
Testing for Structural Breaks in the Nigerian Exchange Rate using Univariate time Series Analysis

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Abstract

The research was conducted on time series data with the objective of trying to find out if there are structural breaks in the Ordinary Exchange Rate (OER) in Nigeria. But more specifically, the researchers applied various methods in testing the structural breaks such as the F Statistic in comparing statistical models fitted to the data set to find out if the model fits the population. The robustness of this test was further validated with Quant Andrew and Bai Perron test. And unit root tests were employed to test the stationarity of values using Bartlett kernel and Kwiatkowski-Phillips-Schmidt-Shin. With evidence of stationarity an equation was introduced to capture seasonality given that the data is times series. Further correlogram tests was used to test if the error term is stationary and the results indicate that the level of Autocorrelation and the Partial Autocorrelation were very insignificance. A major finding was that in using the ARIMA model it was evident that AR is stationary and MA is invertible. However, the MA has roots close to 1, implying that there may be evidence of over differencing of the series. In conclusion, the identified break dates of 1992Q2, 1995Q3 and 2005Q3 coincides with a period of persistent excess liquidity exacerbated by the monetization of excess crude receipts and the distribution of enhanced statutory allocation to the three tiers of government. The effect of the identified structural break was accommodated in our modeling approach to ensure that the estimated parameters are unbiased. The preliminary analysis shows that the exchange rate was more robust than other rates in explaining developments in the foreign exchange market. Policy recommendations include that policy makers give feasible proposals on diversification away from oil. Other measures include a review on regulatory, fiscal and monetary policy to reduce the impact of inflation and to increase global competitiveness of exports so as to attain the adequate level of exchange rate. Furthermore, the uncertainties inherent in the timing of the breaks and the different models used in capturing them in theory makes a case for more research on structural breaks in modeling and forecasting the volatility in exchange rate.

Keywords: Structural breaks, Nigerian exchange rate, multivariate, time series

1.0 Introduction

In the field of quantitative economics structural breaks are especially useful in detecting faulty models in forecasting due to errors resulting from an unexpected movement away from the time series. In testing for structural breaks in linear models, the use of '*Chow test*' is common however '*Hartley's test*' may be employed if the single break in the mean is uncertain. Where there are multiple cases of breaks in the mean and variance and whether they are certain or uncertain the chow test cannot be used in isolation of further validity tests. If not the parameters would be unstable and inappropriate for the research. In this case it is highly recommended that one moves on to more robust tests such as '*Quant Andrews test*', '*Gregory-Hansen test*' and '*Hatemi-J test*'. Gregory-Hansen test is a popular tool suitable for conditions where the findings exhibit one uncertain structural break. The Hatemi-J test is preferred where two uncertain breaks are found. In the last decade several computer programs have improved upon structural break tests on multivariate analysis prominent among them include *R*, *GAUSS*, *Bai and Perron*. These structural changes occur as a result of economic development, such as global changes in resource availability, shifts in capital and labour. The dynamic change caused by globalization, improved technology and regional economic cooperation are reasons why structural breaks exist. Income elasticity facilitates demand shifts that are driven by patterns and changes in sectoral employment. Every country's economy goes through demand shifts that are captured at each stage of their development process and Nigeria is no exception. Changes in expenditure and production caused by obsolescence of labour, level of technology and International Trade can alter the trend in structural breaks.

For instance the division of Korea into North Korea and South Korea after the Second World War created a different economic structure than was the case when Korea was under Japanese rule. Another example of structural breaks made possible by a nation's geopolitics is the Unification of Germany in 1989 from the territories of the former West Germany and East Germany. Earlier on in the 1960s the coal crisis witnessed in Germany changed the economic structures to information technology, services and logistics. South Korea structural breaks in the 1960s and 1970s was mainly as a result of policies that transformed its economy from an Agricultural driven economy to a structure based on information technology, micro systems technology and services. Samsung a South Korean based company has been said to manufacture 50% of the mobile phones being used in the world so this can give one an idea of the structural breaks to expect at each stage of the country's transformation process. In a developed nation like the United States and Germany for instance studies reveal that the impact of economic structural changes on employment is higher in the tertiary sector of the economy unlike that of emerging economies where the effect is mainly on the primary sector.

There are periods when the probability distribution associated with time series or a stochastic process evolves. This evolution over time is identified by what scholars call '*change point detection*' in statistical analysis. In instances like these, occurring changes are detected and the timing of their occurrence as well. According to statisticians, changes in the mean, variance, spectral density and correlation are detected through '*step detection*' and '*edge detection*' procedures. Step detection also called step smoothing is the procedure involved in detecting abrupt changes in the mean level of time series. The time series here may be obscured by noise such as those common in studying volatility in hourly or daily stock returns in the stock market. In observing linear and non-linear signal processing methods, many scholars like Basseville, M

and Nikiforov I.V (1993) who studied structural breaks agree that steps and the attendant noise (though occurs in isolation of the steps) have infinite bandwidth theoretically speaking and so are overlapping when measured using smoothing techniques. The objective of step detection is for the researcher to establish a trend in instantaneous jumps in the mean. The step detection reveals a constant signal caused by the underlying noise.

1.1 Research objectives

The research is intended to determine if there are structural breaks in the Ordinary Exchange Rate (OER) in Nigeria generally. But more specifically, the researchers want to apply various methods in testing the structural breaks such as using F Statistics suitable for null hypothesis since it is useful in comparing statistical models fitted to a data set to find out which model fits the population. The robustness of this test is further validated with Quant Andrew. And unit root tests will be employed to test the stationarity of values. If we established stationarity we will form an equation to capture seasonality given that the data is times series. We will use correlogram tests to find out if the error term is stationary and the level of significance of the Autocorrelation and the Partial Autocorrelation results.

2.0 Literature review

The Chow test remains the most conventional method to determine structural breaks in longitudinal data. This method was proposed by Gregory Chow in 1960, an econometrician who prescribed this method that is especially useful in determining if the coefficients in two linear regressions on different data sets are equal. Subsequent scholars have employed this method using time series data to test for the presence of a structural break at an a priori period such as a major event like a civil war or an economic depression. The chow tests determine the level of impact the independent variables have on the various segments of the data set. Sani, Olorunsola, Stephen, Ibrahim and Abiodun (2014) attempted at avoiding the spurious regression problem. They did this by testing the order of integration of the variables being investigated using the Augmented Dickey Fuller (ADF) and Phillip-Perron's (PP) unit root tests. In a second step, a test for cointegration with structural breaks amongst the variables was conducted based on Gregory and Hansen (1996). If there is evidence of cointegration with structural breaks, an appropriate error correction model is estimated. Finally, the stability of the model parameters is investigated using the Cumulative Sum of Squares (CUSUMQ) of the recursive residuals. After utilizing unit root test, cointegration tests, residual tests and error correction estimation tests Sani et al concluded that the real money supply is cointegrated with real GDP, real monetary policy rate, exchange rate premium and exchange rate movements, albeit with a break in 2007:Q1 for the period under study.

Omotor D.G (2010) citing Douglason G. Omotor and Patience E. Omotor Arinze, Darrat and Meyer (1990) in his submissions maintained that foreign interest rates are inversely related to the demand for money. Teriba (1974) using double digit log specification and static Ordinary Least Square (OLS) technique with annual data from 1958-1972 discovered a high significant income-elasticity of demand deposits. Nwaobi (2002) employed vector autoregression approach in examining the stability of money demand for Nigeria and the findings indicated significant stability in money demand for the period under consideration. Consistent with the monetarists ideology on importance of liquidity in variations in income, interest rates and exchange rate, Akinlo (2006) found evidence that there is a strong relationship between broad money (M2)

demand stability and its attendant cointegration with income, interest rate and exchange rate. Akinlo (2006) achieved this with an autoregressive distributed lag (ARDL) technique combined with CUSUMQ and CUSUM tests.

Nachegea (2001) investigated broad money pattern in Cameroon over a period of thirty years (1963-1993) using error correction modeling and cointegrated analysis, the findings were excess aggregate demand relationship amidst a stable money demand function. Nachegea (2001) findings further established support for both the international Fisher parity and purchasing power parity (PPP) between France and Cameroon. Kallon (1992) studies the Ghanaian economy for structural breaks, Nell (1999) investigated the South African economy for structural breaks resulting from pro-market based policies in the early 1980s. Chukwu, Agu and Onah (2010) applied the Gregory-Hansen (1996) framework to capture endogenous structural breaks in Nigeria for the period 1986:1 to 2006:4. They did these using estimates of slope coefficients and structural break periods. Sani et al tests for structural breaks suggested that real money cointegrates with GDP, real money policy rate, exchange rate premium and exchange rate movements, although with a break in 2007:Q1. Their findings found significant relationship between the coefficient of one period lag of the error correction term in one quarter and the change in the disequilibrium in the subsequent quarter. The period of break remarkably coincides with a period persistent excess liquidity exacerbated by the monetization of excess crude receipts and the distribution of enhanced statutory allocation of the three tiers of government. Other factors identified as underlying causes of the exacerbated liquidity include huge autonomous inflow of foreign exchange and pre-election spending. V. Dropsy (1996) stressed that despite new advances in econometrics, there is still no consensus on whether real exchange rates follow a random walk. In his work he compared purchasing power parity (PPP) and the monetary model (MM) to account for omitted long-run economic differentials, such as the Balassa-Samuelson productivity bias.

3.0 Methodology of study

Many researchers testing structural breaks applied unit root tests on variables by running the analysis on a constant and trend term. Results will either indicate the presence of unit roots or its absence at all levels of difference. This will form the basis of the decision to accept or reject the null hypothesis. Where there seems to be stationarity at first difference it implies that the work has to be further examined to test for the presence of possible cointegration relationship between the variables. Many studies on cointegration and cultural breaks adopt conventional and non conventional methodologies.

In this study the analysis is based on Ordinary Least Squares (OLS), and then several other tests would be conducted to test structural break results got to confirm earlier tests. Such tests include the Quant Andrews tests, Kwiatkowski-Phillips-Schmidt-Shin tests, Hansen 1997 model tests, Bai Perron's test. If there is stationarity established then an equation will be formed to capture seasonality given that the data is times series. This will involve using the ARIMA model, but the level of differencing and ordering will follow the objectives of the research. In this case the researcher chooses a model that states thus:

ARIMA (1.1.1)

d(oer) c ar(1) ma(1) sar(1) and sma(4)

An autoregressive model is one where the current value of a variable depends upon only its previous values and a white noise error term.

$$AR(p): Y_t = \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \dots + \alpha_p Y_{t-p} + \varepsilon_t$$

$$= \sum_{j=1}^p \alpha_j Y_{t-j} + \varepsilon_t$$

(1)

Using a lag operator L such that $L^k Y_t = Y_{t-k}$

The AR(p) is given as: $Y_t = \sum_{j=1}^p \alpha_j L^j Y_t + \varepsilon_t$

$$\Rightarrow Y_t - \sum_{j=1}^p \alpha_j L^j Y_t = \varepsilon_t \quad \text{or} \quad 1 - \sum_{j=1}^p \alpha_j L^j Y_t = \varepsilon_t$$

(2)

The term: $1 - \sum_{j=1}^p \alpha_j L^j$ is the characteristics polynomial of the AR model.

AR1 is given as $1 - \alpha L Y_t = \varepsilon_t$

(3)

An MA(q) model a linear combination of white noise processes, so that y_t depends on the current and previous values of a white noise disturbance term.

$$MA(q): Y_t = \varepsilon_t + \vartheta_1 \varepsilon_{t-1} + \vartheta_2 \varepsilon_{t-2} + \dots + \vartheta_p \varepsilon_{t-p}$$

$$= \varepsilon_t + \sum_{j=1}^q \vartheta_j \varepsilon_{t-j}$$

(4)

$$= \vartheta(L) \varepsilon_t$$

For $\vartheta(L) = 1 + \sum_{j=1}^q \vartheta_j L^j$

$$\vartheta(L) = 1 + \sum_{j=1}^q \vartheta_j L^j$$

(5)

The term: $1 + \sum_{j=1}^q \vartheta_j L^j$

$\vartheta_j L^j$ is the characteristics polynomial of the MA model. where ε_t are the independent and identically distributed innovations for the process

MA(p) Model : A review

The distinguishing properties of the moving average process of order q given above are:

1. $E y_t = \mu$
2. $var y_t = \gamma_0 = 1 + \vartheta_1^2 + \vartheta_2^2 + \dots + \vartheta_q^2$
3. $cov y_t = \gamma_s = 1 + \vartheta_1^2 + \vartheta_2^2 + \dots + \vartheta_q^2$ for $s = 1, 2, \dots, q$
- 0 for $s > q$

ARMA model: A review

ARMA p, q is a combination of Ar(p) and MA(q) as follows:

$$ARMA \ p, q : Y_t = \sum_{j=1}^p \alpha_j Y_{t-j} + \varepsilon_t + \sum_{j=1}^q \vartheta_j \varepsilon_{t-j} \quad (6)$$

$$ARMA \ (1,1) \text{ is given as: } 1 - \alpha L \ Y_t = 1 + \vartheta L \ \varepsilon_t \quad (7)$$

Seasonal AR and MA Terms:

Due to seasonal patterns in most monthly and quarterly data, Box and Jenkins (1976) recommend the use of seasonal autoregressive (SAR) and seasonal moving average (SMA) terms in the ARMA process. SAR p is a seasonal AR term with lag p and it adds to an existing AR, a polynomial with lag p given as

$$1 - \phi_p L^p :$$

A second order AR process for quarterly data can be written as;

$$1 - \alpha_1 L - \alpha_2 L^2 \ 1 - \phi_4 L^4$$

$$Y_t = \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} - \phi_4 Y_{t-4} - \alpha_1 \phi_4 Y_{t-5} - \alpha_2 \phi_4 Y_{t-6} + \varepsilon_t \quad (8)$$

AR, MA and ARMA, : A review

(8) on expansion will give:

$$Y_t = \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} - \phi_4 Y_{t-4} - \alpha_1 \phi_4 Y_{t-5} - \alpha_2 \phi_4 Y_{t-6} + \varepsilon_t \quad (9)$$

For seasonal moving average with lag q , the resulting MA lag structure is obtained from the product of the lag polynomial specified by the MA terms and the one specified by any SMA terms.

For a second order MA without seasonality, the process is written as:

$$Y_t = \varepsilon_t + \vartheta_1 \varepsilon_{t-1} + \vartheta_2 \varepsilon_{t-2} \\ = \varepsilon_t + \sum_{j=1}^2 \vartheta_j \varepsilon_{t-j}$$

$$Y_t = \varepsilon_t + \vartheta_1 \varepsilon_{t-1} + \vartheta_2 \varepsilon_{t-2} \quad (10)$$

$$\text{This in the lag form is given as: } Y_t = 1 + \vartheta_1 L + \vartheta_2 L^2 \ \varepsilon_t \quad (11)$$

AR, MA and ARMA, : A review

If the data for (11) is quarterly for example, we introduce the SMA(4) given as $1 + \phi_4 L^4$ in the MA term.

$$\text{This will give: } Y_t = 1 + \vartheta_1 L + \vartheta_2 L^2 \ 1 + \phi_4 L^4 \ \varepsilon_t \quad (12)$$

Expansion of Eq (12) will give:

$$Y_t = \varepsilon_t + \vartheta_1 \varepsilon_{t-1} + \vartheta_2 \varepsilon_{t-2} + \phi_4 \varepsilon_{t-4} + \vartheta_1 \phi_4 \varepsilon_{t-5} + \vartheta_2 \phi_4 \varepsilon_{t-6} \quad (13)$$

The parameter φ is associated with the seasonal part of the MA process.

ARIMA and ARIMAX models

The AR, MA and ARMA models discussed before assumes that the series in question is at least weakly stationary. (see Gujarati, 2004, pp. 840). Since most time series are not stationary, there is need to account for this in our ARMA model. Hence, the need for ARIMA model, In our previous class, a series that must be differenced d times for it to become stationary is said to integrated of order d i.e. $I(d)$ ARIMA (p,d,q) is an ARMA (p,q) model of non-stationary series differenced d times to make it stationary. Estimating ARIMA models: The BJ [Box–Jenkins] Methods Revisited will help one to identify the value of P , d and q for an ARIMA (p, d, q) models. The BJ methodology has an answer and consists of the following steps:

- Differencing to achieve Stationarity
- Identification
- Estimation
- Diagnostic Checking
- Forecasting

4.0 Data Analysis

TESTS determining if there are structural break in the Ordinary Exchange Rate (OER)

Table 4.0.1

Dependent Variable: OER
Method: Least Squares
Date: 04/2/17 Time: 22:38
Sample (adjusted): 1972Q2 2012Q4
Included observations: 163 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	47.56075	4.574512	10.39690	0.0000
R-squared	0.000000	Mean dependent var	47.56075	
Adjusted R-squared	0.000000	S.D. dependent var	58.40346	
S.E. of regression	58.40346	Akaike info criterion	10.97874	
Sum squared resid	552576.3	Schwarz criterion	10.99772	
Log likelihood	-893.7676	Hannan-Quinn criter.	10.98645	
Durbin-Watson stat	0.002909			

And because F Statistics is suitable for null hypothesis since it is useful in comparing statistical models fitted to a data set to find out which model fits the population. It becomes fundamental that Quant Andrew test be employed.

Table 4.0.2

Quandt-Andrews unknown breakpoint test
Null Hypothesis: No breakpoints within 15% trimmed

data

Varying regressors: All equation variables

Equation Sample: 1972Q2 2012Q4

Test Sample: 1978Q3 2006Q4

Number of breaks compared: 114

Statistic			Value	Prob.
Maximum	LR	F-statistic		
(1999Q3)			2820.033	0.0000
Maximum	Wald	F-statistic		
(1999Q3)			2820.033	0.0000
Exp LR		F-statistic	1405.280	0.0000
Exp Wald		F-statistic	1405.280	0.0000
Ave LR		F-statistic	423.1646	0.0000
Ave Wald		F-statistic	423.1646	0.0000

Note: probabilities calculated using Hansen's (1997) method

Statistical diagnostic is one of a set of procedures available for regression analysis that seek to assess the validity of a model in any of a number of different ways. This assessment may be an exploration of the model's underlying statistical assumptions, an examination of the structure of the model by considering formulations that have fewer, more or different explanatory variables.

There are three main statistics here, Maximum F statistic, Exp F Statistic and Ave F statistic each of which employs the LR and Wald perspectives. The Quandt-Andrews table shows that there are no breakpoints within 15% trimmed data. Again the probability values are less than 5% so the decision rule is to accept the null hypothesis.

Tests for multiple break point is conducted.

Table 4.0.3

Multiple breakpoint tests

Bai-Perron tests of L+1 vs. L sequentially determined breaks

Date: 04/02/17 Time: 23:06

Sample: 1972Q2 2013Q4

Included observations: 163

Breaking variables: C

Break test options: Trimming 0.15, Max. breaks 5, Sig. level 0.05

Sequential F-statistic determined breaks:			3
Break Test	F-statistic	Scaled F-statistic	Critical Value**

0 vs. 1 *	2820.033	2820.033	8.58
1 vs. 2 *	69.77560	69.77560	10.13
2 vs. 3 *	92.42306	92.42306	11.14
3 vs. 4	5.546025	5.546025	11.83

* Significant at the 0.05 level.

** Bai-Perron (Econometric Journal, 2003) critical values.

Break dates:

	Sequential	Repartition
1	1999Q3	1992Q2
2	1992Q2	1999Q3
3	2005Q3	2005Q3

Because there were structural breaks discovered one must go for a specific unit root test

Null Hypothesis: OER is stationary

Exogenous: Constant, Linear Trend

Bandwidth: 10 (Newey-West automatic) using Bartlett kernel

	LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic	0.328909
Asymptotic critical values*:	
1% level	0.216000
5% level	0.146000
10% level	0.119000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	711.2856
HAC corrected variance (Bartlett kernel)	7040.686

Table 4.0.4

KPSS Test Equation

Dependent Variable: OER

Method: Least Squares

Date: 04/02/17 Time: 23:22

Sample (adjusted): 1972Q2 2012Q4

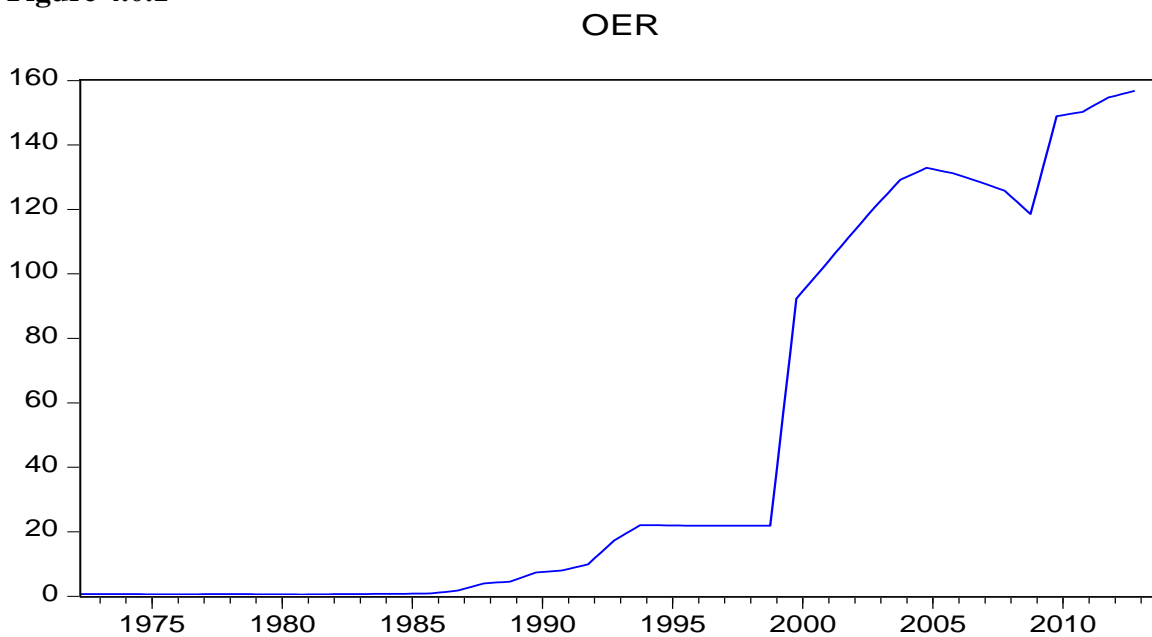
Included observations: 163 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-41.53614	4.184502	-9.926184	0.0000
@TREND("1972Q2 ")	1.099962	0.044670	24.62392	0.0000

R-squared	0.790184	Mean dependent var	47.56075
Adjusted R-squared	0.788880	S.D. dependent var	58.40346
S.E. of regression	26.83508	Akaike info criterion	9.429491
Sum squared resid	115939.6	Schwarz criterion	9.467451
Log likelihood	-766.5035	Hannan-Quinn criter.	9.444902
F-statistic	606.3376	Durbin-Watson stat	0.012595
Prob(F-statistic)	0.000000		

The Unit root test conducted revealed that variables were stationary when the critical staitic is compared to each confidence level of 1%, 5% and 10%.

Figure 4.0.1



There is evidence of trend and intercept from the graph.

Having established stationarity we then formed an equation to capture seasonality given that the data is times series. This will involve using the ARIMA model, but the level of differencing and ordering depends on what the researcher wants to achieve. In this case the researcher chooses a model that states thus:

ARIMA(1.1.1)
d(oer) c ar(1) ma(1) sar(1) and sma(4)

Table 4.0.5

Dependent Variable: D(OER)
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 04/02/17 Time: 23:41
Sample: 1976Q2 2016Q4
Included observations: 163

Convergence achieved after 252 iterations

Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.957608	1.659069	0.577196	0.5646
AR(1)	0.978936	0.104379	9.378712	0.0000
MA(1)	0.006656	1.092929	0.006090	0.9951
SMA(4)	-0.923986	0.105352	-8.770428	0.0000
SIGMASQ	2.294906	0.258185	8.888629	0.0000
R-squared	0.743465	Mean dependent var	0.957734	
Adjusted R-squared	0.736971	S.D. dependent var	3.000169	
S.E. of regression	1.538678	Akaike info criterion	3.773483	
Sum squared resid	374.0697	Schwarz criterion	3.868384	
Log likelihood	-302.5389	Hannan-Quinn criter.	3.812012	
F-statistic	114.4752	Durbin-Watson stat	1.988057	
Prob(F-statistic)	0.000000			
Inverted AR Roots	.98			
Inverted MA Roots	.98	-.00+.98i	-.00-.98i	-.01
	-.98			

The next thing is to test for correlogram of the error term.

Table 4.0.6

Date: 04/02/17 Time: 23:45

Sample: 1972Q2 2013Q4

Included observations: 163

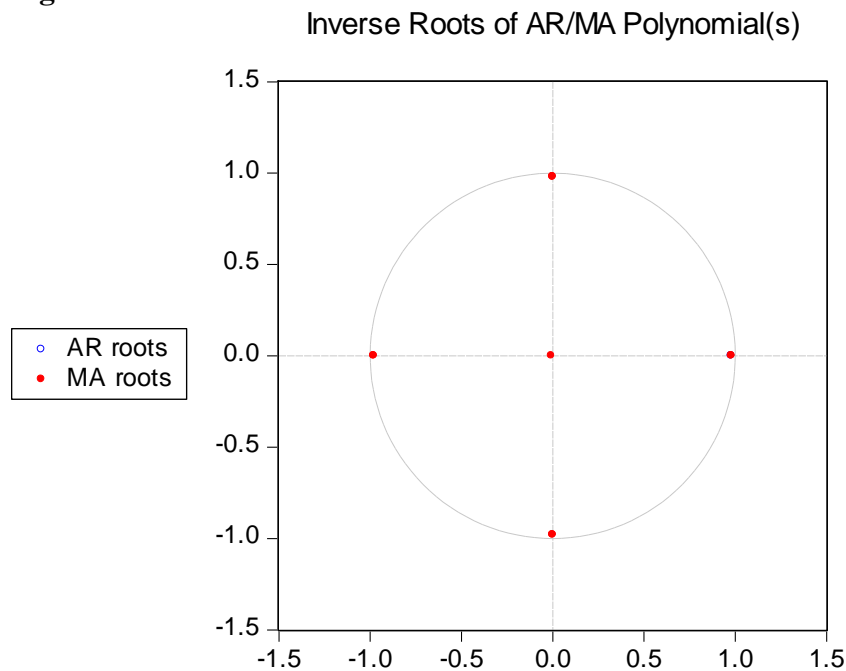
Q-statistic probabilities adjusted for 3 ARMA terms

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
.	.	1	0.006	0.006	0.0053	
.	.	2	0.012	0.012	0.0300	
.	.	3	0.012	0.011	0.0524	
.	.	4	0.017	0.017	0.1018	0.750
.	.	5	0.011	0.011	0.1229	0.940
.	.	6	0.011	0.010	0.1438	0.986
.	.	7	0.010	0.010	0.1622	0.997
.	.	8	0.034	0.033	0.3581	0.996
.	.	9	0.010	0.009	0.3747	0.999
.	.	10	0.010	0.008	0.3915	1.000
.	.	11	0.009	0.008	0.4066	1.000
.	.	12	-0.006	-0.008	0.4132	1.000
.	.	13	0.009	0.007	0.4275	1.000
.	.	14	0.009	0.007	0.4412	1.000

. .	. .	15	0.008	0.007	0.4535	1.000
. .	. .	16	-0.020	-0.022	0.5251	1.000
. .	. .	17	0.006	0.005	0.5317	1.000
. .	. .	18	0.006	0.005	0.5377	1.000
. .	. .	19	0.006	0.005	0.5435	1.000
* .	* .	20	-0.071	-0.071	1.4887	1.000
. .	. .	21	0.006	0.006	1.4955	1.000
. .	. .	22	0.005	0.006	1.5010	1.000
. .	. .	23	0.005	0.006	1.5061	1.000
. .	. .	24	-0.050	-0.048	1.9810	1.000
. .	. .	25	0.005	0.007	1.9865	1.000
. .	. .	26	0.005	0.007	1.9911	1.000
. .	. .	27	0.004	0.006	1.9949	1.000
. .	. .	28	-0.013	-0.009	2.0286	1.000
. .	. .	29	0.005	0.006	2.0327	1.000
. .	. .	30	0.004	0.006	2.0365	1.000
. .	. .	31	0.004	0.006	2.0400	1.000
. .	. .	32	-0.063	-0.063	2.8587	1.000
. .	. .	33	0.004	0.006	2.8626	1.000
. .	. .	34	0.004	0.007	2.8658	1.000
. .	. .	35	0.004	0.007	2.8690	1.000
* .	* .	36	-0.115	-0.119	5.6475	1.000

The correlogram tests prove the error term is stationary since the Autocorrelation and the Partial Autocorrelation results are insignificant.

Figure 4.0.2



The inverse roots of AR and MA lie within the circle. It means the AP is stationary and the MA invertible.

Both the AR and the MA has no root outside the unit circle. Hence, AR is stationary and MA is invertible. However, the MA has roots close to 1, a sign that we may have over differenced the series.

Table 4.0.7

INVERSE ROOTS OF AR/MA POLYNOMIAL(S)
 Specification: OER C AR(1) MA(1) SMA(4)
 Date: 10/11/16 Time: 10:43
 Sample: 1972Q3 2012Q4
 Included observations: 162

AR Root(s)	Modulus	Cycle
0.998364	0.998364	
No root lies outside the unit circle. ARMA model is stationary.		
MA Root(s)	Modulus	Cycle
-0.927253	0.927253	
0.301513 ± 0.301513i	0.426404	8.000000
-0.301513 ± 0.301513i	0.426404	2.666667

No root lies outside the unit circle.
 ARMA model is invertible.

Both the AR and the MA has no root outside the unit circle. Hence, AR is stationary and MA is invertible. However, the MA has roots close to 1, a sign that we may have over differenced the series.

Reducing the number of differencing by 1 gives us: an ARIMA (1, 0, 1) model or an ARMA(1, 1) model with the result as below:

Table 4.0.8

Dependent variable: OER
 Method: ARMA Maximum Likelihood (OPG - BHHH)
 Date: 10/11/16 Time: 10:38
 Sample: 1972Q3 2012Q4
 Included observations: 162
 Convergence achieved after 332 iterations
 Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	75.41121	77.31820	0.975336	0.3309
AR(1)	0.998364	0.011903	83.87615	0.0000
MA(1)	0.927253	0.020812	44.55378	0.0000
SMA(4)	0.033059	0.212749	0.155389	0.8767
SIGMASQ	4.734610	0.192380	24.61077	0.0000

R-squared	0.998606	Mean dependent var	47.85010
Adjusted R-squared	0.998571	S.D. dependent var	58.46724
S.E. of regression	2.210293	Akaike info criterion	4.510177
Sum squared resid	767.0068	Schwarz criterion	4.605473
Log likelihood	-360.3243	Hannan-Quinn criter.	4.548869
F-statistic	28124.57	Durbin-Watson stat	1.741899
Prob(F-statistic)	0.000000		

Inverted AR Roots	1.00
Inverted MA Roots	.30-.30i -.30+.30i -.93

Figure 4.0.3

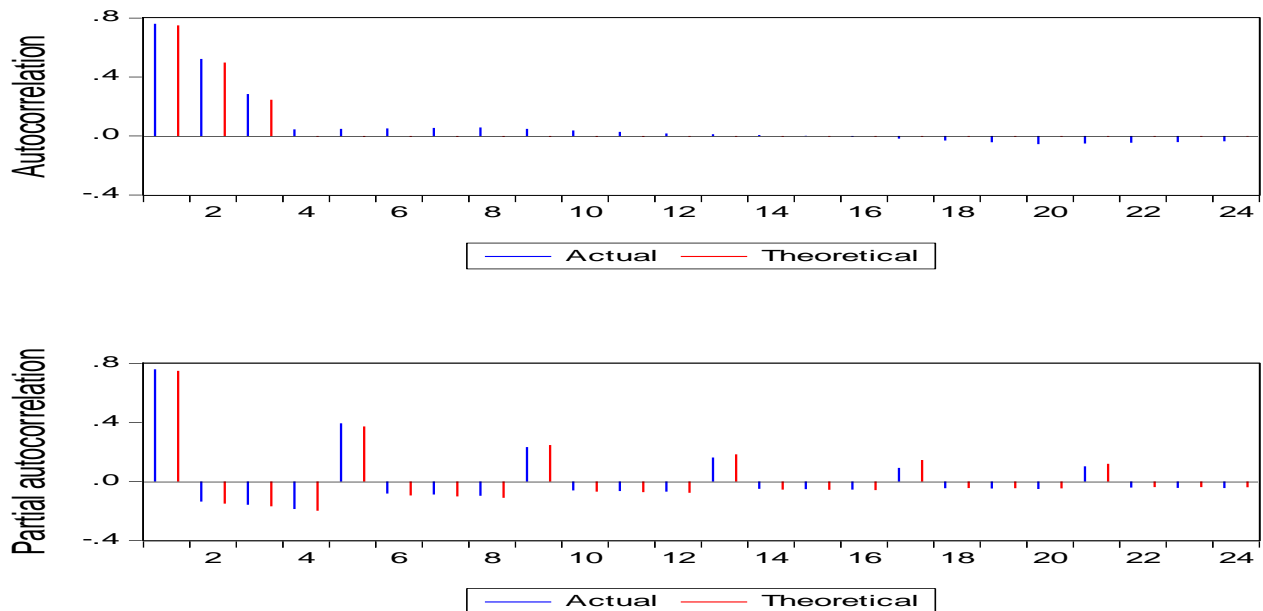
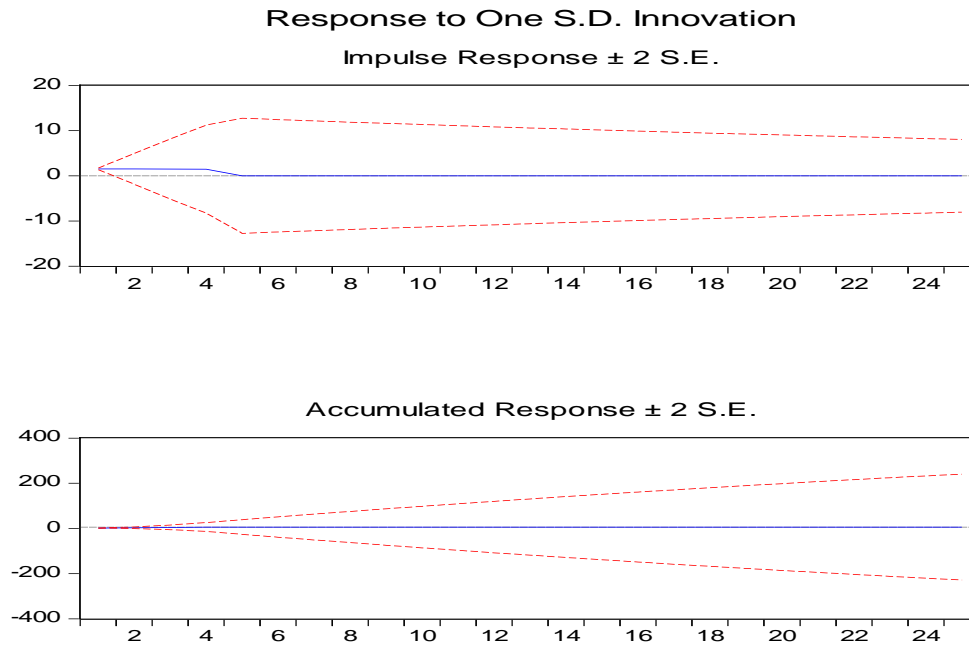


Figure 4.0.4



5.0 Findings and Conclusions

This paper investigated the presence of structural breaks, cointegration and its effect on the exchange rate from 1972:Q1 to 2012:Q4. We employed the Gregory-Hansen test to detect possible structural breaks and to also estimate the cointegrating equation. The results suggested that the ordinary exchange rate is cointegrated with the monetary policies at different periods in Nigeria's history within the years under study. After testing for structural breaks using OLS and Quant Andrews test, we proceeded to use the Bai Perron method we discovered structural breaks. But to rule off any stationarity issues we employed Unit Root tests using Bartlett kernel and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS). The identified break date coincides with a period of persistent excess liquidity exacerbated by the monetization of excess crude receipts and the distribution of enhanced statutory allocation to the three tiers of government. Other contributory factors to the liquidity surfeit include huge autonomous inflow of foreign exchange and pre-election spending. The effect of the identified structural break was accommodated in our modeling approach to ensure that the estimated parameters are unbiased. The short run model revealed that a decline in spread will lead to an increase in economic agents' desire to hold cash, as the incentive for arbitrage transactions moderates. The preliminary analysis shows that the exchange rate was robust enough in explaining developments in the foreign exchange market.

6.0 Recommendations

The consequences to policy are that in an import based economy with oil as its major income, Nigerian policy makers should understand the importance of productivity growth vis-à-vis diversification and economic performance. This can be done by focusing on prudent implementation of the macro economy. This may be regulatory, fiscal, monetary and labour related issues. Adequate measures can be put in place by reducing inflationary effects and

increasing the global competitiveness of exports. By so doing an acceptable level of exchange rate can be achieved through these policies. Given the timing of these breaks, the different models used and their attendant uncertainties we further recommend that more research be conducted in structural breaks role in modeling and forecasting exchange rate volatility.

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