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## The Impact of Floating Exchange Rate Market to Nigeria Naira: Time-series Intervention Analysis

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**Abstract** This study examined the Nigeria Floating exchange rate regime introduced in June 2016 using Autoregressive Integrated Moving Average (ARIMA) Intervention analysis and monthly Nigeria Naira (NGN) to the United State (U.S) dollar exchange rate for the period January, 2004 to August, 2016. The findings indicate a persistent and permanent increase in the value of the dollar against naira because the intervention increases the value of the observed variable by approximately 9%, 16% and 25% in June, July and August 2016 respectively. The permanent or Step intervention was confirmed by the Akaike Information Criteria (AIC). The result shows that the trend is expected to persist for a period unless economic measures are taken by the government or private organization, such as diversifying the economy, chasing locally manufacture products and raw materials as well as given appropriate support to small businesses to become the employer of labor.

**Keywords** Intervention analysis, Floating exchange rate, Step function, ARIMA model, Naira and U.S dollar

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### 1. Introduction

Nigeria has been struggling with the effects of vital global shocks of 2014 namely: The U.S normalization of Monetary Policy, the slowdown in global growth rate and world trading routes geopolitical tensions as well the decline of the crude oil price by 70-percent that supported the country's Foreign Exchange Reserves. Intervention analysis investigate a shift to a regulation, or rule, etc. that altered the values of a series. In time series, Intervention analysis explained how the average level of a series changes after intervention, when it is perceived that the values remain unchanged after the intervention. In practice, identification of series behavior and quantifying the magnitude of the changes of the series are the task. There are several ways for how an intervention may affect the values of a series. Four possible patterns are: Permanent increase/decrease to the average level where a value has been added or subtracted to each series after a specific time interval, a hasty permanent change to the average level because of brief change of one or more periods after which there is no effect of the intervention, a gradual change to a new average level which later levels off at a new position and [1] provides good illustrations based on these patterns. The intervention Time Series Analysis (ITSA) procedure shared similarity with quasi-experiment [2].

It was demonstrated that the application of ITSA to analyze the role of unexpected phenomena on a time series when the timing of the phenomena is unknown using Australian Heroin Shortage of 2001 [2]. IA is an extension of the modeling procedure to determine changes due to new policy [3]. It was examined that the impact of Commonwealth legislation on abolish of sentencing in Virginia using ITSA [4]. showed The evidence was shown of ARIMA Intervention model to be statistically adequate than the normal ARIMA model using monthly



Nigeria interest rate [5]. The impact of Japan 1999 Earthquake was assessed with the 2003 high Acute Respiratory Syndrome outbreak using intervention analysis and the research outcome indicate that both disasters demonstrated a temporary change [6]. The ARIMA-Intervention model for time series analysis is a useful developed procedure that exposed the price decrease of Shanghai A share index due to the 2008 world economic crisis [7]. Policy makers does not have specific intervention strategy while intervention that cut exchange rate, volatility reduces speculation risk and create medium for feedback [8]. The 1986 transition from the fixed to a floating exchange rate regime in Nigeria exposed the ineffectiveness of monetary policy in stabilizing exchange rate, but a reasonable control should introduce to reduce the high demand for foreign currency [9]. Nelson 2000 [6] uses an ARIMA intervention analysis to estimate the role of the 1978 Bankruptcy Reform Act using adjusted quarterly data and obtained an intervention model that suggested increase of consumer bankruptcies by 36% per year after the act introduction. The nonlinearity of intervention not studied by past research to determine the effect of intervention may assist in determining intervention effect and in addition overcome the problem of simultaneity [10].

Sanjeev et al 2003 [11] discovered a temporary and linear impact in the naira – dollar exchange rates. In June 2016, the Central Bank of Nigeria announced the re-introduction of Floating regime exchange rate policy for the market force to determine the value of naira-dollar. Most research focused on modeling and identifying the type of intervention (e.g [2], [11], [3], [7], and [8] without estimating the magnitude of the impact of intervention at the time interval. This research wants to determine the type of the intervention that occurs due to the exchange rate regime switching by the Apex Bank and how much the new policy (Floating regime) affected the naira value monthly from June, 2016. The remaining part paper consists of material and methods used in section 2, results and discussion in section 3 while the concluding remarks is discussed in section 4.

## 2. Materials and Methods

### 2.1. The dataset

The data for this research were obtained from the website of the Central Bank of Nigeria (CBN) and include monthly NGN to the U.S dollar exchange rate for the period January, 2004 to August, 2016.

### 2.2 Methodology

Box and Tao(1975) introduced a methodology that could be used to perform ITSA. Newbold and Bos (1990) proposed the use of the transfer function-noise class of models with  $X_t$  a dummy variable to take the value zero till the intervention occurs, and unity value thereafter.

$$Y_t = \alpha + \frac{\omega(B)}{\delta(B)} X_t, \quad (1)$$

where:  $\omega(B) = \omega_0 + \omega_1 B^1 + \omega_2 B^2 + \dots + \omega_m B^m$ ,  $\delta(B) = 1 - \delta_1 B^1 - \delta_2 B^2 - \dots - \delta_n B^n$ ,  $B =$  the backshift operator.  $X_t =$  the independent explanatory variable of interest.

### 2.3. Transfer Functions

The equation below represents the transfer function.

$$\left[ \frac{\omega_0}{(1 - \delta_1 B^1)} \right] X_t, \quad (2)$$

### 2.4. Noise process

The noise process can be represented by  $N_t$ . It usually represent a time space model, namely an Autoregressive Integrated Moving Average (ARIMA) or a seasonal ARIMA model depending on the behavior of the series.

### 2.5. Pulse and Step Function

Adding the transfer function in (2) and the noise process  $N_t$  produced the transfer function noise class of the model. The dummy variable  $X_t$  is replaced by  $P_t$  and  $S_t$  to demonstrate the Pulse and Step function respectively represented by:



$$Y_t = \alpha + \left[ \frac{\omega_0}{(1 - \delta_1 B^1)} \right] P_t + N_t, \tag{3}$$

$$Y_t = \alpha + \left[ \frac{\omega_0}{(1 - \delta_1 B^1)} \right] S_t + N_t, \tag{4}$$

Equation 3 and 4 above are the first order transfer function for Pulse and Step representation respectively. Additional parameters,  $\omega$ , in the numerator of (3) and (4) are necessary to model the intervention that persist after onset and this can be extended till all existed effect after intervention are accommodated each of which will extend growth for one more period beyond onset (Jamie, 2012).

**2.6. Software used**

The software used is R and Regression Analysis Time Series (RATS) version 9.1.

**3. Results and Discussion**

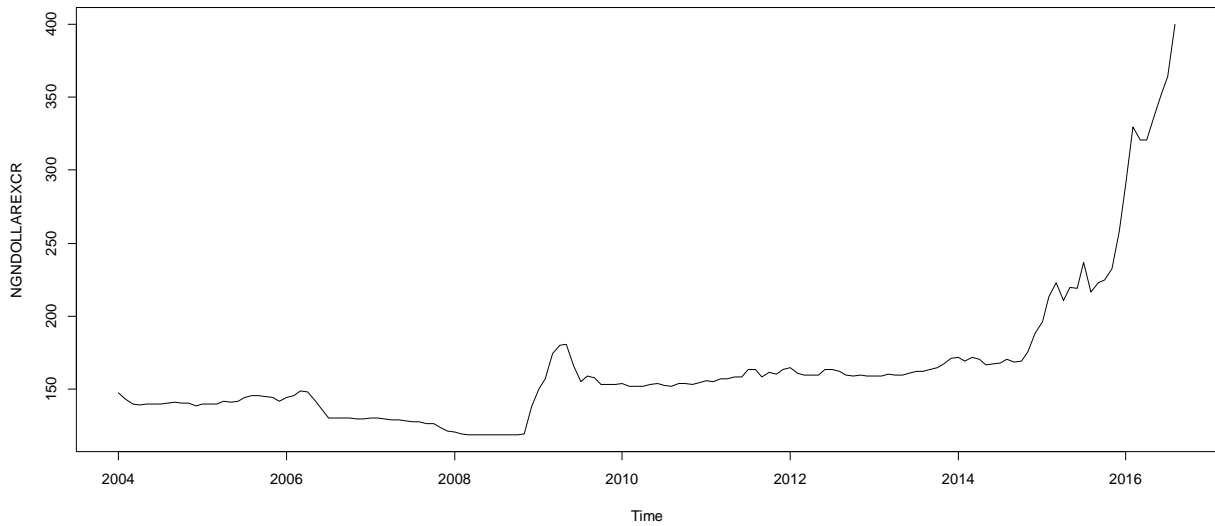


Figure 1: A time plot of monthly NGN to the U.S dollar exchange rate

The Nigeria monthly naira to the U.S dollar exchange rate is displayed in Figure 1. The graph explained two major evidence of economic intervention, such as August 2014 to February 2015 which decided to control the Naira-Dollar Exchange Rate at N197 to a U.S dollar for a period of sixteen months and the switch to the Floating exchange rate regime in June 2016.

Table 1: The interventions ARIMA modeling of NGN to U.S dollar exchange rate

Parameters	Estimate	Std.Error	z-value	Pr(> z )
AR1	0.99614	0.004651	214.19	0.00000
Intercept	5.28725	0.323405	16.349	0.00000
May16a-MA0	-0.00806	0.027279	-0.295	0.76770
May16b-AR1	1.60452	0.287785	5.575	0.00000
May16b-MA0	0.05618	0.037818	1.486	0.13740

The Table 1 above displayed the model that detect outliers/interventions in monthly NGN to the U.S dollar exchange rate and all the pulse are not significant at the 5% significance level so the effect of the intervention may be already captured by the step change.

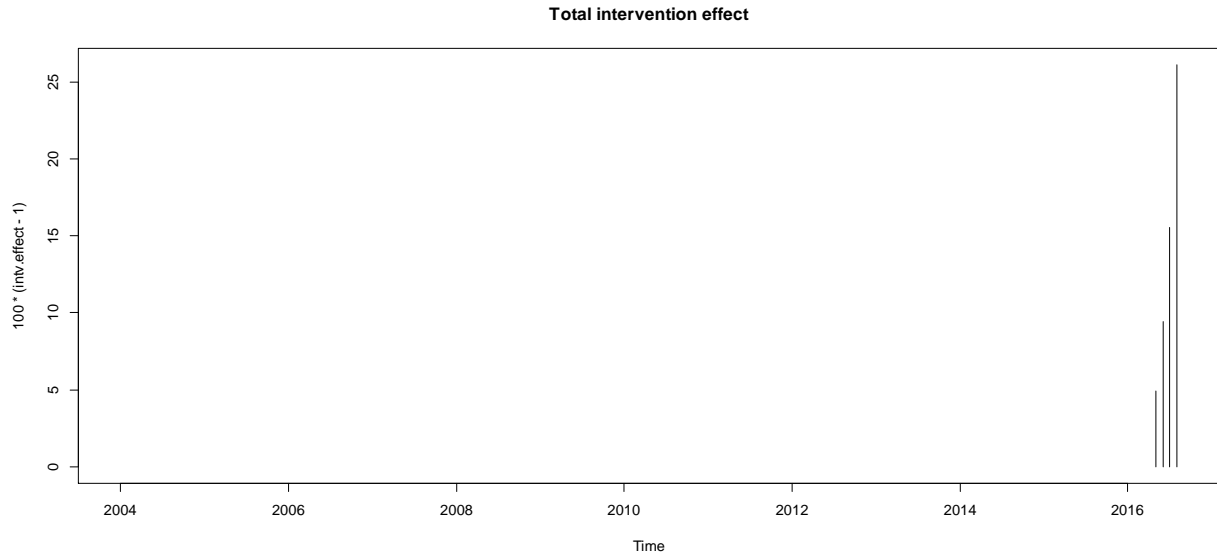


Figure 2: A plot of the effect of June 2016 Floating exchange rate intervention

The percentage increase of the monthly intervention effect is displayed in the Table 2. Numerically, these are the estimated increases quantified at each time point caused by the introduction of the Floating exchange rate regime in June 2016.

Table 2: The percentage of the monthly floating regime intervention effect

May, 2016	June, 2016	July, 2016	August, 2016
4.93%	9.43%	15.56%	26.12%

The intervention increases the value of the observed variable in May 2016 by around 5%. In subsequent months, the effect remains with an increasing weight and reached approximately 26% in August 2016. When the intervention impact is temporary, the dynamic shows how fast the effect decays to zero and increase to infinity when the intervention is permanent and we can inspect this by fitting the model for a range of values of  $\delta$ . The Akaike Information Criteria (AIC) is used to confirmed the intervention effect (whether temporary or permanent) for the model estimated and the result is displayed in the graph below

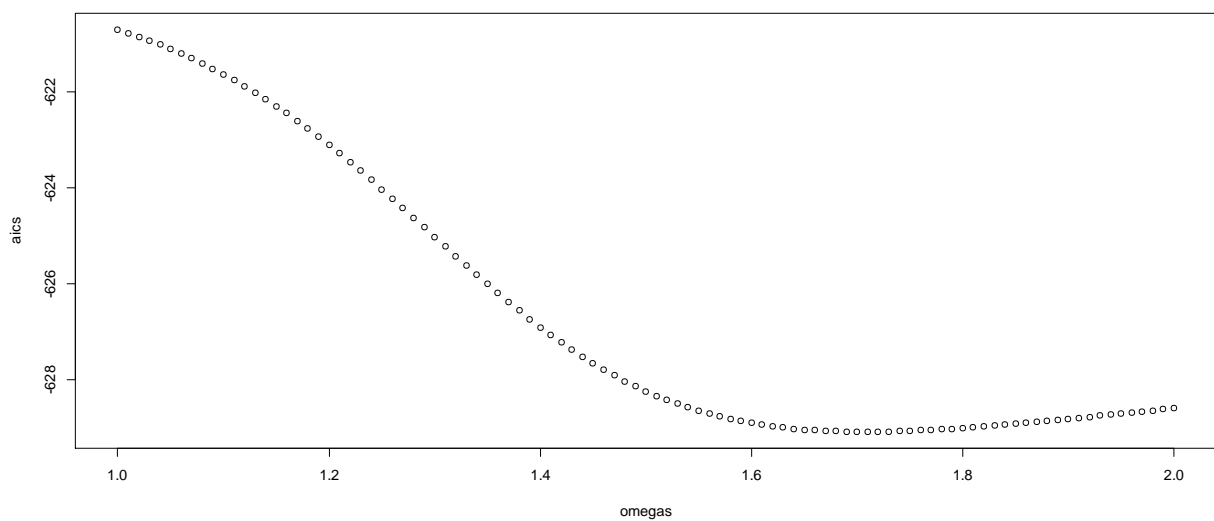


Figure 3: The plot of AIC for the type of the intervention effect

The lowest AIC is found for  $\delta = 1.71$  and is very close to the 1.604521 value estimated. This parameter indicated a persistent permanent effect. We therefore confirmed that the effect is permanent since the increase in dynamic values,  $\delta = 1.604521$  also increases the AIC estimates.

#### 4. Conclusion

Time series Intervention analysis (TSIA) is a necessary procedure if one faced with challenge of handling a series that is affected by a policy change. The Nigeria deteriorating economy witnessed a switch to Floating exchange rate regime in June 2016, while after four months, the effect is relatively persistent and permanent because the degree of intervention decay is greater than one. This increase is expected to continue (indicating naira will continue to lose value) unless intervention measures are introduced by the Apex bank or economic domestic activities (such as patronizing locally manufactured goods) responds to the floating regime especially when market force absolutely determine the dollar rate.

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