. The authors concluded that prices, parallel exchange rate and lending rate were important sources of fluctuations in the official foreign exchange rate.

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, it is evident that most cases of contractionary devaluations had been focused on Latin America

and other developed nations. Only few studies have been conducted on the issue in Sub-Saharan Africa, particularly Nigeria.

3. 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.

3.1 Exchange Rate Movement and Macroeconomic Performance

Analysis of Nigeria's exchange rate movement from 1970-2010 showed that there exists a causal relationship between the exchange rate movements and macroeconomic aggregates such as inflation, fiscal deficits and economic growth. Consequently, 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. During periods of high inflation rate, volatility in the exchange rate was high, which was 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 in1995 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 1999-2009, 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.

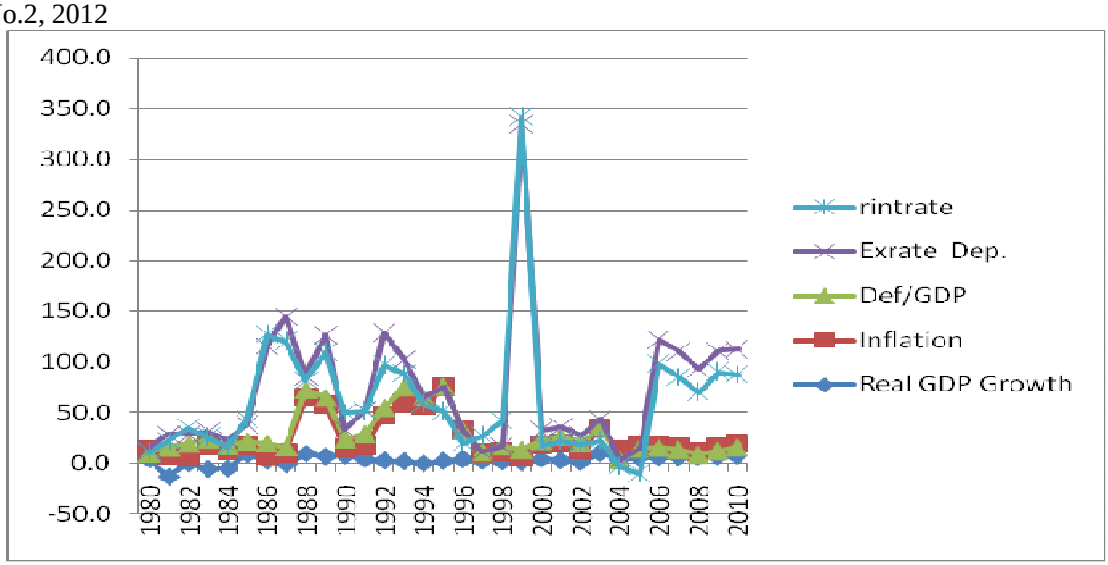

Figure 1: Trend of Exchange Rate and Selected Macroeconomic Indicators in Nigeria (1980-2010)
Source: Underlying data from Central Bank of Nigeria Statistical Bulletin Various Years

4. Framework

For the purpose of the analysis, Nigeria is treated as a small open developing economy, which is affected by world market fluctuations. A simultaneous equations model is adopted to investigate the effect of the money supply, inflation and the exchange rate on the real output growth of the manufacturing sector. To capture the inter-linkages, based on the structure of the Nigerian economy a simple structural model of the Nigerian economy is estimated which includes equations for inflation rate, real income growth, changes in the exchange rate and changes in government revenue.

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.

4.1 The model

The model employed in the research draws on the structural macroeconomic model of Khan and Knight (1991).[2] It includes all the basic elements of the financial programming framework used by the international Monetary Fund. This work enhances the original Khan-Knight model by adding open economy indicators: exchange rate and imports. 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.
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;

$$LnINF_t = \alpha_0 + \alpha_1 lnMs_t + \alpha_2 LnYr + \alpha_3 inf_{t-1} + \alpha_4 ex_t + \varepsilon_t \quad (1)$$

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 ε is the error term.
Income Equation
The income equation expresses real GDP as a function of monetary and fiscal variables such that;

$$LnYr_t = \beta_0 + \beta_1 lnMs_t + \beta_2 Ln\ lnex_t + \beta_3 lnex_{t-1} + \beta_4 lninf_t + \beta_5 lnyr_{t-1} + \varepsilon_t \quad (2)$$

The variables are as previously defined.

Exchange Rate Equation

Exchange rate is modeled as a function of fiscal and monetary variables. Such that;

[2] See Khan and Knight (1991) for detailed specification of the model.

$$LnEx_t = \mu_0 + \mu_1 LnYr_t + \mu_2 Lninf_t + \mu_3 Lnex_{t-1} \mu_4 LnIMs_t + \varepsilon_t \quad (3)$$

Where IM refers to imports, while all other variables are as previously defined

Government Revenue Equation

Theoretically, exchange rate movements have some impacts on the general price level and some aspects of revenue and expenditure. For instance a depreciation of the exchange rate raises interest charges and capital repayment on external debt, hence an increase in overall government expenditure. The following relationship is thus, derived.

$$LnGOR_t = \gamma_0 + \gamma_1 LnYr_t + \gamma_{2Ln} GRR + \gamma_3 LnGOR_{t-1} + \varepsilon_t \quad (4)$$

Where GOR is real total government revenue, GRR is government retained revenue.

Definition of Variables

$Lninf_t$	rate of inflation (P is the Nigerian Consumer Price Index)
$Lninf_{t-1}$	a proxy for the expected inflation rate at time t
$LnYr_t$	growth rate of nominal GDP (market prices)
$Lnexr_t$	real exchange rate
$LnIm_t$	Real Imports
$LnMs_t$	Money Supply
$LnGOR_t$	Real government Revenue
LnGER	Real Government Expenditure
Ln=Logarithm	
t= time subscript	

5. Data and Sources

The study employs annual data covering the period 1970-2008. 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 study was obtained from the IFS CD ROM 2009 and Central Bank of Nigeria (CBN) Annual Report and Statement of Accounts. Specifically, money supply, real GDP and its deflator, consumer price index and official exchange rate were drawn from the IFS CD ROM 2009. Government revenues and expenditure were collected from Central Bank of Nigeria (CBN) Annual Report and Statement of Accounts, various issues.

6. Estimation Strategy and Results

The system was estimated using Two-stage Least squares (2SLS). This method is explored to minimize the problem of simultaneous equation bias. Prior to the estimation, unit root tests were performed on the series to determine their stationarity using the Augmented Dickey-Fuller and Sargan Bhargava Durbin-Watson tests. Most series were not stationary at levels and were differenced accordingly before being used in the estimation.

Next, a co-integration analysis was carried out to ascertain the existence of a long run relationship between the dependent and independent variables. This was followed by the error correction mechanism. The outcome of the integration process suggests that an error correction specification would provide a better fit than would the case without it. The results for the estimated behavioural equations are presented below.

$$INF_t = -0.074 + 0.426Ms_t \quad -1.976\ Yr + 0.167\ inf_{t-1} + 0.040ex_t - 0.2817ECM_{t-1}$$
(2.073) (2.645) (3.672) (1.952) (2.436) (2.31)
$R^2 = 0.54$

$$Yr_t = -0.074 + 0.298Ms_t - 0.150ex_t + 0.342ex_{t-1} - 0.214inf_t + 0.345Yr_{t-1} - 0.125ECM_{t-1}$$
(1.354) (1.243) (1.145) (1.257) (2.349) (3.421) (2.130)
$R^2 = 0.62$

$$Ex_t = -1.107 + 0.652Yr_t + 0.452inf_t + 0.674ex_{t-1}\ 0.165Ims_t + 1.135ECM_{t-1}$$
(0.942) (1.240) (2.34) (2.654) (2.18) (1.970)
$R^2 = 0.61$

$$GOR_t = 0.012 - 0.813Yr_t + 0.765GER + 0.326GOR_{t-1} - 0.134ECM_{t-1}$$

(2.260) (2.967) (5.980) (6.625) (0.716)
R^2 = (0. 48)

The interpretation of the results begins with the inflation equation (equation 1). From the results presented above, the principal determinants of inflation have been real output (as a supply variable), the growth of money supply, inflation expectation and exchange rate. Indeed, the coefficient of lagged exchange rate is highly significant; indicating that depreciation of exchange rate exerts upward pressure on inflation. The coefficient of the ECM indicates that the feedback between inflation and money supply is 0.3.

From the income equation, it is interesting to note that income growth and real exchange rate were negatively related, though the estimated coefficient was not statistically significant. This does not conform to what is normally expected, i.e. real exchange depreciation associated with a decline in growth. This outcome is repeated in the next equation (equation 3). One explanation is that slower income growth has put pressure on the exchange rate.

Nonetheless, it is useful to note from the exchange rate equation that real exchange rate, imports and income growth have the correct signs on the respective coefficients. Thus, within the context of the model, the direct relationship between the real exchange rate and real income growth is negative.

The result of government revenue equation is reported in equation 4. As the result shows, government revenue is an important determinant of government expenditures an also responds significantly to growth in the economy, represented by real GDP. The elasticity of government expenditure at 0.76 is quite high. A plausible explanation is the Wagner's law of increasing state activities which posits that as the economy grows, government outlay tends to grow.
Largely, the results are instructive. Some results confirm theoretical expectations while others do not. Nonetheless, the use of lags, natural logarithms and error correction mechanism makes the model very dynamic and highly appreciated.

6.1 Co-integration Test Results

The simultaneous equation results presented above provide some indication of the direct and indirect links between exchange rate movements and growth. They expressed the short-run dynamics of the real exchange rate – real income growth relationship. These results, and the basic conclusions of the paper, do not concern the question whether the two variables are related in the long-run. This issue is tackled by running a Johansen cointegration test based on VAR model of the real income and the real exchange rate. Since there is no direct theoretical linkage between these two variables, the structure of the VAR model used has to be seen as a statistical relationship.

Estimating VAR models of real exchange rate and real income with different number of lags (from 1-4) and comparing the value of the Akaike Information Criterion (AIC) statistics suggests that the optimal VAR structure has one lag for each variable:

$$Yr_t = c_1 + \theta_{11} Yr_{t-1} + \theta_{12} ex_{t-1} + u_1$$
$$ex_t = c_2 + \theta_{21} Yr_{t-1} + \theta_{22} ex_{t-2} + u_2,$$

then the Johansen method for the VAR model with one lag is used to test for cointegration. The likelihood ratio test finds no, cointegration in this case. His result is consistent with the earlier findings. The real exchange rate and the real income are not significantly related. At most there is weak long-run relationship between the variables. These results are consistent with earlier findings. The real exchange rate and the real income are not statistically related. At most, there is a weak long-run relationship between the two variables.

7. Summary, Policy and Conclusion

This research has provided empirical estimates of the economic relationship between exchange rate, inflation, government revenue and income growth in Nigeria. The objective was achieved through the use of a system of equations which captured the inter-linkages between the above listed variables. The estimation strategy involved the use of cointegration and a two stage least squares estimation technique.

The results of the estimation demonstrate that there is no statistically significant direct relationship between inflation and exchange rate. They, however, are indirectly linked through several channels, including money and output. The vector autoregression result shows that real exchange rate and real income are not significantly cointegrated. In the long run, the exchange rate and income may not drift apart, but in the short run their relationship is weak and indirect. Together, these results provide confirmation that there is no evidence of a strong direct relationship between changes in the exchange rate and GDP growth. Rather, Nigeria's economic growth has been directly affected by fiscal and monetary factors, particularly the growth of government revenue and

expenditure. These factors have tended to sustain a pattern of real exchange rate over-valuation, 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. This should include among others a restrictive monetary policy to complement the exchange rate policy adopted.

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