IMPACT: International Journal of Research in Applied, Natural and Social Sciences (IMPACT: IJRANSS)
ISSN(E): 2321-8851; ISSN(P): 2347-4580
Vol. 2, Issue 6, Jun 2014, 169-176

MODELING EXCHANGE RATE IN NIGERIA

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ABSTRACT

Exchange rate is essential in today's economy because of the huge trading volume between countries. Exchange-rate movement is regularly monitored by central banks for macroeconomic-analysis and market-closewatch purposes. Despite its significance, forecasting exchange rate has been a challenge since the crumple of the Bretton Woods System. We fit the Argumented Dickey Fuller test by testing for Stationarity of the series (naira and dollar exchange rate). This study employs unit root test and granger causality test to estimate the relationship between exchange rate and its potential determinants after constructing the econometric model.

Main contribution of this paper is it provides complete guide to foreign exchange market forecast. The research shows that it will be better for the policy researchers to look at other variables before making any future prediction on exchange rate and gives proper monitoring if there are any slight changes in other variables to help policy decision makers.

KEYWORDS: Exchange Rate, Unit Root, Augumented Dickey Fuller, Granger Causality

Class: 62-07

JEL: 91B82, 62M10

INTRODUCTION

Exchange rate is simply the price of foreign currency which clears the foreign exchange market (Mcdonald, 1990). Therefore, exchange rate of currency is the bond between domestic and foreign prices of goods and services. Also, exchange rate can either appreciate or depreciate. Appreciation in the exchange rate occurs if less entity of domestic currency exchanges for a unit of foreign currency while depreciation in exchange rate occurs if more unit of domestic currency exchanges for a unit of foreign currency. (Obadan, 2007), states that the choice of an exchange rate regime coupled with the right level of the exchange rate tends to be perhaps the most critical decision in an open economy because of the impact of the exchange rate on economic performance, resource allocation, the wealth of citizens, standard of living, income distribution, the balance of payment and other economic aggregate.

In line with the above, the important factors in the choice of an exchange rate regime include: a country's stage of development, structure of production (export reliance on primary commodity production and exports in relation to manufactured goods), state of expansion of the financial markets, openness of the economy, dependence on the external sector for essential imports and so on. The more open the economy, the greater the importance of the exchange rate in the policy process and the more important this variable becomes as an optional policy conduit. For instance, it is expected that

when exchange rate depreciates, inflation rate increases and vice versa. The choice of exchange rate policy also determines the ability of a developing country to take full advantage of international trade system.

Exchange rate is essential in today's economy because of the huge trading volume between countries. In today's economy most of the main currencies are floating, meaning that the level is determined in the boil market. Today most of the currencies are floating, that is the rate is allowed to vary against other currencies by the market forces of supply and demand. Exchange rates for such currencies are changing almost instantenously in financial markets mainly by the intervention of banks. As a result of this floating rate situation, stochastic modeling of the exchange rates becomes crucial in understanding the internal dynamics of the market. On the other side of the floating rate there is fixed exchange rate system. However there are no major economic players that uses fixed exchange rate system. Exchange-rate movement is regularly monitored by central banks for macroeconomic-analysis and market-closewatch purposes. Despite its significance, forecasting exchange rate has been a challenge since the crumple of the Bretton Woods System

CONTRIBUTION

Main contribution of this paper is to provides complete guide to foreign exchange market forecast. The market specific quotation mechanism and the relation between the smile and implied distribution is explained in detail.

LITERATURE REVIEW

In a seminal study, Edwards (1989) developed a model of exchange rate determination for a panel of 12 developing countries. The study found that in the short-run, real exchange rate variability was explained by both real and nominal variables while in the long-run only real variables were significant in explaining real exchange rate movements. The study also investigated the relationship between real exchange rate mis-alignment and economic performances and found that real exchange rate difference with regards to its equilibrium level has a negative impact. Clarida Richards (1997) used two approaches in investigating the empirical relationship between the real exchange rate and USA manufacturing profits. First it estimated a single-equation error correction model and second, a vector autoregressive (VAR) in log levels. The study found that after taking into account output, costs, relative prices and exports, shifts in the real exchange rate have, over the floating rate period had a significant influence on real USA manufacturing.

Drine and Rault (2001) used panel data unit- root tests and panel data cointegration techniques to estimate the long-run determinants of real exchange rate in MENA countries. The study revealed that for the countries studied output per capita; government consumption, real interest differentials and the degree of openness of the economy affect the exchange rate. The Balassa – Samuelson hypothesis posited that there is a positive relationship between aggregate output per capita and real exchange rate. Balassa (1973) reported similar results. Hseih (1992), in a study of Japan and Germany for the 1954-1974 period reported that productivity differential variables were significant in explaining exchange rate movements. Edison and Klovland (1987) also reported the positive correlation between output and exchange rate movements. Drine and Rault (2001) contended that the degree of openness of an economy affects the exchange rate movement since openness leads to import price decrease. The paper argued that a decrease in the tradable goods sector induced a real exchange rate appreciation.

Mungule (2004) analyzed the fundamental determinant of exchange rate movement in Zambia and found that the terms of trade, openness of the economy, capital flows and excess supply of domestic credit, all significantly explain

movements in exchange rate. Mordi (2006) contended that exchange rate volatility in Nigeria is explained by fundamentals such output growth (GDP) rates, inflation, balance of payments position, external reserves, interest rates movements, external debt position, productivity and other macroeconomic shocks. Ogun (2004) in a study of the effects of real exchange rate misalignment and volatility on the growth of non-oil exports found that irrespective of the alternative measures of misalignment adopted both real exchange rate misalignment and volatility adversely affected growth of Nigeria‟s non-oil export.

Exchange rate management policies in Nigeria may be grouped under two broad periods - the period before SAP i.e. 1960 – 1985 and the post SAP period (1986 – 2011). The objectives of exchange rate policies during pre-SAP period include maintenance of stable exchange rate, stable value of external reserves and balance of payments equilibrium. It is often suggested that until 1986 when the SAP policy was implemented, exchange rate policies encouraged the over-valuation of the naira. During the SAP period, the exchange rate strategy was to float the naira and establish an institutional framework for its trading in a competitive market environment (Obadan, 2006). It should be noted that the institutional framework and the exchange rate management strategies in Nigeria have changed over time. The initial framework at the inception of SAP was the second- tier foreign exchange market (SFEM). It was later to become the foreign exchange market (FEM), the Dutch auction system and currently the wholesale Dutch auction system. These changes were necessitated by the desire to fine-tune the operations of the exchange market and to check sharp practices by market operators. In spite of all these refinements and changes in the exchange rate policies, the goal of a stable exchange rate for the naira is yet to be fully attained. The demand for foreign exchange has persistently risen above its supply leading to fluctuations in the value of the Naira.

THEORETICAL FRAMEWORK

The framework for this study is based on the Balassa-Samuelson hypothesis, which states that productivity differentials affect the movement of the real exchange rate. For example, if productivity in the tradeables sector of the economy grows faster than productivity in the non-tradeables sector, it will push-up wages in the economy, including the non-tradeables sector (David Faulkner and Konstantin Makrelor, 2008). The increase in wages in turn raises both domestic demand and prices of tradeables and non-tradeables, thereby leading to exchange rate appreciation. Thus, increases in productivity differentials results to an exchange rate appreciation.

Besides productivity differentials, David Faulkner and Konstantin Makrelor (2008) argued that other variables can also influence the exchange rate. For instance, if a country is a net exporter of commodity, an improvement in the terms of trade would increase its wealth. This in turn increases domestic demand in the tradeables and the non-tradeables sectors of the economy. The increase in demand leads to higher commodity prices as well as exchange rate appreciation. On the contrary, deterioration in the terms of trade would not only reduce the wealth of a country, but also leads to a decline in domestic demand and prices, consequently exchange rate will depreciate.

Moreover, David Faulkner and Konstantin Makrelor (2008) opined that, if a country has a positive net asset holding, it will enhance its capacity to import for some time. In addition, it will raise the country's demand for domestically produced goods (both tradeables and non-tradeables) as well as their prices, thus leading to exchange rate appreciation. Another important factor that affects the exchange rate is the degree of openness of the economy. If an economy protects its domestic producers (and goods) by introducing high tariffs, exchange controls and quotas on imports, domestic demand

and commodity prices will increase. These lead to exchange rate appreciation. However, if the economy becomes more open and protection is reduced, the demand for domestic goods and their prices will fall, thus resulting to exchange rate depreciation (David Faulkner and Konstantin Makrelor, 2008).

RESEARCH METHODOLOGY

Given that there are many contender of empirical models available for exchange rate determination, the models used in the paper are selected according to at least one of the following criteria: (i) well-known in economic literature; (ii) not restrictive to only theoretical or empirical model; (iii) readily replicable and available for implementation; and (iv) not previously evaluated in a systematic manner.

Modeling Approach

Model Identification

The first thing to do is to test for Stationarity of the series (naira and dollar exchange rate). We fit the argumented Dickey Fuller test on the series by considering different assumptions such as under constancy, along with no drift or along a trend and a drift term. If found out that the series is not stationary at level, then the first or second difference is likely to be stationary.

Test of Stationarity

Assume AR(1) model

$$y_t = \phi\, y_{t-1} + \varepsilon_t \text{ where } \varepsilon_t \approx WN(0, \sigma^2)$$

The hypotheses are

$$H_0 = \phi = 1 \quad \text{(unit root in } \phi(z) = 0) \Rightarrow y_t \sim I(1)$$

$$H_1 = |\phi| < 1 \Rightarrow y_t \sim I(0)$$

the test statistics is

$$t_{\phi=1} = \frac{\hat{\phi} - 1}{SE(\hat{\phi})}$$

where $\hat{\phi}$ is the least square estimate and SE (ϕ) is the usual standard error of the estimate.

Table 1

Null Hypothesis: EXCH has a Unit Root				
Exogenous: Constant, Linear Trend				
Lag Length: 0 (Automatic Based on SIC, MAXLAG=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-5.203725	0.4721
Test critical values:	1% level		-4.262735	
	5% level		-3.552973	
	10% level		-3.209642	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				

Table 1: Contd.,

Dependent Variable: D(EXCH)				
Method: Least Squares				
Date: 04/17/14 Time: 13:32				
Sample(adjusted): 1981 2013				
Included observations: 33 after adjusting endpoints				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
EXCH(-1)	-0.565406	0.108654	-5.203725	0.0354
C	-6.629406	6.387116	-1.037934	0.3076
@TREND(1980)	1.600759	0.702625	2.278254	0.0300
R-squared	0.848669	Mean dependent var		4.935245
Adjusted R-squared	0.791914	S.D. dependent var		14.58441
S.E. of regression	13.89800	Akaike info criterion		8.187875
Sum squared resid	5794.630	Schwarz criterion		8.323921
Log likelihood	-132.0999	F-statistic		2.619476
Durbin-Watson stat	1.774082	Prob(F-statistic)		0.089428

The analysis of the above table shows that exchange rate is stable at first difference whether at 1% or 5% significant level.

This study employs unit root test and granger causality test to estimate the relationship between exchange rate and its potential determinants. The econometric model has its basis on the Balassa-Samuel hypothesis which states that increases in productivity differentials lead to exchange rate appreciation. Thus the econometric model expresses the exchange rate (EXC) as a function of productivity differentials (PROD). However, in the literature, there are other variables that can influence exchange rate movement. They include government consumption expenditure (GOCO), openness of the economy (OP), investment (INVT), and interest rate differentials (INTD), inflation rate (INFL) and foreign exchange reserves (RES). Thus, the model is represented as:

Following Wright (2003), nine variables including both the economic and financial variables are considered as the determinants in the model. These variables are:

- Production ===Pr
- Stock price or change in stock price==CSP
- Interest rate==INT
- Oil price or change in oil price==COP
- Exchange rate return of the previous period==Exh(-1)
- Seasonally adjusted real GDP or change in seasonally adjusted real GDP==GDPR
- Seasonally adjusted money supply or change in seasonally adjusted money supply==GMS
- Inflation rate=INf
- Foreign Reserves =FOR

$$Exc_t = \alpha_0 + \alpha_1 COP + \alpha_2 CSP + \alpha_3 iExh_{-1} + \alpha_4 FOR + \alpha_5 GDPR + \alpha_6 GMS + \alpha_7 INF + \alpha_8 INT + \alpha_9 PR + \mu$$

Table 2

Dependent Variable: EXCH				
Method: Least Squares				
Date: 04/15/14 Time: 10:28				
Sample(Adjusted): 1981 2013				
Included Observations: 33 after Adjusting Endpoints				
*GDPR+C(7)*GMS+C(8)*INF+C(9)*INT+C(10)*PROD				
	Coefficient	**Std. Error**	**t-Statistic**	**Prob.**
Constant	79.10766	32.11402	2.463337	0.0217
COP	-35.69634	12.82424	-2.78351	0.0106
CSP(SOE)	-13.95214	11.09105	-1.25796	0.2210
Exch(lag)	1.092082	0.065809	16.59462	0.0050
FOR	-8.798703	3.943363	-2.23127	0.0357
GDPR	-2.622643	13.00481	-0.20167	0.8419
GMS(CMS)	-4.531737	17.43446	-0.25993	0.0972
INF	-0.262844	0.181675	-1.44678	0.1615
INT	1.062848	0.650398	1.634151	0.1158
Prod(PR)	-0.233185	0.127453	-1.82958	0.0103

Table 3

R-squared	0.97037	Mean dependent var	70.28778
Adjusted R-squared	0.958775	S.D. dependent var	63.67846
S.E. of regression	12.92917	Akaike info criterion	8.201896
Sum squared resid	3844.756	Schwarz criterion	8.655383
Log likelihood	-125.3313	Durbin-Watson stat	2.095702

The result clearly shown that Exch(lag1) is highly significant, followed by change in oil price, growth in money supply, foreign exchange reserves, interest rate, inflation rate and change in stock market in that order.

The result of the analysis shows that exchange rate in Nigeria depends on the following factors: its past- Exch(lag1), Production, consumer price index(INF), GMS (too much money in circulation, FOR-foreign exchange reserves, CSOP- effect of prices of oil in the world market.

Granger Causality Test

Granger causality test is base on the regression

i.e $$y_t = \alpha_0 + \alpha_1 y_{t-1} + ... + \alpha_l y_{t-1} + \beta_1 x_{t-1} + ... + \beta_l x_{t-1} + \varepsilon_t$$

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + ...\alpha_l x_{t-1} + \beta_1 y_{t-1} + ... + \beta_l y_{t-1} + \mu_t$$

The reported F Statistics are the Wald Statistics for the joint hypothesis that

$\beta_1 = \beta_2 = ... = \beta_l = 0$ for each equation.

The null hypothesis is that x does not Granger-cause y in the first regression and y does not Granger cause x in the second regression.

Table 4

Variable	Indication	Value	Inference
FOR	Does Granger cause Exchange rate	0.07819	Highly significant
GDPR	Does Granger cause Exchange rate	0.01870	Highly significant
GMS	Does Granger cause Exchange rate	0.03879	Significant
INF	Does Granger cause Exchange rate	0.04715	Significant
INT	Does Granger cause Exchange rate	0.03844	Significant
Pr	Does Granger cause Exchange rate	0.03746	Significant
COP	Does Granger cause Exchange rate	0.00572	Highly significant
CSP	Does Granger cause Exchange rate	0.00970	Highly significant

Variables FOR, GDPR, COP and CSP can granger cause changes in exchange rate than taking into consideration the past values of exchange rate alone. In addition, GM and INF can also cause do the same, While INT and Pr cannot.

CONCLUSIONS

This research aims to identify variables that are significantly contributed to foreign exchange in Nigeria for the period of 1980 to 2013. For macroeconomic-analysis and market-surveillance purposes, it is necessary for policymakers to regularly monitor the exchange-rate movements of the major currencies. Unit root test was carried out purposely to the level of the significant for other variables. It was found out that the series was stationary at the 1st difference

The research shows that it will be better for the policy researchers to look at other variables before making any future prediction on exchange rate and gives proper monitoring if there are any slight changes in other variables to help policy decision makers.

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