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FORECASTING THE NIGERIA FOREIGN EXCHANGE, LEVERAGING ON THE ARIMA MODEL

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ABSTRACT: *This study seeks to build an appropriate model that will be used to forecast the US Dollar to the Nigerian Naira Exchange Rate. The exchange rate market is known to be unstable; this is due to the constant changes in the economic or market environment of countries. Therefore, forecasting the exchange rate accurately is very important in the economic decisions of countries and the organized private sector. The Autoregressive Integrated Moving Average (ARIMA model) is used as the basis of the time series analysis to forecast the US dollar to Naira Exchange Rate. We also test to check the stationarity condition of the variable using the time plot and Augmented Dickey Fuller. Data used for this study was derived from the Central Bank of Nigeria (CBN) spanning from 2002 to 2022. After model estimation, identification and diagnostic, results show that ARIMA (1, 1, 1) remains a better model to forecast the US dollar to Naira Exchange Rate.*

KEYWORDS: ARIMA, Exchange Rate, Model Estimation and Identification, Model Diagnostic and Forecasting.

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INTRODUCTION

Exchange rate remains a tropical macro-economic variable that has continued to gain the attention and constantly continue to arouse the interest of major world economic decision makers (Agyekum et al., 2021; Schwab & Malleret, 2020; Ngan, 2016; Richards et al., 2012). It continues to serve as an authorized aspect whereby countries are allowed to transact business with one another. It is known as the relative rate at which a particular country's currency is measured in terms of other countries' currencies (Kaboro et al., 2018). It is mainly determined by factors like inflation rate, interest rate, growth rate and competition. Discussions on foreign exchange also remain a major discussion of the global economy due to the huge reliability of other modern macroeconomic variables on it (Yang et al., 2021; Murshed & Rashid, 2020). It clearly determines how domestic currencies will be traded for internationally approved currencies for trade among countries (Yang et al., 2021; Nor et al., 2020).

The modeling of exchange rate and forecasting future values from past values using suitable model are so important and necessary (Rowland et al., 2020), as it plays significant role on other variables like price of crude oil, unemployment rate, wage rate, interest rate and equally tells whether an economy grows or not (Nyoni, 2018). It provides decision makers with foresight information on the prices of international goods and openly displays the contribution of other external sector involvement in the international market (Gylych et al., 2020; Caporale & Zekokh, 2019). It also determines wealth distribution among countries, and determines the monetary policies adopted by countries. Exchange rate plays important and significant roles in the growth of Nigeria's economy as a country that solely depends on exportation of crude oil for her source of income (Abdlaziz et al., 2021; Gylych et al., 2020). The price of crude oil in the international market, which is controlled by the exchange rate, equally determines the optimal performance capacity of a country's year on year budget (Gylych et al., 2020). Therefore, the exchange rate remains the foundation for all economic activities in the country, being a country that hugely supports the importation of foreign goods into the country with little or no restriction (Nuhu & Bukari, 2021; Rotimi et al., 2019). Due to the consistent quest of the country to significantly grow her economy by becoming one of the twelve largest economies in the world by 2050 according to CBN (2009), concerned policy makers in the country have highlighted a managed and consistent exchange rate policy as one of the keys to achieving this stated goals (Nyoni & Bonga, 2017; Obi et al., 2016). They all agree this will promote sustainable and consistent economic growth in the country as this mainly depends on how a nation is capable of making productive use of all resources at her disposal.

LITERATURE REVIEW

Some authors in the field of econometrics have all agreed that effective management of exchange rate is germane for Nigeria sustainable economic growth (Nyoni, 2018; Rahim et al., 2018; Okonkwo et al., 2017; Isola et al., 2016). According to Nyoni (2018) and Alam (2012), a timely and suitable forecast of exchange rates adequately provides decision makers with viable information that will improve profitability and promote a nation's overall economic growth. Forecasting in time series analysis is theoretically based on the analysis of past historical data to predict future values. Before now, a lot of models have been used to forecast Nigeria's exchange rate where some of the models were seen to possess strong forecasting power while some possess weak forecasting power. Nyoni (2018) used Arima (1,1,1) with

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preferred suitable forecast accuracy to show that naira to US dollar will continue to depreciate using yearly data that ranges from 1960 to 2017. Nwankwo (2014) used ARIMA (1,0,0) to forecast Nigeria exchange rate since it has better prediction capacity and satisfied most of the diagnostic requirements. Ajao et al., (2017) also used ARIMA (0,1,0) to forecast dollar to naira exchange rate on a yearly data that covers 1972 to 2017. Other time series models that have been used to model dollar to naira exchange rate for Nigeria include SARIMA (Etuk et al., 2016) and GARCH models (Musa et al., 2014). Almost all the above-mentioned works have forecasted Nigeria naira to US dollar exchange rate using annual data, but there is an urgent need for this to be broken down into monthly in order to comprehensively observe the volatility of how this rate changes from one month to another and help in preparing for the unseen in terms of other variables that are attributed or connected to exchange rate. ARIMA model remains a forecasting tool in time series analysis that econometricians and researchers used to forecast important macroeconomic variables like inflation, GDP, interest rate, exchange rate, investment among other variables, in order to formulate well-informed policies that will provide sustainable economic growth for nation's development (Rasheed et al., 2020).

Theoretical Review

This study is hinged on the notable quantity theory of money. This is a theory popularly used to determine the long-run equilibrium value of exchange rate and based on the monetarist views. According to Nyoni (2018), changes in money quantity only affect the level of price leaving the major sector of the economy untouched and that money supply increase comes as a result of exchange rate increase. Exchange rate is commonly determined by how people or nations demand for money (Oleka & Okolie, 2016), which as a result influences a nation's economic growth positively but can be badly affected by inflation rate. Therefore, the quantity of money and the level of price are both in direct proportion as explained by the quantity theory of money which necessitated the need to always forecast the exchange rate as the causes in price fluctuations might not be well explained sometimes.

METHODOLOGY

Time series data remain data points collected over time, i.e. data that are distinctively collected at different times with similar intervals. This explains why they can be collected on a daily, weekly, monthly, and quarterly or at annual intervals. Considering the monthly interval of the US dollar to naira exchange rate, the suitable tool for analyzing this type of data remains the time series. An ARIMA (Autoregressive Integrated Moving Average) model is a time series model usually used to predict future values or occurrences from the past occurrences. It is a model that generally combines AR (Autoregressive) model, MA (Moving Average) model and d (the number of differencing done before the data becomes stationary).

Considering an autoregressive model of order p i.e. AR (p) which is expressed as

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$$Y_t = \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + \cdots + \varphi_p Y_{t-p} + \varepsilon_t \quad (1)$$

Applying a backward shift operator, equation (1) becomes

$$\left(1 - \varphi_1 B - \varphi_2 B^2 - \cdots \varphi_p B^p\right) Y_t = \varepsilon_t \quad (2)$$

A moving average of order q is given as

$$Y_t = \varepsilon_t + \emptyset_1 \varepsilon_{t-1} + \emptyset_2 \varepsilon_{t-2} + \cdots + \emptyset_q \varepsilon_{t-q} \quad (3)$$

Applying a backward shift operator, this also becomes

$$\Phi(B) = 1 + \vartheta_1 B + \vartheta_2 B^2 + \cdots + \vartheta_q B^q = 0 \quad (4)$$

To obtain an ARMA (p, q) model, equation (1) and (3) are both combined as expressed below:

$$Y_t - Y_{t-1} - \varphi_2 Y_{t-2} - \cdots - \varphi_p Y_{t-p} = \varepsilon_t - \emptyset_1 \varepsilon_{t-1} - \emptyset_2 \varepsilon_{t-2} - \cdots - \emptyset_q \varepsilon_{t-q} \quad (5)$$

Where ε_t remains the white noise process that is normally distributed with mean (0) and variance (σ^2). Equation (5) can further be expressed as:

$$\Theta(B) Y_t = \Phi(B) \varepsilon_t \quad (6)$$

Where$\Theta(B)$ =$\left(1 - \varphi_1 B - \varphi_2 B^2 - \cdots \varphi_p B^p\right)$.

ARIMA (p, d, q) can then be obtained as follows

Let

$$Y_t = X_t - X_{t-1} = (1 - B) X_t \quad (7)$$

$$Y_t - Y_{t-1} = X_t - 2X_{t-1} + X_{t-2} = (1 - B)^2 X_t \quad (8)$$

:

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$$Y_t - \sum_{k=1}^{d} Y_{t-k} = (1-B)^d X_t \qquad (9)$$

$$\Theta_p(B)(1-B)^d X_t = \Phi_q(B) a_t$$

It is very essential that non-stationary data are made stationary either through transformation or differencing. Differencing is a commonly used way of making a series stationary; it is all about obtaining the difference that exists between two successive series.

$$\Delta Y_t = Y_t - Y_{t-1} \qquad (10)$$

Where

$$Y_t = \delta Y_{t-1} + \varepsilon_t \qquad (11)$$

Model Identification and Diagnostic

The common methods of identifying a suitable model in autoregressive integrated moving average (ARIMA) were propounded by Box and Jenkins (Osho, 2019; Saboia, 1977) where their common tools are the partial autocorrelation function (PACF) for the autoregressive model and autocorrelation function (ACF) for the moving average model. The PACF is the correlation found between two residuals that is usually obtained from regressing the observations Y_t and Y_{t-k} i.e. it gives the dependence existing between Y_t and Y_{t-k}. The ACF on the other hand explains how time series data are related to the preceding or previous data point (Ashik & Kannan, 2019). The PACF and ACF graphs are usually plotted to obtain the lags of the autoregressive model and the moving average. A careful selection of these lags will determine the ARIMA model that is suitable for our data before carrying out residual diagnostic on any of the models that is most preferred. This has to do with ensuring that the selected model meets the requirements of a stationary univariate process and comparing with different similar ARIMA model in order to ensure that the best among the selected is used for forecasting using their goodness of fits measures like Alikaik Information Criteria (AIC), Schwartz Criterion and Durbin-Watson Stat.

RESULTS AND DISCUSSION

The data used for this modeling is a single set of data on daily levels of US dollar to naira exchange rate. The data was obtained from the Central Bank of Nigeria (CBN) official website from 10th December, 2001 to 4th March, 2022. It was later converted into monthly data in order to have overall exchange rate per month and equally forecast future values in months, which shows there are 244 observations of this exchange rate that are used for this analysis, satisfying the Box-Jenkins criteria of having at least 50 observations (Chatfield, 2016). The first test is to

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check the stationarity condition of this variable using the time plot and Augmented Dickey Fuller Test.

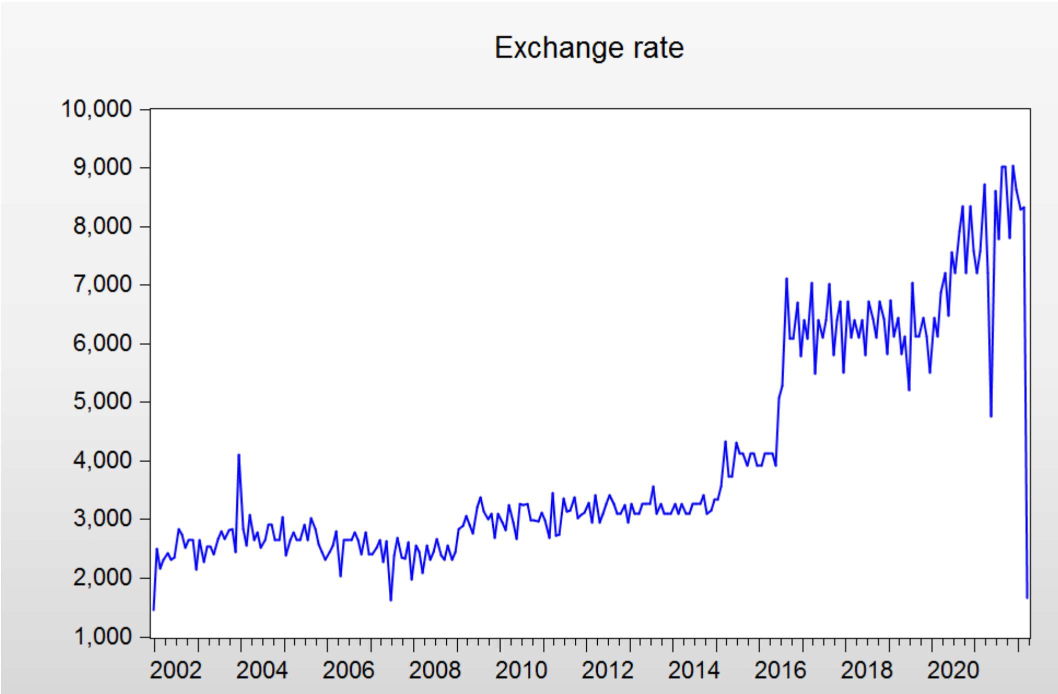

Figure 1: Graph of monthly Exchange rate showing non-stationarity

Table 1: Augmented Dickey Fuller Test

Variable	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	P-Value
Exchange rate	-1.4985	-3.4574	-2.8733	-2.5731	0.5329

A common characteristic of time series data is time plot which displays the observed values on y-axis against time increment on x-axis. Statistically, it is a graph that explains the behavior of data and becomes a suitable check to build a reliable and good model. The time plot in figure 1 and Augmented Dickey Fuller Test (a notable unit root test for time series data) in Table 1 both confirm the presence of non-stationarity in the data. To get the data stationary, the log form of the data was differenced to have

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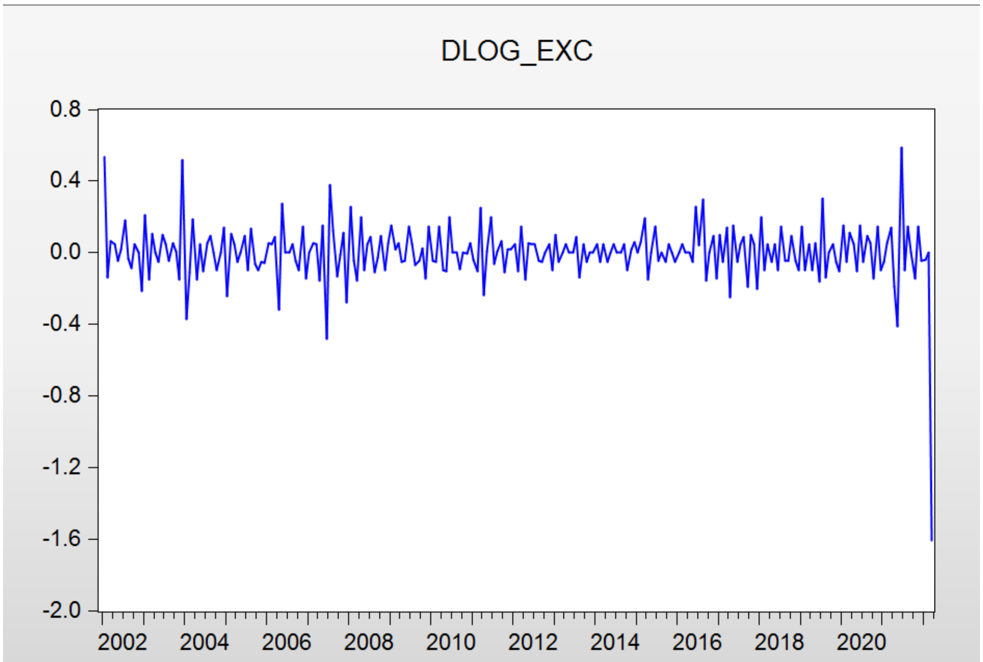

Figure 2: Graph of differenced log of Exchange rate showing stationarity

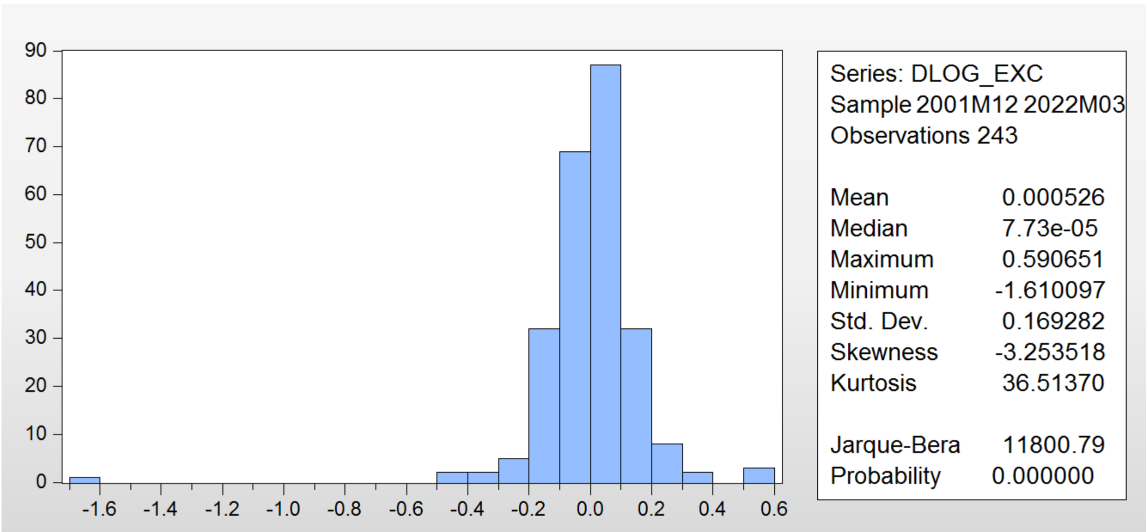

Figure 3: Histogram of differences log of exchange rate

Table 2: Augmented Dickey Fuller Test for dlog (exchange rate)

Variable	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	P-Value
Dlog(Exchange rate)	-13.9064	-3.4574	-2.8733	-2.5731	0.0000

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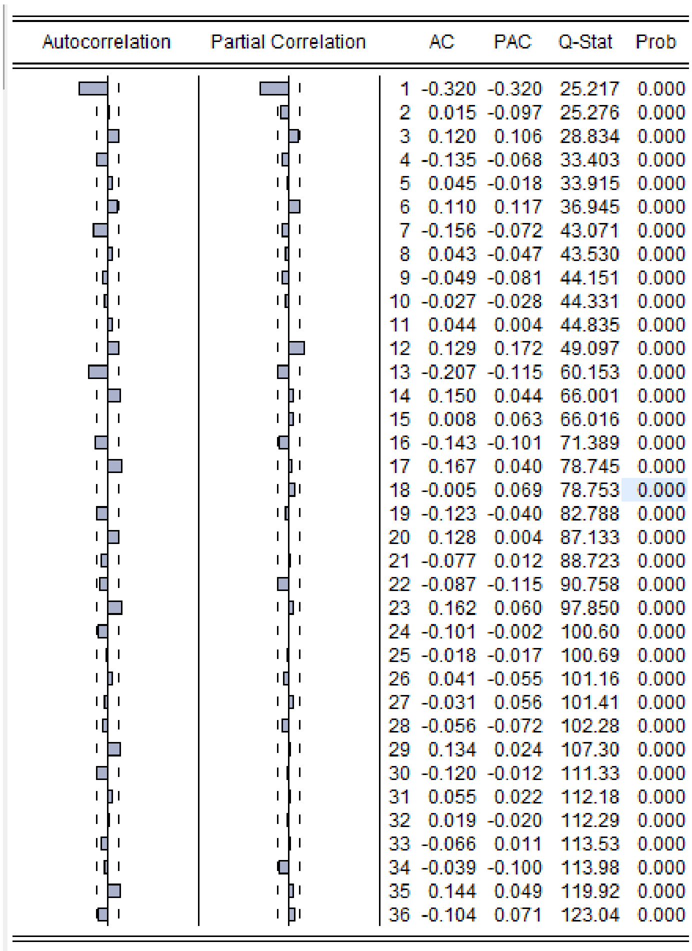
The differencing of the log transformation of exchange rate makes the data to be stationary as shown in figure 2 and Table 2. Figure 3 also confirms the stationarity of the first differencing of the log US dollar to Naira exchange rate with a normally skewed series and having a probability of 0.000. Since it contains no trend and p-value recorded is far below 0.05. The differencing of log of exchange rate clearly signifies that our d=1 and the next step is to plot a correlogram to determine our p and q.



	AC	PAC	Q-Stat	Prob
1	-0.320	-0.320	25.217	0.000
2	0.015	-0.097	25.276	0.000
3	0.120	0.106	28.834	0.000
4	-0.135	-0.068	33.403	0.000
5	0.045	-0.018	33.915	0.000
6	0.110	0.117	36.945	0.000
7	-0.156	-0.072	43.071	0.000
8	0.043	-0.047	43.530	0.000
9	-0.049	-0.081	44.151	0.000
10	-0.027	-0.028	44.331	0.000
11	0.044	0.004	44.835	0.000
12	0.129	0.172	49.097	0.000
13	-0.207	-0.115	60.153	0.000
14	0.150	0.044	66.001	0.000
15	0.008	0.063	66.016	0.000
16	-0.143	-0.101	71.389	0.000
17	0.167	0.040	78.745	0.000
18	-0.005	0.069	78.753	0.000
19	-0.123	-0.040	82.788	0.000
20	0.128	0.004	87.133	0.000
21	-0.077	0.012	88.723	0.000
22	-0.087	-0.115	90.758	0.000
23	0.162	0.060	97.850	0.000
24	-0.101	-0.002	100.60	0.000
25	-0.018	-0.017	100.69	0.000
26	0.041	-0.055	101.16	0.000
27	-0.031	0.056	101.41	0.000
28	-0.056	-0.072	102.28	0.000
29	0.134	0.024	107.30	0.000
30	-0.120	-0.012	111.33	0.000
31	0.055	0.022	112.18	0.000
32	0.019	-0.020	112.29	0.000
33	-0.066	0.011	113.53	0.000
34	-0.039	-0.100	113.98	0.000
35	0.144	0.049	119.92	0.000
36	-0.104	0.071	123.04	0.000

To obtain suitable values of p and q for our ARIMA model, the PACF was carefully examined to obtain p while the ACF plot was equally studied to determine q since d=1. From Figure 3 above, it is evident that almost all the lags are within the confidence interval with probability values less than 0.05 except lag 1 in PACF and ACF, this shows that a suitable and parsimonious model for Nigeria exchange rate is ARIMA (1,1,1).

Table 3: Output of Model Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.0035	0.0052	0.6749	0.5003
AR(1)	-0.2157	0.1498	-1.4399	0.1512
MA(1)	-0.5515	0.1353	-4.0771	0.0001
SIGMASQ	0.0221	0.0005	41.2544	0.0000
Adjusted R^2 = 0.2163				

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Based on Table 3 above, the model output can be written as

$$X_t + 0.2157X_{t-1} = \varepsilon_t + 0.5515\varepsilon_{t-1}$$

Model Diagnostic

Since ARIMA (1, 1, 1) has been selected, a diagnostics check needs to be run on this model to make sure it follows all criteria that will make our forecast valid. According to the Ljung-Box Q statistic which states the residuals must be white noise, the null hypothesis of this test is that all residuals are white noise and the alternative hypothesis is just opposite of this.

Q-statistic probabilities adjusted for 2 ARMA terms

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.018	0.018	0.0827	
		2	0.004	0.003	0.0862	
		3	0.062	0.061	1.0265	0.311
		4	-0.065	-0.068	2.0937	0.351
		5	0.040	0.042	2.4889	0.477
		6	0.019	0.013	2.5762	0.631
		7	-0.138	-0.132	7.3822	0.194
		8	-0.053	-0.057	8.0922	0.231
		9	-0.042	-0.036	8.5319	0.288
		10	0.059	0.080	9.4328	0.307
		11	0.036	0.023	9.7698	0.369
		12	0.055	0.064	10.552	0.393
		13	-0.064	-0.074	11.622	0.393
		14	0.095	0.093	13.951	0.304
		15	0.009	-0.019	13.974	0.376
		16	-0.063	-0.069	15.000	0.378
		17	0.134	0.133	19.760	0.181
		18	0.004	0.027	19.765	0.231
		19	-0.072	-0.050	21.137	0.220
		20	0.037	-0.003	21.494	0.255
		21	-0.084	-0.050	23.394	0.220
		22	-0.060	-0.069	24.371	0.227
		23	0.061	0.054	25.392	0.231
		24	-0.041	-0.017	25.854	0.258
		25	-0.028	-0.013	26.062	0.298
		26	0.003	-0.007	26.065	0.350
		27	-0.029	-0.021	26.299	0.392
		28	-0.048	-0.091	26.928	0.413
		29	0.051	0.025	27.647	0.429
		30	-0.057	-0.027	28.562	0.435
		31	-0.003	-0.009	28.564	0.488
		32	-0.015	-0.025	28.625	0.537
		33	-0.041	-0.002	29.107	0.564
		34	-0.025	-0.065	29.291	0.604
		35	0.106	0.097	32.478	0.493
		36	-0.015	0.021	32.545	0.539

Figure 4 above also showed the selected model is within lay down criteria. Since all p-values for the model Q- stat are above 0.05, we fail to reject the null hypothesis and conclude that the

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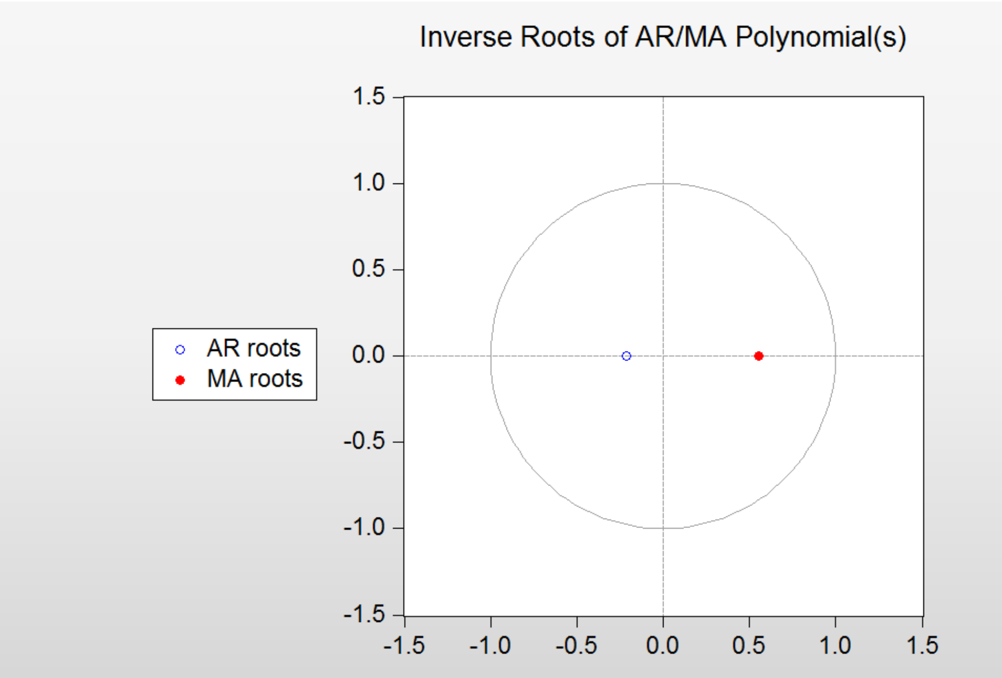
residuals are white noise. The next thing is to check if the estimated ARMA process is stationary i.e. AR roots lie in the unit circle and also check if the estimated ARMA process is invertible i.e. the MA roots should also lie in the unit circle which are fully satisfied by figure 4 below.



Out-of-Sample: Forecasting Results

Since ARIMA (1, 1, 1) model remains the only suitable model for this US dollar to naira exchange rate and it has satisfied all required diagnostic requirements, therefore we proceed to forecast the log of US dollar to naira exchange rate values for the next nine months i.e. from April, 2022 to December, 2022 using this selected model which are given in Table 5 below. The within sample forecasts are presented in the appendix section and further ascertain the predictive power of the selected model.

Year and Month	Forecasted Log of US dollar to Naira Exchange Rate
2022M04	-0.00038
2022M05	0.004352
2022M06	0.003331
2022M07	0.003552
2022M08	0.003504
2022M09	0.003514
2022M10	0.003512
2022M11	0.003513
2022M12	0.003512

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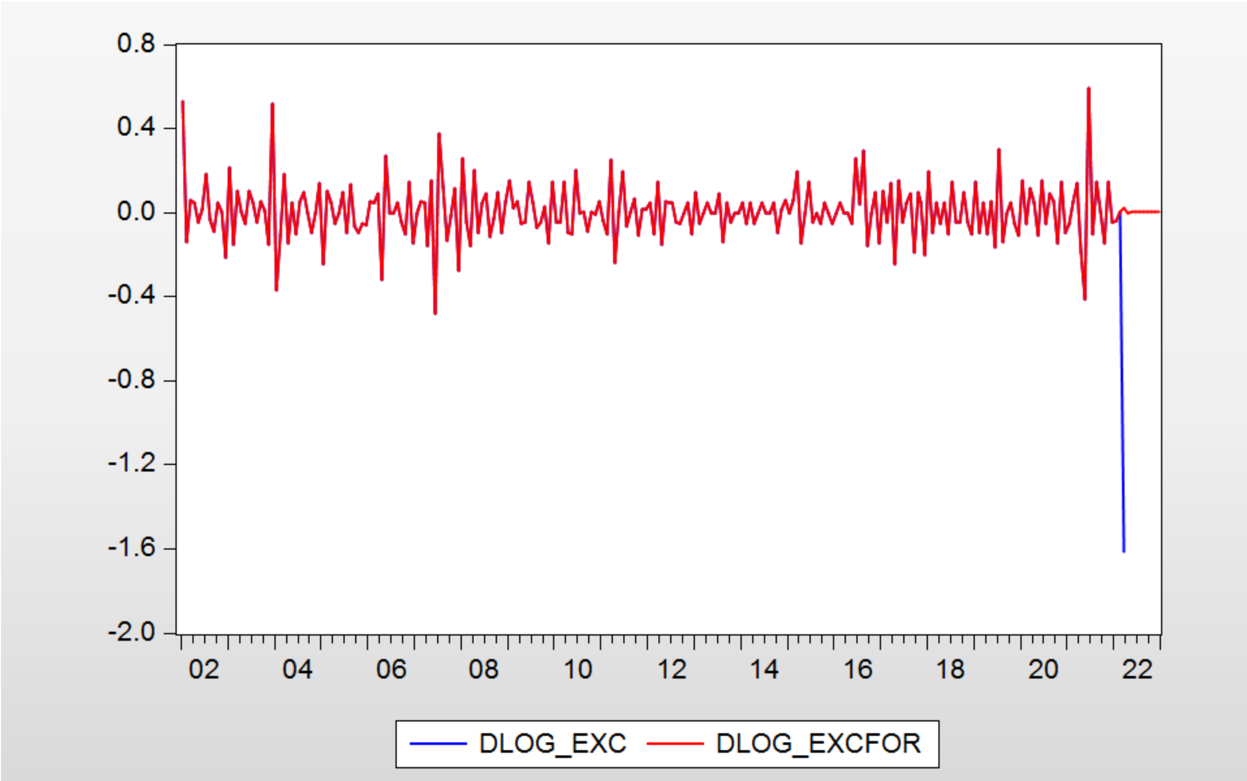

CONCLUSION

This study seeks to obtain a suitable ARIMA model and forecast US dollar to naira exchange rate. Every stage of Box-Jenkins' approach which is identification, estimation, diagnostics and forecasting were followed before obtaining a suitable ARIMA model and this selected model was used to forecast the next nine months i.e. from April, 2022 to December, 2022. It was discovered that the data was not stationary at level using time plot but the first difference of its log form was. In determining the values of p and q, the correlogram was plotted to obtain these two values. After model estimation, ARIMA (1, 1, 1) was picked based on the goodness of fit measures and satisfying all requirements for this forecast.

Research Implication

The economic or research implication of this study is that, it will be of great help to users of economic variables like traders, investors, financial analysts, government, researchers, among others in Nigeria to make financial decisions that involve exchange rate and plan for the future. Apart from that, for the country as a whole to achieve a sustainable and consistent economic growth, there is a need to properly manage its exchange rate and properly plan ahead.

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APPENDICES

In Sample Forecast.

Year/Month	Actual Differenced Log EXC	Forecasted Differenced Log EXC	Year/Month	Actual Differenced Log EXC	Forecasted Differenced Log EXC
2002M01	0.533176432	0.533176432	2012M07	0.046481567	0.046482
2002M02	-0.139253084	-0.139253084	2012M08	-0.046867789	-0.04687
2002M03	0.062671107	0.062671107	2012M09	-0.049024728	-0.04902
2002M04	0.049383372	0.049383372	2012M10	-0.000173889	-0.00017
2002M05	-0.045152115	-0.045152115	2012M11	0.048434932	0.048435
2002M06	0.017044775	0.017044775	2012M12	-0.099674667	-0.09967
2002M07	0.183672529	0.183672529	2013M01	0.099938495	0.099938
2002M08	-0.030867278	-0.030867278	2013M02	-0.04880182	-0.0488
2002M09	-0.087783716	-0.087783716	2013M03	7.73E-05	7.73E-05
2002M10	0.048795645	0.048795645	2013M04	0.048749063	0.048749
2002M11	0.002748063	0.002748063	2013M05	-2.76E-05	-2.76E-05
2002M12	-0.210800988	-0.210800988	2013M06	3.68E-05	3.68E-05
2003M01	0.212913518	0.212913518	2013M07	0.091036722	0.091037
2003M02	-0.150895239	-0.150895239	2013M08	-0.139782105	-0.13978
2003M03	0.104208084	0.104208084	2013M09	0.048803659	0.048804
2003M04	0.000996693	0.000996693	2013M10	-0.048146896	-0.04815
2003M05	-0.049834156	-0.049834156	2013M11	-0.000943428	-0.00094
2003M06	0.101910319	0.101910319	2013M12	3.54E-05	3.54E-05
2003M07	0.0459201	0.0459201	2014M01	0.048901523	0.048902
2003M08	-0.044317897	-0.044317897	2014M02	-0.04868894	-0.04869
2003M09	0.050953834	0.050953834	2014M03	0.048747222	0.048747
2003M10	0.008661609	0.008661609	2014M04	-0.048847066	-0.04885
2003M11	-0.149268652	-0.149268652	2014M05	-2.90E-05	-2.90E-05
2003M12	0.517657153	0.517657153	2014M06	0.048790164	0.04879
2004M01	-0.367689106	-0.367689106	2014M07	0	0
2004M02	-0.106621812	-0.106621812	2014M08	0	0
2004M03	0.185962961	0.185962961	2014M09	0.04660493	0.046605
2004M04	-0.147113635	-0.147113635	2014M10	-0.095224394	-0.09522
2004M05	0.045188715	0.045188715	2014M11	0.016959328	0.016959
2004M06	-0.102061876	-0.102061876	2014M12	0.058945435	0.058945
2004M07	0.051648619	0.051648619	2015M01	0	0
2004M08	0.09538439	0.09538439	2015M02	0.061642541	0.061643
2004M09	0.000285109	0.000285109	2015M03	0.193716764	0.193717
2004M10	-0.095030989	-0.095030989	2015M04	-0.146973519	-0.14697
2004M11	0.000109526	0.000109526	2015M05	0	0
2004M12	0.139473569	0.139473569	2015M06	0.146175439	0.146175
2005M01	-0.245106034	-0.245106034	2015M07	-0.046237393	-0.04624

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2005M02	0.105307628	0.105307628	2015M08	0.000145412	0.000145
2005M03	0.048792683	0.048792683	2015M09	-0.048802887	-0.0488
2005M04	-0.04879646	-0.04879646	2015M10	0.048744725	0.048745
2005M05	-0.000249365	-0.000249365	2015M11	1.45E-05	1.45E-05
2005M06	0.095681457	0.095681457	2015M12	-0.048815247	-0.04882
2005M07	-0.095303655	-0.095303655	2016M01	0.000323125	0.000323
2005M08	0.133687194	0.133687194	2016M02	0.048535744	0.048536
2005M09	-0.064024453	-0.064024453	2016M03	0	0
2005M10	-0.095118188	-0.095118188	2016M04	0	0
2005M11	-0.052675883	-0.052675883	2016M05	-0.048790164	-0.04879
2005M12	-0.056888889	-0.056888889	2016M06	0.258196264	0.258196
2006M01	0.054058575	0.054058575	2016M07	0.03960618	0.039606
2006M02	0.046026531	0.046026531	2016M08	0.29538381	0.295384
2006M03	0.088656154	0.088656154	2016M09	-0.154438954	-0.15444
2006M04	-0.320679223	-0.320679223	2016M10	-4.10E-05	-4.10E-05
2006M05	0.271811555	0.271811555	2016M11	0.095209484	0.095209
2006M06	3.01E-05	3.01E-05	2016M12	-0.146466075	-0.14647
2006M07	-0.000522624	-0.000522624	2017M01	0.100013546	0.100014
2006M08	0.046054243	0.046054243	2017M02	-0.048428831	-0.04843
2006M09	-0.046825519	-0.046825519	2017M03	0.143330467	0.14333
2006M10	-0.100146256	-0.100146256	2017M04	-0.246265293	-0.24627
2006M11	0.146637701	0.146637701	2017M05	0.152464829	0.152465
2006M12	-0.1465961	-0.1465961	2017M06	-0.04821858	-0.04822
2007M01	-8.74E-05	-8.74E-05	2017M07	0.049279555	0.04928
2007M02	0.051235671	0.051235671	2017M08	0.090334582	0.090335
2007M03	0.048003661	0.048003661	2017M09	-0.190336379	-0.19034
2007M04	-0.155515394	-0.155515394	2017M10	0.099221778	0.099222
2007M05	0.150848065	0.150848065	2017M11	0.047439665	0.04744
2007M06	-0.4805495	-0.4805495	2017M12	-0.199331261	-0.19933
2007M07	0.377370118	0.377370118	2018M01	0.198914439	0.198914
2007M08	0.12413895	0.12413895	2018M02	-0.094924614	-0.09492
2007M09	-0.134566565	-0.134566565	2018M03	0.048284056	0.048284
2007M10	-0.011682321	-0.011682321	2018M04	-0.049217709	-0.04922
2007M11	0.113570745	0.113570745	2018M05	0.049498479	0.049498
2007M12	-0.276900092	-0.276900092	2018M06	-0.099936537	-0.09994
2008M01	0.256601561	0.256601561	2018M07	0.146393103	0.146393
2008M02	-0.04666016	-0.04666016	2018M08	-0.04570044	-0.0457
2008M03	-0.154483097	-0.154483097	2018M09	-0.048085611	-0.04809
2008M04	0.20028701	0.20028701	2018M10	0.096039066	0.096039
2008M05	-0.095647406	-0.095647406	2018M11	-0.045812902	-0.04581
2008M06	0.048565097	0.048565097	2018M12	-0.099400675	-0.0994
2008M07	0.090625176	0.090625176	2019M01	0.146356731	0.146357
2008M08	-0.111924617	-0.111924617	2019M02	-0.095556516	-0.09556

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2008M09	-0.028204384	-0.028204384	2019M03	0.04929224	0.049292
2008M10	0.095302347	0.095302347	2019M04	-0.099955055	-0.09996
2008M11	-0.095142959	-0.095142959	2019M05	0.051250359	0.05125
2008M12	0.050958551	0.050958551	2019M06	-0.162528527	-0.16253
2009M01	0.152406529	0.152406529	2019M07	0.302247905	0.302248
2009M02	0.020325366	0.020325366	2019M08	-0.139776486	-0.13978
2009M03	0.053068852	0.053068852	2019M09	-4.90E-05	-4.90E-05
2009M04	-0.052435346	-0.052435346	2019M10	0.04893507	0.048935
2009M05	-0.047106782	-0.047106782	2019M11	-0.048837169	-0.04884
2009M06	0.149041241	0.149041241	2019M12	-0.105352358	-0.10535
2009M07	0.047226344	0.047226344	2020M01	0.154181757	0.154182
2009M08	-0.069513989	-0.069513989	2020M02	-0.048804926	-0.0488
2009M09	-0.043547057	-0.043547057	2020M03	0.113868703	0.113869
2009M10	0.027107593	0.027107593	2020M04	0.048552328	0.048552
2009M11	-0.1426009	-0.1426009	2020M05	-0.105360516	-0.10536
2009M12	0.144847193	0.144847193	2020M06	0.15415068	0.154151
2010M01	-0.048035433	-0.048035433	2020M07	-0.048790164	-0.04879
2010M02	-0.048487312	-0.048487312	2020M08	0.092974836	0.092975
2010M03	0.143959221	0.143959221	2020M09	0.053697984	0.053698
2010M04	-0.094957909	-0.094957909	2020M10	-0.146464797	-0.14646
2010M05	-0.102528116	-0.102528116	2020M11	0.146464797	0.146465
2010M06	0.200034572	0.200034572	2020M12	-0.09531018	-0.09531
2010M07	-0.000806849	-0.000806849	2021M01	-0.051293294	-0.05129
2010M08	0.001150252	0.001150252	2021M02	0.051293294	0.051293
2010M09	-0.09015798	-0.09015798	2021M03	0.139761942	0.139762
2010M10	0.001026043	0.001026043	2021M04	-0.191055237	-0.19106
2010M11	-0.006391323	-0.006391323	2021M05	-0.414083375	-0.41408
2010M12	0.050923224	0.050923224	2021M06	0.590651408	0.590651
2011M01	-0.042312411	-0.042312411	2021M07	-0.100161892	-0.10016
2011M02	-0.102607792	-0.102607792	2021M08	0.14665364	0.146654
2011M03	0.248855226	0.248855226	2021M09	0.000887275	0.000887
2011M04	-0.235871401	-0.235871401	2021M10	-0.145638581	-0.14564
2011M05	0.005776716	0.005776716	2021M11	0.147560158	0.14756
2011M06	0.198685896	0.198685896	2021M12	-0.045723356	-0.04572
2011M07	-0.063807214	-0.063807214	2022M01	-0.04054917	-0.04055
2011M08	0.005611699	0.005611699	2022M02	0.003885959	0.003886
2011M09	0.063244739	0.063244739	2022M03	-1.610096547	0.021549
2011M10	-0.108648769	-0.108648769	2022M04		-0.00038
2011M11	0.016069042	0.016069042	2022M05		0.004352
2011M12	0.015991045	0.015991045	2022M06		0.003331
2012M01	0.049926768	0.049926768	2022M07		0.003552
2012M02	-0.103406375	-0.103406375	2022M08		0.003504
2012M03	0.144851444	0.144851444	2022M09		0.003514

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2012M04	-0.148235313	-0.148235313	2022M10		0.003512
2012M05	0.050931389	0.050931389	2022M11		0.003513
2012M06	0.049845729	0.049845729	2022M12		0.003512

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