Macroeconomic Variables and the Nigerian Exchange Rate Performance

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ABSTRACT
This study investigates the effects of macroeconomic variables on the Nigerian exchange rate performance. Using annual data for the period 1985-2018, the study employed the ordinary least square (OLS) technique, the unit root test, the Johansson co-integration test and the error correction mechanism (ECM) to examine the relationship between some macroeconomic variables and exchange rate of Naira. The result suggests that unemployment rate is a strong determinant of exchange rate of Naira both in the short run and in the long run. Thus this study recommends that Nigeria improve its competitive capacity in the international market through increase in domestic production and export diversification which will obviously reduce unemployment and strengthen the exchange rate of Naira.

Keywords: Macroeconomic variables, Exchange rate depreciation, Exchange rate of Naira, Currency

1.0 INTRODUCTION
“In foreign commerce, as in international dialogue, somebody has to translate. People in different countries use different currencies as well as different languages. The translator between different currencies is the exchange rate - the price of one country’s money in units of another country’s money” (Pugel 2005).

The foreign exchange market according to the Central Bank of Nigeria is the medium of interaction between the seller and the buyer of foreign exchange. The seller of foreign exchange constitutes the supply while the buyer constitutes the demand. The supply of foreign exchange is derived from oil export, non-oil export, expenditure of foreign tourist in Nigeria, capital repatriation by Nigerian residents abroad etc. The demand for foreign exchange on the other hand consist of payments for imports, financial commitments to international organizations, external debt service obligations etc. By implication both the supply and the demand of foreign exchange depends on economic activities of a country.

It is the supply and demand of a nation’s currency that determines the exchange rate (except where the government intervenes through the policy of the central bank). What determine the demand for a nation’s currency are its export potentials, while its import ability determines the supply of its currency.
The demand and supply curves represent all demand and supply for Naira in the foreign exchange market, except for any official intervention by the central bank. With a floating exchange rate the market reaches equilibrium at point E. If the government intervenes as the Nigerian monetary authority did recently (i.e. devaluing Nigerian currency relative to dollar), then the exchange rate will be below the equilibrium rate. The demand for Naira may increase owing to export increase and the supply of Naira may decrease owing to a decline in import. This is in theory. In practice the objective of such policy could be achieved only if the nation has enough goods and services for export and also has the potential to reduce its imports through import substitution policies. Indeed such policy may not yield enough gain to Nigeria because of its dependence on oil as major source of export. The increase in oil revenue will depend on the elasticity of demand for oil. It is not certain that the increase in oil revenue as a result of Naira devaluation will be larger than additional expenditure on imports also as a result of Naira devaluation.

Thinking in terms of supply and demand is a necessary first step toward understanding exchange rates; we need to know the perceptions and actions of international financial investors especially when dealing with the floating exchange rate. It is believed that the billions of Naira of foreign exchange trading that occurs each day is related to both international trade in goods and services and positioning/repositioning of the currency composition of the portfolio of international financial investors. With this an exchange rate policy adopted by a country becomes very sensitive to macroeconomic shocks. Countries therefore tend to adopt exchange rate policy that absorb both internal and international trade shocks, this is because the performance of the country’s economy is better if shocks are less disruptive as the economy is more stable with such policy.

Nigeria has adopted several exchange regimes. During the time of fixed exchange rate, the movement of exchange rate seemed to be stable but the economy were getting worse every day, the alarming deterioration of the economy called for a change, hence the switch over to flexible exchange rate. The management of the floating exchange rate has not proved better as the naira deteriorates everyday and many macroeconomic variables are not stable. It is very unfortunate that in such state of Naira depreciation, the Nigerian monetary authorities came up with devaluation policy (and most recently supplying Billions of Naira to the forex to save the Naira from further loss of value), instead of looking inward to find out why Naira continues to depreciate in the face of other strong currencies.
It is therefore the aim of this paper to examine those macroeconomic variables that affect exchange rate directly or indirectly by influencing the volume of exports (goods, services and financial transactions) and imports.

2.0 BRIEF REVIEW OF RELATED LITERATURE

2.1 Conceptual Issues

Exchange rate is the price of the currency of one country expressed in terms of the currency of another. For example, the Nigeria Naira has exchange rate against the U.S. dollar and many other currencies. It may be expressed as nominal exchange rate or real exchange rate.

The nominal exchange rate is a monetary concept which measures the relative price of two moneys e.g. Naira in relation to dollar (₦/$), while the real exchange rate is a real concept that measures the relative price or value of different countries products. An exchange rate system can also be fixed or allowed to fluctuate. A fixed exchange rate is a system in which a country’s exchange rate remains constant or stays within some small margin of fluctuation around a constant par value. On the other hand, the floating exchange rate (which is our concern in this study) is an exchange rate system with no government or central bank action to keep it stable (Black 2003).

Macroeconomic variables are indicators or main signposts signaling the current trend in the economy. The governments in order to do a good job of macro-managing the economy need to study, analyze and understand the major variables that determine the current behavior of the macro-economy. So governments must understand the forces of the growth of any macroeconomic variable and how such macroeconomic variable affects other variables in the economy. www.auburn.edu/-gadzeak/macro-variable.htm

In this study the following key macroeconomic variables are discussed:

- Economic output: This is measured in terms of the gross domestic product (GDP). A higher rate tends to indicate a more economically solvent nation. Analysts measure GDP income by adding consumer spending, private investment, government spending and net export. Most of these variables have impact on the exchange rate of a nation.
- Unemployment rate: The employment rate is the percentage of the working population that is not currently employed. The percentage only takes into account the number of people who are actively searching for employment. Many governments set benchmark unemployment rate since they are aware that a zero rate is next to impossible. If the actual aggregate unemployment rate is at or below the benchmark rate, the economy is considered to be fully employed and this strengthens the exchange rate.
- Inflation rate: The inflation rate measures changes in the average price level based on a price index. The most commonly known index in most nations is the consumer price index (CPI). This index measures average retail price that consumers pay. A high or increasing CPI indicates the existence of inflation. Higher prices tend to reduce overall consumer spending, which in turn leads to decrease in GDP.
- Interest rate: Interest rates are a reflection of the risk of borrowing. In terms of macroeconomic reporting, the interest rate is the nominal rate. Nominal rates are not adjusted for inflation. Lower interest rates typically occur when there is a need to stimulate consumer spending. www.ehow.com/info-810727-key.macroeconomic-variable.html

2.2 THEORETICAL LITERATURE

The earliest theory developed by Mundell (1961) and Mickinnon (1963) focused on trade and stabilization of the business cycle. According to the theory a fixed exchange rate regime can increase trade and output growth by reducing exchange rate uncertainty and encourages investment by lowering currency premium from interest rates. On the other hand a flexible exchange rate could increase output growth and trade by price adjustment process. For this theory there is a positive relationship between exchange rate and economic growth.
Another standing point of exchange rate theory is the purchasing power parity (PPP) which is also called the inflation theory of exchange rates. This theory argues that the exchange rate will change so that the price of a particular good or service will be the same regardless of where you buy it. For this reason, the theory of PPP is often known as the law of one price. It is expressed with the equation:

\[ E = \frac{P_{dd}}{P_{ff}} \]

Where;
- \( E \) = Nominal exchange rate
- \( P_{dd} \) = Domestic prices in domestic currency (P)
- \( P_{ff} \) = Foreign prices in foreign currency (P*)

This is simply expressed as \( E = \frac{P}{P^*} \).

Relative money supplies affect exchange rates. On the international front as on the domestic front, a currency is less valuable the more of it there is to circulate. The increase in the German money supply in 1922-1923 was the key proximate cause of the increase in price of foreign exchange and of everything else in Germany at that time. Hyperinflation of the money supplies is also the key to understanding why the currencies of Israel and several Latin American countries lost almost all their value during the same period (Pugel 2005; Chambeline and Yuch 2006).

The link between domestic product and the demand for a nation’s money is central to the quantity theory of demand for money. The quantity theory equation says that in any country the money supply is equated with the demand for money, which is directly proportional to the money value of gross domestic product. In separate equations for the home country and the rest of the world, the quantity theory equation becomes a pair:

\[ M^* = K \cdot P \cdot Y \]

and

\[ M^*_f = K_f \cdot P_f \cdot Y_f \]

where \( M^* \) and \( M^*_f \) are the home and foreign money supply, \( P \) and \( P_f \) are the home and foreign price levels, and \( Y \) and \( Y_f \) are the real (constant price) domestic product. By taking the ratio of the two equations and rearranging the terms, Thomas used the quantity theory equation to determine the ratio of prices between countries as:

\[ \left( \frac{P}{P_f} \right) = \left( \frac{M^*}{M^*_f} \right) \cdot \left( \frac{K_f}{K} \right) \cdot \left( \frac{Y_f}{Y} \right). \]

Combining the absolute purchasing power parity equation with the quantity theory equation for the home country and the rest of the world yields a prediction of exchange rates ‘e’ based on money supply and national products. Where ‘e’ is defined as:

\[ e = \left( \frac{P}{P_f} \right) = \left( \frac{M^*}{M^*_f} \right) \cdot \left( \frac{K_f}{K} \right) \cdot \left( \frac{Y_f}{Y} \right). \]

However, the effect of income(Y) on the exchange rate must be treated with caution. This is because income is not an independent force that can simply move or change by itself. What causes it to change has a great influence on the exchange rate. A rise in income through productivity income of the nation would strengthen the nation’s currency while a rise in income through the Keynesian effect of extra government spending may lower the value of the national currency.

Another theory that explained exchange rate is the balance of payment theory. It holds that under free exchange rates, the exchange rate of the currency of a country depends upon its balance of payment. A favorable balance of payment raises the exchange rate, while an unfavorable balance of payment reduces the exchange rate. Thus the theory implies that, exchange rate is determined by the demand for and supply of currencies which depends on imports and exports of goods/services, international loans, reparation payments, etc. (Jhingan, 2003). It takes exchange rate to be endogenously determined.
2.3 Empirical Investigation

Changes in exchange rates are given various names depending on the kind of exchange rate regime prevailing. Under the floating-rate system, a fall in the market price of a currency is called a “depreciation” of that currency; a rise is an “appreciation. We refer to discrete official reduction in the otherwise fixed par value of a currency as a “devaluation”, “revaluation” is the antonym describing a discrete raising of the official par. In this sub-section, we tend to review the relationship between macroeconomic variables and exchange rate. However the effect of exchange rate fluctuation on inflation or on the economy or on any other macroeconomic variable is widely discussed in literature without a matching recourse on what causes the so called fluctuation on exchange rate.

According to Kandil, (2004), exchange rate fluctuations influence domestic prices through their effects on aggregate supply and demand. In general, when a currency depreciates it will result in high import prices if the country is an international price taker, while lower import prices result from appreciation.. A panel estimation for about 18 countries carried out by Edwards and Levy-Yeyati (2003) observed that countries with more flexible exchange rates grow faster. This study was supported by Eichengream and Leblang (2003) whose study reveal a strong negative relationship between exchange stability and growth for 12 countries over a period of 120 years. Olanipekun (2016), empirically examined the relationship between oil price shocks, exchange rate, external reserve, and real GDP in Nigeria using data spanning from 1971Q1 – 2014Q4. The variables of interest were analyzed using structural vector Autoregressive (SVAR) model. He concluded that the transmission channel of crude oil price shock to economic performance is through external reserves, exchange rate and inflation. The work of Mireille (2007) suggests that over valuation of exchange rates have constituted a major setback in the recovery process of Nigeria and Benin republic. This was in support of the work of Daiz-Alyandro (1985) and Gylfson and Schmidt (1983). The implication is that overvaluation of exchange rate reduces output growth. Enekwe et'al (2013), examined the effects of exchange rate fluctuations on manufacturing sector in Nigeria. They employed descriptive statistic and multiple regression analysis. Their result indicated that manufacturing foreign private investment (MFPI) and exchange rate (ER) have positive effect on manufacturing gross domestic product (MGDP). They recommended that Government should stimulate export diversification in the area of agriculture, agro-investment etc. Another study by Adubi (1999) used empirical study to determine the dynamic effects of exchange rate fluctuations on exchange rate risk in agro trade flows. He observed that exchange rate changes have a negative effect on agricultural export. He concluded thus, the more volatile the exchange rate changes the low the income earnings of farmers which in turn leads to a decline in output production and a reduction in export trade. An interesting work was carried out by Batini (2004) and Mordi (2006) who examined the relationship between exchange rate, inflation and output in Nigeria; their models showed a contractionary impact on the parallel exchange rate on output in the short run. Dickson and Ukavwe (2013), investigated the hypothesis that exchange rate risk affect international trade. Using the ordinary least squares (OLS) technique, they found that exchange rate volatility is insignificant in explaining variations in imports but significant and positive with respect to export. They recommended the need to adopt policies that will enhance non-oil export and reduce importation. In an attempt to explain the inflation movement in Kenya, Ndung’u (1993) and Akonji (2013) used Vector Auto Regression (VAR) analysis to analyze six variables- money supply, domestic price level, exchange rate index, foreign price index, real output and the rate of interest. TheY noted that the rate of inflation and exchange rate explained each other. The work of Imimole and Enoma (2011) on the impact of exchange rate depreciation on inflation in Nigeria for the period 1986-2008 used Auto Regressive Distributed Lag (ARDL) cointegration procedure. The research found that exchange rate depreciation, money supply and real gross domestic product are the main determinants of inflation in Nigeria. They recommended the need for policy-makers to employ exchange rate depreciation as a measure to compliment other macroeconomic policies to stabilize the volatile inflationary rate in Nigeria. Kamin and Klan (1998) used error correction technique to estimate a regression equation linking the output to the real exchange rate for a group of twenty seven countries. They did not find that devaluation were contractionary in the long run. Nyahokwe and Newadi (2013), analysed the impact of the real exchange rate volatility on unemployment and the dynamic adjustment of unemployment rate following
shocks to its determinants using quarterly data covering the period 2000-2010. They made the use of cointegrating and vector autoregressive (VAR) and the GARCH model. Their test suggested that exchange rate volatility and export were statistically significant in explaining the variation in the unemployment. Morley (1992) estimated the effect of real exchange rates on output for twenty eight developing countries that devalued their currencies using a regression analysis; he observed that depreciation of the level of the real exchange rate reduced the output. Akpan and Atan (2012) investigated the effect of exchange rate movements on real output growth in Nigeria based on quarterly series for the period of 1986-2010, the paper examined the possible direct and indirect relationship between exchange rates and GDP growth; the estimation results suggest that there is no evidence of a strong direct relationship between changes in exchange rate and output growth, rather Nigerian’s economic growth has been directly affected by monetary variables. Dada and Oyeranti (2012) established a structural macroeconomic model to find the relationship between exchange rate and macroeconomic aggregates in Nigeria. The result of their estimate demonstrated that there is no statistically significant direct relationship between inflation, import, real income and exchange rate. They however, found that there are indirect link between these variables and exchange rate through several channels including money and output. There vector autoregressive result shows that real exchange rate and real income are not significantly co-integrated.

In literature, there seems to be a consensus view on the fact that devaluation or depreciation could boost domestic production through stimulating the net export components. But our concern in this study is to search for those variables that can boost or stimulate the exchange rate of a nation from the side of the real economy and not through government intervention. Based on this fact, we found the need to carry out a research on the subject matter.

2.4. 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 application 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 Inter-bank Foreign Exchange Market- AFEM in 1995 and the Autonomous Foreign Exchange Market- IFEM in 1999) were introduced 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 facilitate 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 introduced the Wholesale Dutch Auction System (WDAS) on February 20, 2006.

In June 2016, the CBN formally unveiled the much awaited flexible foreign exchange policy that would allow the foreign exchange interbank trading window to be driven purely by market forces. This policy was designed to effectively remove controls on the Naira, allowing increased dollar supply that would help strengthen the countries weak economy. Mr. Emefiele (the CBN governor) said at the launch that
Nigeria’s foreign exchange reserve declined from $42.8b in January 2014 to about $36.7b as of June 2016, with average monthly inflow falling from about $3.2b to below a billion dollars per month. Despite these outcomes, the CBN governor said that the dollar for foreign exchange rose significantly from an average import bill of #148.3b per month in 2005 to about #917.6b per mount in 2015.

3.0. METHODOLOGY

The study aims at providing empirical evidence on the effect of macroeconomic variables on the Nigerian exchange rate performance. Theoretically, exchange rate fluctuations – depreciation or appreciation of the exchange rate may be attributed to changes in macroeconomic conditions. To determine the effect of such variables like inflation rate, economic output, unemployment rate etc; on Nigerian exchange rate, we employed annual time-series data from 1980-2015, sourced from Central Bank of Nigeria (CBN), statistical bulletin 2015, 2016 and other annual reports. The data was analyzed using the Augmented Dickey-Fuller unit root test, Johansen co-integration test and error correction mechanism, (ECM) in case there is co-integration among the variables.

3.1 Specification of the Model

\[ \text{EXR} = f (\text{EOP}, \text{UER}, \text{IFR}, \text{INR}) \]  

This is specified in econometric form as:

\[ \text{EXR}_t = \alpha_0 + \alpha_1 \text{EOP}_t + \alpha_2 \text{UER}_t + \alpha_3 \text{IFR}_t + \alpha_4 \text{INR}_t + \mu \]  

Where

- \( \text{EXR} \) = Exchange rate (which measures the price or value of Currency in relative sense)
- \( \text{EOP} \) = Economic output (proxy of gross domestic product – GDP)
- \( \text{UER} \) = Unemployment rate (that is the percentage of the work force that is currently not employed).
- \( \text{IFR} \) = Inflation rate (this measures changes in the general price level of goods and services).
- \( \text{INR} \) = Interest rate (this is a reflection of the risk of borrowing).
- \( t \) = time subscript

Given the above relation, based on a priori reasoning the expected signs for the parameter estimates are:

\[ \alpha_1 < 0, \alpha_2 > 0, \alpha_3 > 0, \alpha_4 > 0 \]

In this sense when we say that there is increase in the exchange rate of a nation it means depreciation of the nation’s currency.

4.0 DATA ANALYSIS AND INTERPRETATION OF RESULTS

We begin our empirical analysis by showing the degree of association between exchange rate and some macroeconomic variables (as measured by economic output (EOP), unemployment rate (UNR), inflation rate (IFR), and interest rate (INR)). Table 4.1 depicts the result of the ordinary least square (OLS), and it shows that statistically significant positive relationship exist between UNR, INR and EXR. This means that the more unemployment rate and interest rate increases the more exchange rate increases relative to other currencies meaning depreciation in the value of Naira. It also revealed that a negative relationship exists between EOP and EXR. This means that as the Nigeria’s output improves, the exchange rate becomes stronger; that is, it appreciates in relation to other currencies. The autonomous variable shows that if the change in the macroeconomic variables are zero there will be reduction in Nigerian exchange rate in relation to other currencies given the value of the constant, which is \(-8.2255\). This signifies appreciation of the exchange rate if macroeconomic variables remain stable.
Table 4.1 Multiple Regression Result
Dependent Variable LOG(EXR)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std error</th>
<th>t. stat</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-8.225514</td>
<td>0.606256</td>
<td>-13.56773</td>
<td>0.0000</td>
</tr>
<tr>
<td>(LOG(EOP))</td>
<td>-0.612584</td>
<td>0.056054</td>
<td>-10.92837</td>
<td>0.0000</td>
</tr>
<tr>
<td>(UNR)</td>
<td>0.067399</td>
<td>0.0198550</td>
<td>3.394525</td>
<td>0.0021</td>
</tr>
<tr>
<td>(IFR)</td>
<td>0.002285</td>
<td>0.004983</td>
<td>0.458485</td>
<td>0.6501</td>
</tr>
<tr>
<td>(INR)</td>
<td>0.136359</td>
<td>0.22333</td>
<td>6.105616</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R. square = 0.953298
Adj R2 = 0.946626
F.Stat = 142.8862
Prob(F.stat) = 0.00000
Durbin-Watson (DW) Stat = 2.002253

From the above table, the degree of responsiveness of exchange rate (in the short run) to economic output, unemployment rate and interest rate are -0.6126, 0.61 percent reduction in nominal value of Naira exchange rate. Accordingly, 1 percent increase in UNR and INR will increase the nominal value of Naira exchange rate by 0.07 and 0.14 percent respectively.

The coefficient of determination (R²) indicates that about 95.3 percent of the changes in Naira exchange rate are explained by macroeconomic variables. The joint significant of the model, F-statistic, which is 124.8862, shows that the model is statistically significant and can really explain the reasons for the changes in the rate of exchange rate.

4.1 Unit Root Test
Non-stationary data produces spurious regression; hence the result may be misleading. Therefore, it is cognizant to establish the stationarity of data to be used. This is carried out using the Augmented Dickey-Fuller (ADF) unit root test. The decision rule is that the ADF test statistic value must be greater than Mackinnon critical value of 5% in absolute value.

Table 1: Unit Root Test Result

<table>
<thead>
<tr>
<th>Variable</th>
<th>At level</th>
<th>At 1st level</th>
<th>Order of integration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ADF Stat</td>
<td>Prob</td>
<td>ADF Stat</td>
</tr>
<tr>
<td>EXR</td>
<td>-0.161832</td>
<td>0.9659</td>
<td>-5.415652</td>
</tr>
<tr>
<td>EOP</td>
<td>0.945358</td>
<td>0.9949</td>
<td>-8.424269</td>
</tr>
<tr>
<td>UNR</td>
<td>0.486268</td>
<td>0.9835</td>
<td>-4.849915</td>
</tr>
<tr>
<td>INR</td>
<td>-2.855019</td>
<td>0.0614</td>
<td>-6.194058</td>
</tr>
<tr>
<td>IFR</td>
<td>-2.417951</td>
<td>0.1736</td>
<td>-3.088421</td>
</tr>
</tbody>
</table>

Note: The maximum critical values at 5 percent level and at 1st difference are 2.951125 and 2.956021 respectively.

The result of table 1 above showed that the variables are non-stationary in level form since their ADF values are less than their critical values at 5%, the null hypothesis of a unit root was accepted for all the variables but was rejected at 1st difference (ADF value > critical value). We therefore conclude that the variables under investigation are integrated of order one 1(1). Since the variables are integrated of the
same order, 1(1), we proceed to examine their co-integration relationship using the Johansson co-integration test.

4.2 Co-Integration Test

Given the unit root properties of the variables, we proceed to carry out the co-integration test.

**Table 2: Johansson Co-integration Test**

<table>
<thead>
<tr>
<th>Hypothesized No of CE(s)</th>
<th>Eigen value</th>
<th>Trace statistic</th>
<th>0.05 critical value</th>
<th>Prob**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None *</td>
<td>0.727373</td>
<td>79.03088</td>
<td>60.06141</td>
<td>0.0006</td>
</tr>
<tr>
<td>At Most 1</td>
<td>0.457579</td>
<td>36.14238</td>
<td>40.17493</td>
<td>0.1202</td>
</tr>
<tr>
<td>At Most 2</td>
<td>0.258807</td>
<td>15.95583</td>
<td>24.27596</td>
<td>0.3828</td>
</tr>
<tr>
<td>At Most 3</td>
<td>0.066081</td>
<td>6.072497</td>
<td>12.32090</td>
<td>0.4272</td>
</tr>
<tr>
<td>At Most 4</td>
<td>0.066018</td>
<td>2.253843</td>
<td>4.129906</td>
<td>0.1573</td>
</tr>
</tbody>
</table>

Note: * denotes rejection of the hypothesis at the 0.05 level.


from the table above, it could be deduced that the Trace statistic of 79.03 is greater than 5% critical value of 60.06; indicating that at least there is one co-integrating equation hence the none* hypothesis was rejected. This shows the existence of a long-run equilibrium relationship among the variables. Consequently, we adopt the error correction mechanism which was specified in case, co-integration was established among the variables.

The equation is therefore rewritten to determine both short and long run impact of the macroeconomic variables on exchange rate of Nigeria.

\[ \Delta EXR_t = \alpha_0 + \lambda (EXR_t - \delta x_t) + \alpha_1 \Delta EOP_t + \alpha_2 \Delta UNR_t + \alpha_3 \Delta IFR_t + \alpha_4 \Delta INR_t. \]

Where;

- \( \Delta \) = Difference operator
- \( \lambda \) = The long run multiplier
- \( (EXR_t - \delta x_t) \) = The error correction term (ECM)
- \( X_{t-1} \) = Exogenous variable that are integrated of order zero

4.3 Parsimonious ECM Result

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std error</th>
<th>t. stat</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>2.263565</td>
<td>2.046322</td>
<td>1.19613</td>
<td>0.2784</td>
</tr>
<tr>
<td>( \Delta(\text{LOG}(E0P)) )</td>
<td>-1.163059</td>
<td>3.016536</td>
<td>-0.38561</td>
<td>0.7028</td>
</tr>
<tr>
<td>( \Delta(UNR) )</td>
<td>4.010497</td>
<td>0.867701</td>
<td>4.621982</td>
<td>0.0001</td>
</tr>
<tr>
<td>( \Delta(IFR) )</td>
<td>0.046198</td>
<td>0.105199</td>
<td>0.439151</td>
<td>0.6640</td>
</tr>
<tr>
<td>( \Delta(INR) )</td>
<td>0.554352</td>
<td>0.520297</td>
<td>1.065453</td>
<td>0.0961</td>
</tr>
<tr>
<td>ECM(-1)</td>
<td>-0.658917</td>
<td>0.304061</td>
<td>-2.522649</td>
<td>0.0360</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R. square = 0.574271</th>
<th>Adj R(^2) = 0.55385</th>
<th>F.Stat = 66.08930</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prob(F.stat) = 0.001258</td>
<td>Durbin-Watson (DW) = 1.945904</td>
<td></td>
</tr>
</tbody>
</table>

The estimated model in table 4.3 can be represented as:

\[ \Delta EXR_t = 2.26 - 1.16 \Delta(\text{LOG}(E0P_t)) + 4.01 \Delta(UNR_t) + 0.05 \Delta(IFR_t) + 0.55 \Delta(INR_t) - 0.66 \Delta EC(-1). \]
Table 4.4: Diagnostic Tests

<table>
<thead>
<tr>
<th>Tests</th>
<th>F-Statistics</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jacque-Bera</td>
<td>2.908470</td>
<td>0.1416</td>
</tr>
<tr>
<td>Breasch Godfrey</td>
<td>0.964558</td>
<td>0.3967</td>
</tr>
<tr>
<td>Arch</td>
<td>0.719727</td>
<td>0.4034</td>
</tr>
</tbody>
</table>

From the parsimonious result on table 4.3, shows that the signs of all the variables are consistent with ‘a priori’ expectation including the ECM; this is the first step for the acceptance of the result which also suggests that exchange rate is sensitive to macroeconomic variables. However, the T-statistic and probability values reveal that only $\Delta$(UNR) is statistically significant at 5 percent level of significant while $\Delta$(LOG(EOP)) and $\Delta$(INR) will be significant at 10 percent level. The implication is that, Nigeria is yet to put in place the structural transformation required to meet the sensitivity of exchange rate policies. According to our result a one unit increase in unemployment rate $\Delta$(UNR) will increase Nigerian exchange rate (i.e depreciate Naira) by 4.01 units.

The coefficient of determination and its adjusted are 0.5743 and 0.5539 respectively implying that about 57% of the variation in exchange rate is accounted for by the independent variables included in this model. The overall test results (that is F – statistics =66.0893 with probability of 0.0012) is significant at 5% level of significant suggesting that the joint effect of all the included variables were significant in determining the changes in exchange rate during the years under investigation. The D.W. statistic of 1.95 indicates evidence of no serious serial autocorrelation in the model as confirmed by other robust tests. The result shows that the error correction term ECM(-1) is statistically significant and negative. Thus it will rightly act to correct any deviations from long-run disequilibrium. The coefficient of 0.6589 denotes that about 65.9% of any past deviation will be corrected in current period.

For all the diagnostic tests; a low value of F-statistics with corresponding value of probability greater than 5% or (0.05) is an indication of good result (Hill et al 2007). From our result on table 4.4 we conclude that all the variables in the model pass all the diagnostic tests. The diagnostic F-statistics and the corresponding probabilities indicate that the Model is well specified and can be used for policy making and forecasting. This is because the Model fulfilled the conditions of no serial correlation identified by the Breasch-Godfrey test; normality of the disturbance term identified by Jarque Bera test; and no heteroscedasticity in the Model as reveal in the Arch test.

### 5.0 CONCLUSION AND POLICY RECOMMENDATIONS

This paper examined the effects of macroeconomic variables on exchange rate movement in Nigeria. Econometric techniques have been applied in order to determine this relationship. The literature shows that different arguments have been put forward but mainly on the effects of exchange rate volatility on inflation, unemployment rate, exports and imports, manufacturing, etc. Many believe that the exchange rate volatility explains the changes in most of these variables. However the gap or issue seeking for solution is ‘how does the macroeconomic variables affect exchange rate.

Based on the econometric analysis used in this study, we found that unemployment rate is statistically significant (with positive relationship) both in the short run and in the long-run in explaining changes in exchange rate volatility. It was also observed that Economic output and Interest rate were significant in the short run but proved to be insignificant (at 5% level of significant) in the long-run. This result shows that as exchange rate volatility expands variations in unemployment rate which was suggest by Nyahokwe and Ncwadi (2013); so also does unemployment rate expands the variations in exchange rate.

Thus this work concludes that macroeconomic variables are very important factors determining the exchange rate of Naira in relation to other currencies. Following this, we recommend that Government and policy makers should make effort to put macroeconomic variables into serious consideration when making exchange rate policies. There is urgent need for Nigeria to diversify her product and export opportunities so as to become price giver and not a price taker in the international market.
The policy implication of our result is that, for Government to control the Naira exchange rate effectively it needs to create enabling environment for macroeconomic variables to strive in the economy. This is because as far as there is the existence of increasing unemployment more than the natural unemployment rate, economic resources will not be put to full use and/or cannot be effectively utilized. For this reason the output of the nation will continue to decrease. And the low level of production will lead to high cost of the available goods and possibly to low level of export opportunities but more imports to sustain the nation, which in turn creates insufficient availability of foreign exchange and hence leading to exchange rate depreciation of Naira.

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