



Effects of Some Selected Macro-Economic Indicators on Exchange Rates (1986-2019)

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INTRODUCTION

One of the challenges that face any modern economy is the achievement and sustenance of economic growth and development with the ultimate objective of enhancing the welfare of its citizens (Oriakhi and Ameh, 2014). To achieve this lofty objective, a modern economy tries to harness the resources of all the economic units and direct them to productive uses. The owners of the resources are willing to part with them either permanently or temporarily in exchange for other economic benefits.

In traditional society, the exchange of values was done directly without any medium of exchange. This method of exchange, otherwise known as barter, did not allow for much specialization and accumulation of resources as one had to produce most of

ABSTRACT

Background: The foreign exchange market plays a significant role in the development of a country and the stability of her currency in recent years.

Objectives: This article reports the effect of macro-economic indicators on foreign exchange parallel markets for a period between 1986 – 2019.

Methods: The macro-economic indicators used were inflation rate, demand for money, the supply of money, OPEC crude oil and the real GDP growth with the dependency of the foreign exchange market. The data for this project was extracted from the publication of the Statistics Unit of the Central Bank of Nigeria in recent years. Multiple Linear Regression was used with special attention on Multicollinearity, Serial Correlation and Heteroscedasticity. The coefficient of determination value of 0.740 shows that the demand for money, the supply of money, OPEC crude oil and the real GDP growth accounted for over 74 percent of the variation in the exchange rate in Nigeria between the years 1986 and 2019.

Results: It was discovered from the findings that, money supply into the circulation determines the foreign exchange rate. And it was also discovered that the money supply has a high dependency ratio on the exchange rate among other macro-economic indicators. Thus, the reduced model is a result of the insignificance of other variables while only variable two (supply of money) is significant.

Conclusions: The use of a flexible exchange rate had eliminated the over-valuation of the naira. The parallel market premium has also been narrowed from 600 percent in 1986 to about 11.0 percent in 2018. These were attributed to the weak and import-dependent production structure of the economy. The suggested solution was articulated towards increasing foreign exchange inflows, reducing demand, as well as reforming the foreign exchange market to evolve a more realistic exchange rate for the naira.

Keywords: Multiple Linear Regression, Macro-Economic Indicators, Exchange Rate, Multicollinearity, Serial Correlation and Heteroscedasticity.

one's needs.

The use of money as a medium of exchange has made it possible for economic agents to specialize in the provision of goods and services, thereby producing more than their needs and exchanging the excess for money, which can be saved or used to acquire other goods and services (Choudhury, 2005). Money in a modern economy plays the role of a medium of exchange by facilitating trade among economic agents which is certainly superior to trade by barter. Money also serves as a store of value, allowing people to save their excess production in the form of money for future use or lending at a price (Soederberg, 2014). The savings arising from excess

production can be invested in productive activity for further expansion in output. However, the economic activity units which save are not always identical to those units which invest. Modern economies have developed mechanisms, institution and instruments that help to facilitate the mobilization of savings from those who save and to the economic units which invest or consume more than their incomes.

The process that facilitates the transferring of the saving of some economic units to others either for consumption or investment at a price is generally referred to as financial intermediation. For financial intermediation to take place there must be operators, financial instruments and financial institutions operating together with the ultimate objective of bringing about the economic development of the country. As Anamo (2004) noted, there is a relationship between real and financial development, especially in terms of the role of financial intermediation, monetization and capital formation in determining the path and pace of economic development. The mechanism of financial intermediation, the institution in which the processes are carried out, the operators that work out the processes and the instruments with which the intermediation is affected are called the financial markets. In other words, financial markets are places or mechanisms for the exchange of financial instruments.

Financial markets are broadly categorized into *money* and *capital* markets. A money market is a segment of the financial market which deals in short-term securities, therefore the corporate body that requires such funds/securities creates an instrument with which to source such funds. The life span of such funds usually ranges from a few hours to about two years.

However, the major player in the money market is the banking sector which comprises of commercial banks, community banks, merchant or investment banks, central or national banks, etc. while other members are non-bank finance houses, discount houses, brokers and Bureau De Change (which can be a formal or parallel market) (Okurut and Bothole, 2009).

The capital market on the other hand is responsible for long-term investment, savings and fund provision which can be used as capital information for financing small, medium and large-scale industries as well as a measure of economic performance and development of a nation (Healy and Palepu, 2001).

More specifically, in this research work, our focus is basically on the parallel market as a medium of converting dollars (US\$) to 'the naira is because of the role it plays in the economic development and

its deterministic nature in the import and export roles of the economy.

The foreign exchange market in Nigeria has witnessed a tremendous transformation since independence (1960). Activities in the market before the deregulation of the foreign exchange market were relatively low due to administrative fiat. The country operated a fixed exchange rate regime with the British pound sterling serving as the anchor currency. Subsequently, with the Exchange Control Act of 1962, the CBN assumed responsibility in the market. The Act conferred on the CBN the authority to earn and disburse foreign exchange at the rate to be determined by the CBN after consultation with the Federal Ministry of Finance. The Act also vested on the Minister of Finance, the authority to grant approvals for foreign exchange transactions, while the CBN supervised and monitored the operations, including the issuance of guidelines on the sales and allocation of foreign exchange to banks, which are designated as Authorized dealers in the foreign exchange market. Other methods of control of the foreign exchange included: the issuance of exchange control regulations and documentation requirements, and issuance of import licenses. In 1973, the Nigerian currency was changed from pound to naira and was pegged to the US dollar. Both with the devaluation of the US dollar in the same year, the monetary authorities discontinued the peg to the single intervention currency. Consequently, the naira was pegged to a basket of currencies of some of Nigeria's major trading partners, namely – UK, USA, Germany, France, Japan, Switzerland and the Netherlands. As at the end of 1980, the Nigerian naira was exchanged at N1.0/\$1.8.

But with the deregulation of the Nigerian economy and subsequent liberalization of the foreign exchange market, the invisible hand in the second-tier foreign exchange market (SFEM) determined the exchange rate. The reliance on market forces and the weak macro-economic fundamentals led to a rapid depreciation of the naira against the major trading currencies.

MATERIALS AND METHOD

The statistical approach to the analysis of data involves the use of graphs, charts, mathematical models and computation. However, we shall review one major statistical tool that is used in analyzing the data obtained. This is regression analysis.

Regression Analysis

Regression can be defined as the amount of change in (the value of) one variable associated with a unit change in (the value of) another variable and, regression analysis is the study of the relationships among variables and its purpose is to predict or estimate the value of the variable from known or assumed values of other variables related to it (Zou et al., 2003). Also, it can be used for comparison purposes. It can be simple or multiple, linear, or non-linear (which is usually transformed into a linear form) before it can be analysed. However, it can be simply either:

- (i) Two variables of linear regression (simple linear regression)
- (ii) Multiple linear regression (Multi-variate linear regression)

The parameters of this model can be estimated by different methods and they are:

- (i) By inspection on a plotted graph
- (ii) Method of maximum likelihood
- (iii) Method of semi-average
- (iv) Ordinary least squares estimates (OLS) method

However, the OLS method is considered the standard method of obtaining a regression line for both bivariate and multivariate regression models. This article will establish the theory behind the simple linear and hence, generalize it for multiple linear regression by method of least square.

The objective of this empirical work is to show the extent to which the exchange rate is influenced by monetary policy instruments to determine the effectiveness of its control within the economy. The major variables instruments regressed against the exchange rate are demand for money, the supply of money, inflation rate, price of crude oil and real GDP growth rate. The data used was between 1986 and 2019.

The model specified is given as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + e_t$$

Y = foreign exchange rate

X_1 = inflation rate;

X_2 = supply of money,

X_3 = demand for money,

X_4 = price of OPEC crude and

X_5 = real GDP growth.

β_0 = Constant

$\beta_1 - \beta_5$ = Partial slope coefficients

e_t = error term

RESULTS AND DISCUSSION

The overall implication is that the parallel market shows a significant relationship that is it can be regressed by all other variables involved in Nigeria.

Model Specification

From the information obtained from the analysis, the five major determinants can be modeled against the dependent variable as follow:

$$Y = 6.516 + 0.495X_1 + 0.01543X_2 - 0.0009666X_3 + 0.632X_4 - 6.207 X_5$$

$$s.e = (27.836)(0.422)(0.003)(0.001)(0.701)(3.794)$$

$$t = (0.234)(1.174)(5.009)(-1.324)(0.901)(-1.636)$$

$$\hat{Y} = 0.210X_1 + 0.831X_2 - 0.220X_3 + 0.147X_4 - 0.248X_5$$

(corrected data for the mean)

$$R^2 = 0.739 \quad n = 18$$

$$\bar{R}^2 = 0.630$$

$$k=5$$

Interpretation

From the above model, the coefficient (0.495) of inflation rate X_1 , shows that holding money supplied (X_2), money demanded (X_3), price of crude oil (X_4) and real GDP growth (X_5) constant and increasing inflation rate (XI) by one percent, then the exchange rate will increase by US\$6.52.

The coefficient 0.01543 of money supplied (X_2) shows that holding inflation rate (XI), money demanded (X_3), price of crude oil (X_4) and real GDP growth (X_5) constant and increasing the money supply by N1, then the exchange rate will increase by US\$015.

The coefficient (-0.0009666) of money demanded (X_3) shows that holding inflation rate (XI), money supplied (X_2), price of crude oil (X_4) and real GDP growth (X_5) constant and

increasing money demanded, then the exchange rate will decrease by US\$0.009666.

Also, the coefficient (0.632) of the price of crude oil (X_4) shows that holding inflation rate (X_1), money supply (X_2) money demand (X_3) and real GDP growth constant and increasing price of crude oil by US\$1, then the exchange rate will increase by US\$0.63.

While the coefficient (-6.207) of real GDP growth (X_5) shows that holding inflation rate (X_1), money supply (X_2), money demanded (X_3) and price of crude oil (X_4) constant an increasing real GDP growth by one percent then the exchange rate will decrease by US\$6.21

The R^2 obtained above suggests that about 73.9% of the total variation in the exchange rate (Y) is explained by the five variables.

Testing for The Parameters

i. $H_0: \beta_0 = 0$

$H_1: \beta_0 \neq 0$

$p - value = 0.819$

Test statistic, $t = \frac{6.516}{27.836} = 0.234$

Conclusion: it is statistically insignificant

ii. $H_0: \beta_1 = 0$

$H_1: \beta_1 \neq 0$

$p - value = 0.263$

Test statistic, $t = \frac{0.495}{0.422} = 1.174$

Conclusion: it is statistically insignificant

iii. $H_0: \beta_2 = 0$

$H_1: \beta_2 \neq 0$

$p - value = 0.000$

Test statistic, $t = \frac{0.01543}{0.003} = 5.009$

Conclusion: it is statistically significant

iv. $H_0: \beta_3 = 0$

$H_1: \beta_3 \neq 0$

$p - value = 0.210$

Test statistic, $t = \frac{-0.0009666}{0.001} = -1.324$

Conclusion: it is statistically insignificant

v. $H_0: \beta_4 = 0$

$H_1: \beta_4 \neq 0$

$p - value = 0.386$

Test statistic, $t = \frac{0.632}{0.701} = 0.901$

Conclusion: it is statistically insignificant

vi. $H_0: \beta_5 = 0$

$H_1: \beta_5 \neq 0$

$p - value = 0.128$

Test statistic, $t = \frac{-6.207}{3.794} = -1.636$

Conclusion: it is statistically insignificant.

Overall Testing

$H_0: \beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$

$H_1: \beta_0 \neq \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$

$p - value = 0.003$

Test statistic, $F = 6.783$

Conclusion: it shows that all the Beta coefficients are statistically significant.

Correlations

i. $r_{yx_1}^2 = -0.206$

This shows that there is no relationship between the exchange rate and the Inflation rate.

ii. $r_{yx_2}^2 = 0.787$

This shows that about 78.7% of the variation in the exchange rate is explained by the money supply.

iii. $r_{yx_3}^2 = -0.152$

This shows that there is no relationship between the exchange rate and money demand.

iv. $r_{yx_4}^2 = 0.405$

This shows that about 40.5% of the variation in the exchange rate is explained by the price of crude oil.

v. $r_{yx_5}^2 = -0.143$

This shows that there is no relationship between the exchange rate and real GDP growth.

Multicollinearity Detection

i. $VIF_1 = 1.468$

ii. $VIF_2 = 1.264$

iii. $VIF_3 = 1.264$

iv. $VIF_4 = 1.215$

v. $VIF_5 = 1.057$

They are all of low collinearity.

To study how the exchange rate is being determined by the cash inflow in Nigeria.

Interpretation: From Table 1, if demand for money, the supply of money, inflation rate, price of crude oil and real GDP growth rate are fixed at zero value, the average value of the exchange rate estimated at 6.732. The partial regression coefficient of -0.000966 means that holding all other variables constant, a unit increase in demand for money brings about 0 percents decrease in the exchange rate; the partial regression coefficient of 0.01539 means that, holding all other variables constant, a unit increase in the supply of money brings about 1.5percents increase in the exchange rate; the partial regression coefficient of 0.495 means that, holding all other variables constant, a unit increase in inflation rate brings about 49 percents increase in the exchange rate, the partial regression coefficient of 0.633 means that, holding all other variables constant, a unit increase in the price of crude oil brings about 49percents increase in the exchange rate, the partial regression coefficient of -6.248 means that, holding all other variables constant, a unit increase in real GDP growth rate brings about 624percents decrease in the exchange rate.

The ratios of the estimated coefficients tested at a 5% level of significance to their standard error (t-test ratios) are 0.242, -1.326, 5.011, 1.176, 0.904, and -1.651 respectively. Using the two-tail test at the 5% level of significance, the p-value for tare 0.831, 0.210, 0.000, 0.263, 0.384, 0.125 respectively which indicate that each of the computed t-values is insignificantly different from zero except variable two which showed significant, thus this leads to a reduced model of a unit variable. The implication is that variable two only explain the variation in y.

In Table 2, the R^2 value of 0.740 shows that the explanatory variable accounted for over 74 percent of the variation in exchange rate in Nigeria between the years 1986 and 2003. The Durbin-Watson value of 1.048 indicates that there is serial correlation in the error term.

From Table 3, the F-distribution with 5 and 12 d.f. is 4.68. The computed F value is significant since the probability value is less than 0.05 and F-calculated is greater than F-tabulated showing that the null hypothesis which state that exchange rate is not linearly related with other variables is rejected. This indicates that there exchange rate is linearly related with other variables.

From Table 4, the values of variance inflation factor lower than 10 and values of tolerance larger than 0.1 are usually acceptable as no multicollinearity, likewise the conditioning index is less than 25 are equally acceptable, to this end it is vividly clear that multicollinearity do not present on the data. The implication is that the explanatory variables are not strongly related.

Objective 2

To study the relationship between the demand for money and supply of money in the economy with a special consideration on foreign exchange rate of naira.

Table 5 shows that there exists no significant relationship between the demand for money and supply of money. The Pearson correlation coefficient shows negative; this is an indication of poor response of people towards the exchange rate transaction.

Objective 3

To measure the dependency ratio of foreign exchange rate to other independent variables.

Table 1: Regression Coefficients

	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	6.732	27.796		.242	.813
Demand for money	-9.662E-04	.001	-.220	-1.326	.210
Money supply	1.539E-02	.003	.829	5.011	.000
Inflation rate	.495	.421	.210	1.176	.263
Price of OPEC	.633	.700	.147	.904	.384
Real GDP growth	-6.248	3.784	-.250	-1.651	.125

TABLE 2: Coefficient of Multiple Determination

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.860	.740	.631	30.50888	1.048

TABLE 3: ANOVA Table

Source of Variation	Sum of Squares	d.f	Mean Square	F	Sig.
Regression	31714.286	5	6342.857	6.814	.003
Residual	11169.503	12	930.792		
Total	42883.789	17			

TABLE 4: Collinearity Diagnostics

Dimension	Eigenvalue	Condition index	Tolerance	VIF
1	4.559	1.000		
2.	.689	2.573	.791	1.264
3	.333	3.700	.793	1.260
4	.212	4.638	.681	1.468
5	.157	5.392	.824	1.214
6	5.105E-02	9.450	.949	1.054

Table 5: Correlation Analysis

Money supply	Demand for Money
Pearson Correlation	-.045
Sig. (2-tailed)	.860

Table 6: Correlations coefficients

		Parallel market	Demand for money	Money supply	Inflation rate	Price of OPEC crude	Real GDP growth
Parallel market	Pearson correlation	1	-.152	.787	-.206	.405	-.152
	Sig.(2-tailed)	.	.547	.000	.412	.096	.546
	Covariance	2522.576	-87186.510	106883.998	-220.180	236.763	-15.354

** Correlation is significant at the 0.01 level (2-tailed)

Table 7: Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin- Watson
.787	.619	.595	31.97166	.382

- a. Predictors: (Constant), money supply
b. Dependent Variable: exchange rate

Table 8: ANOVA for regression

Source of Variation	Sum of Squares	d.f	Mean Square	F	Sig.
Regression	26528.793	1	26528.793	25.953	.000
Residual	16354.996	16	1022.187		
Total	42883.789	17			

Table 9: Regression coefficients

	Unstandardized coefficients	Std. Error	Standardized coefficients	t	Sig.
(constant)	B 2.595	13.835	Beta	.188	.854
Money supply	1.460E-02	.003	.787	5.094	.000

- a. Dependent Variable: Parallel market

TABLE 10: Residuals Statistics

	Minimum	Maximum	Mean	Std. Deviation
Deleted Residual	-68.8333	51.5103	-3.2636	38.02223
Stud. Deleted Residual	-2.434	1.655	-.045	1.063
Cook's Distance	.000	.744	.098	.183
Centered Leverage Value	.074	.878	.278	.223

From the above result in Table 6, it was only money supply that has high dependency ratio with exchange rate, all other explanatory variables show poor relationships.

Reduced Model

The reduced model is:

$$Y = 2.595 + 0.0146X_2$$

To build regression model that provides error bound that will be smaller enough to meet our needs, we had to reduce the variables in the model (Table 7 -8).

Interpretation: As seen in Table 9, if supply of money is fixed at zero value, the average value of exchange rate estimated at about 2.595. The partial regression coefficient of 0.04146 means that, a unit increase in supply of money brings about 1.46

percents increase in exchange rate.

The ratios of the estimated coefficients tested at 5% level of significance to their standard error (t-test ratios) are 0.003. Using the two tail test at the 5% level of significance, the p-value for *t* indicates that the computed t-values 5.095 is significantly different from zero. The implication is that money supply explains the variation in exchange rate.

Heteroscedasticity

White test: $NR^2 = 13.2$

Durbin Watson: 1.048 rejection rate $dI=O. 710$
 $du=2.060$

1st order autocorrelation 0.169

Reject autocorrelation if $d <$ tabulated value at 5%

Positive autocorrelation: reject $0 < d < dI$

Positive autocorrelation: no decision $dI < d < du$

No negative autocorrelation: reject $4 - dI < d < 4$

No negative autocorrelation: no decision $4 - du < d < 4 - dI$

No autocorrelation: no decision $du < d < 4 - du$

The null homoscedasticity is accepted since the white value is greater than 2 as suggested by Koenkar (1981). Using the chi square test table with 18 degree of freedom the t-tabulated is 28.87. The result shows that calculated (white value) is less t-tabulated, this confirm the Koenkar view that there is no heteroscedasticity.

Outliers

Studentized deleted residual and cooks distances are used to determine the outlier in this study. Anderson-Sprecher (1994) suggested critical level of: ± 1.96 or ± 2 (5% risk) and ± 3 (0.27% risk typical in the process control chart).

Table 10 shows the residual statistics and this shows that there exists no outlier in the data set since none of the item has cooks distance up to 1.96; this shows the appropriateness of the data set.

CONCLUSION

This research work examined foreign exchange policy adopted since 1986, prior to this period, the economy faced serious crises and was characterized by an over-valued currency, low oil receipt, depleted external reserves and high import bills, emergence of trade arrears and rapid accumulation of debts. The various measures adopted were aimed at restructuring the economy and diversifying its revenue base as well as achieving a realistic exchange rate for the naira.

An appraisal of these exchange rate policies indicated that their impacts have been mixed. The use of a flexible exchange rate had eliminated the over-valuation of the naira. The parallel market premium has also been narrowed from 600 percent in 1986 to about 11.0 percent in 2018. It was discovered from the findings that, money supply into the circulation determines the foreign exchange rate. And that the money supply has the highest dependency ratio on the exchange rate among other macro-economic indicators. Thus, the reduced model is as a result of insignificance of other variables while only variable two (supply of money) is significant.

These were attributed to the weak and import dependent production structure of the economy. Suggested solution were articulated towards increasing foreign exchange inflows, reducing demand, as well as reforming foreign exchange market in order to evolve a more realistic exchange rate for the naira.

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