Modelling Mexican Peso to Nigerian Naira Exchange Rates Due to the two Nigerian Economic Recessions: An Intervention Analysis Approach

Amadi, Ebere Peace[1*], Anthony Ike Wegbom[2] and Weli Azubuike[2]
[1]Department of Statistics, Abia State Polytechnic, Aba.
[2]Department of Mathematics, Rivers State University of Science and Technology, Port Harcourt, Nigeria
*Corresponding author email: eberepeaceamadi@gmail.com

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ABSTRACT
Modelling the Mexican Peso to the Nigerian Naira exchange rates with the standard Box-Jenkins ARIMA model in the presence of external events might be misleading and generating forecasts from such model may be unreliable. This study posits that the exchange rate between Mexican Peso and Nigerian Naira was exclusively influenced by the economic downturn experienced in Nigeria during the years 2016 and 2020. Thus, the intervention is described as a step function.

***Key words**: Mexican Peso, Naira, Exchange Rate, Modelling, Intervention Analysis*

INTRODUCTION
Background to the Study

Nigeria has had two occurrences of economic recession throughout the preceding five-year period, specifically in the years 2016 and 2020.The previously mentioned phenomenon has a notable influence on the evaluation of the Nigerian Naira in comparison to different international currencies, resulting in considerable fluctuations in its exchange rate. Ngandu (2008) posits that these oscillations possess the capacity to exert an impact on the expenses incurred in local production. The impact of Naira volatility on the employment market is a topic explored by Nucci and Pozzolo (2010). According to Yokoyama et al. (2015), the appreciation of the Naira's value serves as a catalyst for the creation of domestic job prospects in both the manufacturing and non-manufacturing sectors. Conversely, proponents claim that the devaluation of the Naira may result in an increase in the unemployment rate as a consequence of diminished investments in tangible assets (Belke and Gros, 2001). Hence, the stabilisation of currency rates necessitates the promotion of investment and the regulation of unemployment levels (Chimnani et al., 2012).

Nigeria’s dependent on revenue generated from oil exports, rendering it susceptible to the fluctuations and instability inherent in the global oil market. The year 2016 was characterised by a notable economic downturn in Nigeria, primarily due to a substantial decrease in oil prices. This reduction in oil prices resulted in considerable budgetary difficulties and a contraction of the economy. The economic challenges of Nigeria were further intensified in the year 2020 due to the impact of the COVID-19 pandemic, which was experienced by numerous countries worldwide. The outbreak of the pandemic led to a dual impact on society, encompassing both a significant public health emergency and a notable economic downturn. The implementation of lockdown measures and different limitations had far-reaching consequences on multiple sectors of the economy. The Nigerian government has implemented a range of interventions, such as foreign exchange rate controls, with the aim of achieving economic stabilisation. The examination and forecasting of currency exchange rates yield valuable insights for making well-informed financial choices and are crucial in several international financial endeavours, including speculation, hedging, and capital budgeting (Moosa, 2008). As a result, the modelling and forecasting of currency exchange rates have emerged as a crucial and significant component of economic policy formulation (Hina & Qayyum, 2015). The objective of this study is to analyse the effects of the two Nigerian economic recession on Mexican Pesos to Nigerian Naira exchange rates.

Several studies have investigated the use of intervention analysis and some of the studies include Inyang *et al* (2023) who worked on Time Series Intervention Modelling Based on ESM and ARIMA Models: Daily Pakistan Rupee/Nigerian Naira Exchange Rate. Amadi and Etuk (2023) studied Modelling Intervention of Columbian Peso to Nigerian Naira Exchange Rates Due to 2016 & 2020 Nigerian Economic Recessions. Moffat and Inyang (2022), investigated the impact of the Nigerian government amnesty programme (GAP) on her crude oil production. Etuk *et al* (2022), investigated the impact of declaration of cooperation (DoC) on the Nigerian crude oil production. Etuk *et al* (2021) used Arima-intervention Analysis in modelling Nigerian Automotive Gas Oil Distribution. Etuk and Amadi (2021) modelled Nigerian Monthly Crude Oil Prices using Arima-intervention model. Shittu and Inyang (2019) modelled Nigerian monthly crude oil prices using the ARIMA-Intervention model with a view to comparing the result with that of the intervention model using lag operator. Wiri and Tuaneh (2019) modelled the Nigerian Crude Oil Prices Using ARIMA, Pre-intervention and Post-intervention Model. Mosugu and Anieting (2016) employed intervention analysis as a methodological framework to evaluate the effects of governmental regime and policy alterations on foreign currency rates within the Nigerian context. Mrinmoy *et al* (2014) used time series Intervention Modelling for Modelling and Forecasting Cotton Yield in India. Jarrett and Kyper (2011), used ARIMA Modelling with Intervention to Forecast and Analysed Chinese Stock Prices. Roy *et al* (2009) used ARIMA – Intervention Analysis in Modelling the Financial Crisis in China's Manufacturing Industry.Shittu (2009) utilised intervention analysis as a methodological approach to examine the monthly variations in exchange rates between the Naira and the US Dollar within the time frame of 1970 to 2004. The researcher successfully identified various intervention components during the course of their investigation.

METHODOLOGY

Model Specification

The transfer function-noise model proposed by Box and Tiao (1975) [2] is given as

$$Y_t = c + \frac{\omega_s(B)}{\delta_r(B)} B^b I_t + U_t \qquad (1)$$

$$U_t = \frac{\theta(B)}{\emptyset(B)} a_t \qquad (2)$$
$$\omega_s(B) = \omega_0 + \omega_1(B) + \omega_1 B^2 + \cdots + \omega_s B^s \qquad (3)$$
$$\delta_r(B) = 1 + \delta_1(B) + \delta_2 B^2 + \cdots + \delta_s B^s \qquad (4)$$
$$\theta(B) = (1 - \theta_1 B - \theta_2 B^2 - \cdots - \theta_1 B^q) \qquad (5)$$
$$\emptyset(B) = (1 - \emptyset_1 B - \emptyset_2 B^2 - \cdots - \emptyset_1 B^p) \qquad (6)$$

Where,

Y_t is the response variable at t, b =delay parameter, ω_s=impact parameter, δ_r=slope parameter, $\emptyset$ =Non-seasonal autoregressive parameter, θ =Non-seasonal moving average parameter, a_t =White noise, I_t= Input function or Indicator variable

Mathematically, there exist two input functions:

$$I_t^{(t_0)} = \begin{cases} 0 \; if t \neq t_0 \\ 1 \; if t = t_0 \end{cases} \text{ (Pulse Function)} \qquad (7)$$
$$I_t^{(t_0)} = \begin{cases} 0 \; if t < t_0 \\ 1 \; if t \geq t_0 \end{cases} \text{ (Step Function)(8)}$$

Data Description

The dataset comprises daily exchange rates between the Nigerian Naira and the Columbian Peso, as well as the Mexican Peso, for the periods of January 1st to August 31st in 2016, and September 1st to December 31st in 2020. The exchange rates were obtained from the websites http://www.exchangerates.org.uk/MXN-NGN-spot-exchange-rates-history. The research was conducted with EViews statistical software packages.

RESULTS

Discussion of Results

The time plot of the 244 daily Mexican Peso (MXN) to Nigerian Naira (NGN) exchange rates recorded in 2016 is given in Figure 1.

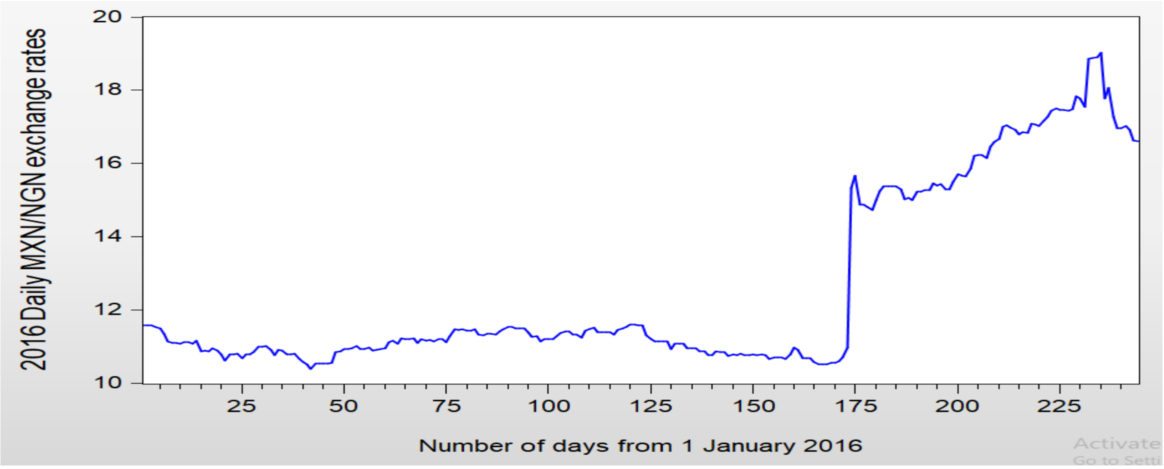


Figure 1: Time Plot of 2016 Daily MXN/NGN Exchange Rate

The time plot in Figure 1 shows a spike at data point 174 which coincided with the intervention period. The plot also shows that the 2016 daily MXN/NGN exchange rate is non-stationary.
The time plot 173 daily exchange rates of the pre-intervention period that ranges from 1st January 2016 to 21st June 2016 is given in Figure 2.

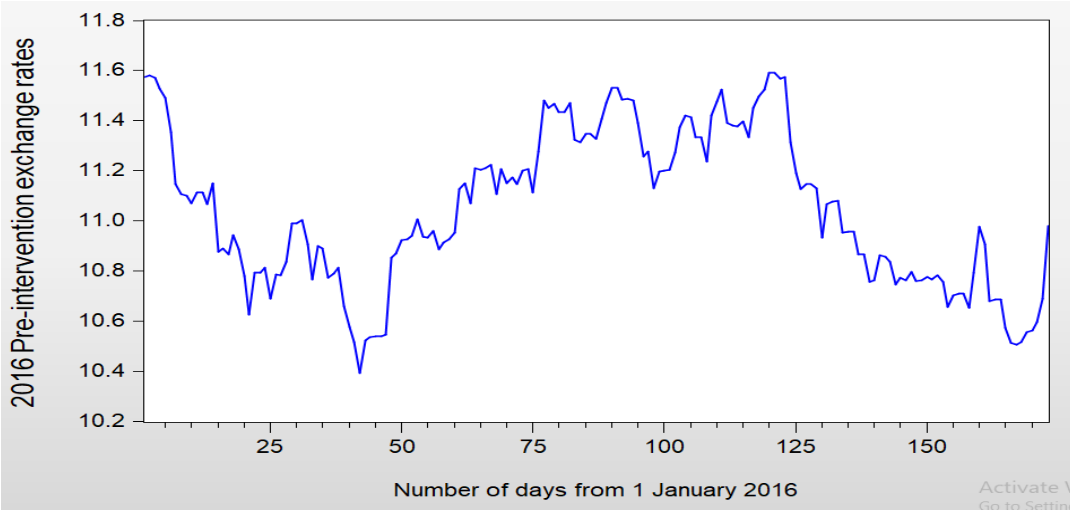


Figure 2: Time Plot of 2016 Daily MXN/NGN Pre-intervention Exchange Rate

The time plot in Figure 2 indicates that the 2016 daily MXN/NGN pre-intervention exchange rate collected is non-stationary.
Conducting a unit root test on the 2016 daily MXN/NGN pre-intervention exchange rate produced the result in Table 1.

Table 1: Unit Root Test for2016 Daily MXN/NGN Pre-intervention Exchange Rate

Null Hypothesis: MXNN has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.280980	0.1793
Test critical values:	1% level	-3.468521	
	5% level	-2.878212	
	10% level	-2.575737	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MXNN)
Method: Least Squares
Date: 03/17/22 Time: 13:05
Sample (adjusted): 2 173
Included observations: 172 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MXNN(-1)	-0.049163	0.021553	-2.280980	0.0238
C	0.539596	0.238177	2.265527	0.0247

R-squared	0.029696	Mean dependent var	-0.003469
Adjusted R-squared	0.023989	S.D. dependent var	0.088280
S.E. of regression	0.087215	Akaike info criterion	-2.029330
Sum squared resid	1.293086	Schwarz criterion	-1.992731
Log likelihood	176.5224	Hannan-Quinn criter.	-2.014481
F-statistic	5.202868	Durbin-Watson stat	1.834161
Prob(F-statistic)	0.023791		

The probability value of 0.1793 in Table 1 indicates that the null hypothesis that the 2016 daily MXN/NGN pre-intervention exchange rate contains a unit root should not be rejected.
Differencing the pre intervention series and making a time plot of the differenced series the time plot in Figure 3 was obtained.

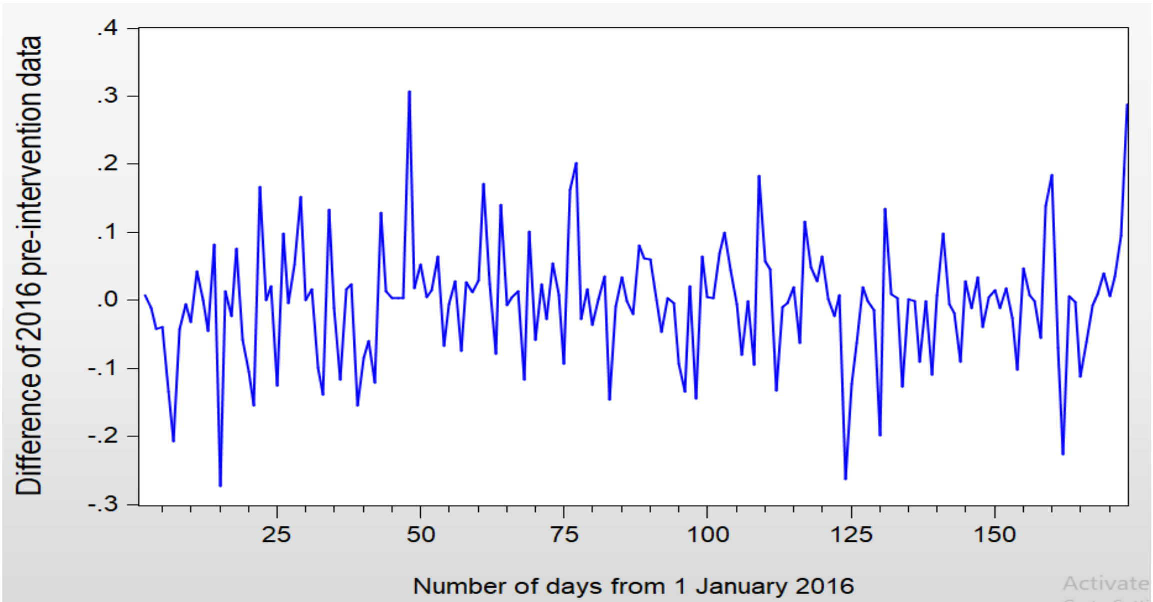


Figure 3: Time Plot of the Differenced 2016 Daily MXN/NGN Pre-intervention Exchange Rate

Figure 3 shows that the differenced 2016 daily MXN/NGN pre-intervention exchange rate is stationary.

The differenced 2016 daily MXN/NGN pre-intervention exchange rate was tested for unit root and the result in Table 2.

Table 2: Unit Root Test for the Differenced 2016 Daily MXN/NGN Pre-intervention Exchange Rate

Null Hypothesis: DMXNN has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.11423	0.0000
Test critical values:	1% level	-3.468749	
	5% level	-2.878311	
	10% level	-2.575791	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DMXNN)
Method: Least Squares
Date: 03/17/22 Time: 13:13
Sample (adjusted): 3 173
Included observations: 171 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DMXNN(-1)	-0.962629	0.079463	-12.11423	0.0000
C	-0.003339	0.006798	-0.491197	0.6239

R-squared	0.464774	Mean dependent var	0.001642
Adjusted R-squared	0.461607	S.D. dependent var	0.120938
S.E. of regression	0.088739	Akaike info criterion	-1.994616
Sum squared resid	1.330798	Schwarz criterion	-1.957871
Log likelihood	172.5397	Hannan-Quinn criter.	-1.979707
F-statistic	146.7545	Durbin-Watson stat	1.936667
Prob(F-statistic)	0.000000		

Since a probability value of 0.000 which less than 0.05 was obtained as shown in Table 4.12, the differenced 2016 daily MXN/NGN pre-intervention exchange rate is stationary.
The Correlogram of the differenced 2016 daily MXN/NGN pre-intervention exchange rate is given in Table 4.13.

Table 3: The Correlogram of the Differenced 2016 daily MXN/NGN Pre-intervention Exchange Rata

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.035	0.035	0.2142	0.643
		2	-0.010	-0.011	0.2324	0.890
		3	-0.017	-0.016	0.2809	0.964
		4	0.042	0.043	0.5972	0.963
		5	0.046	0.043	0.9757	0.964
		6	-0.072	-0.075	1.9076	0.928
		7	-0.214	-0.209	10.242	0.175
		8	0.055	0.069	10.784	0.214
		9	-0.027	-0.040	10.916	0.281
		10	0.021	0.022	10.999	0.358
		11	-0.104	-0.086	12.997	0.294
		12	0.112	0.137	15.340	0.223
		13	0.087	0.047	16.767	0.210
		14	0.078	0.040	17.911	0.211
		15	-0.023	-0.002	18.015	0.262
		16	0.018	0.010	18.077	0.319
		17	-0.012	-0.029	18.103	0.382
		18	0.136	0.109	21.716	0.245
		19	-0.094	-0.045	23.452	0.218
		20	-0.059	-0.041	24.138	0.236
		21	0.019	0.054	24.211	0.283
		22	-0.123	-0.165	27.221	0.203
		23	-0.067	-0.040	28.124	0.211
		24	0.079	0.102	29.383	0.206
		25	-0.066	-0.041	30.258	0.215
		26	0.128	0.076	33.620	0.145
		27	0.006	0.022	33.628	0.177
		28	0.050	0.039	34.155	0.196
		29	0.076	0.032	35.363	0.193
		30	0.023	-0.012	35.476	0.226
		31	-0.060	-0.062	36.234	0.238
		32	0.163	0.196	41.939	0.112
		33	0.006	0.011	41.947	0.137
		34	-0.065	-0.078	42.850	0.142
		35	-0.133	-0.050	46.740	0.089

Table 3 shows that the differenced 2016 daily MXN/NGN pre-intervention exchange rate is a white noise given that F=10.9786. Since the difference 2016 MXN/NGN pre-intervention exchange rate has been established to be a stationary white noise series. Then the transfer function of the intervention analysis was obtained as presented above.

Table 4: The Determination of the Transfer Function of the 2016 MXN/NGN Exchange Rate Intervention Model

Dependent Variable: Z
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 03/17/22 Time: 13:36
Sample: 174 244
Included observations: 71
Convergence achieved after 46 iterations
Coefficient covariance computed using outer product of gradients
Z=C(5)*(1-C(6)^(T-173))/(1-C(6))

	Coefficient	Std. Error	t-Statistic	Prob.
C(5)	0.573954	0.067255	8.534017	0.0000
C(6)	0.906137	0.012548	72.21473	0.0000

R-squared	0.121051	Mean dependent var	5.431232
Adjusted R-squared	0.108312	S.D. dependent var	1.124157
S.E. of regression	1.061533	Akaike info criterion	2.985070
Sum squared resid	77.75283	Schwarz criterion	3.048808
Log likelihood	-103.9700	Hannan-Quinn criter.	3.010417
Durbin-Watson stat	0.099130		

The intervention model Z is given in Table 4 where C(5) and C(6) are the coefficients and T is time after the series started. The model was used to forecast the 2016 post intervention MXN/NGN daily exchange rates and the forecast values are superimposed on the observed post-intervention 2016 daily MXN/NGN exchange rate as shown in Figure 4.

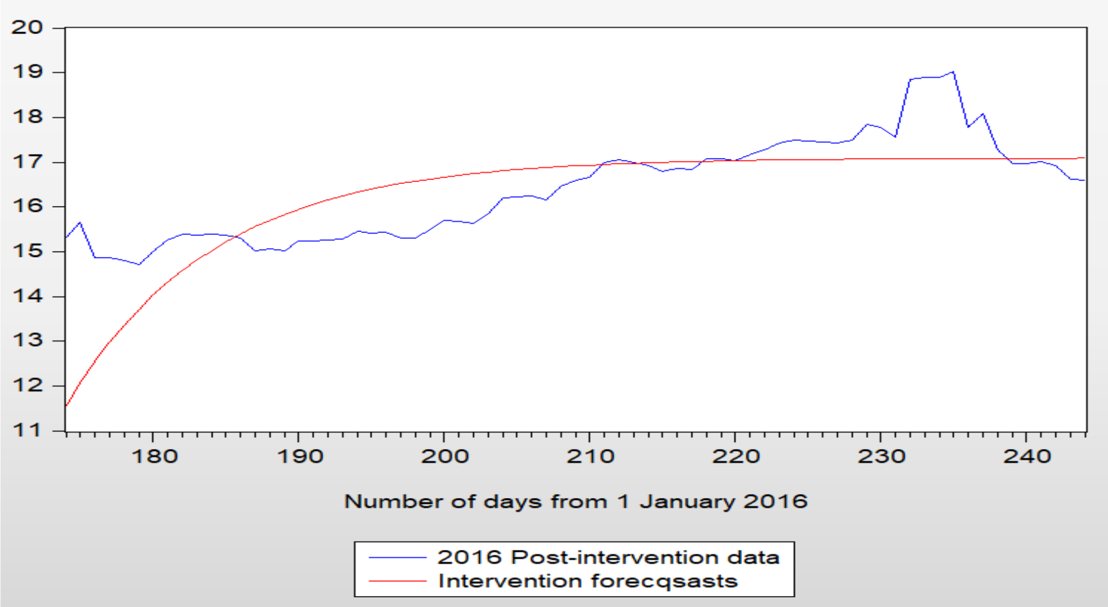


Figure 4: Superimposition of the Intervention Forecast of 2016 MXN/NGN Exchange Rate on the Observed Post-intervention Exchange Rate

The original post-intervention MXN/NGN exchange rate and the corresponding intervention forecast obtained from the intervention model are given as,

$$\chi^2 = \sum \frac{(MXNN - EXPTD)^2}{EXPTD} = 3.01231$$

The null hypothesis, H_0: MXNN (2016 post intervention MVN/NGN exchange rate) and INFL (intervention forecast) agree (there is no significant change in the mean of the MXN/NGN process from pre-intervention series to the post-intervention series in 2016) is not rejected since $\chi^2 = 3.01231 < \chi^2_{0.05,71-1} = 90.531$

The time plot of the 123 daily Mexican Peso (MXN) to Nigerian Naira (NGN) exchange rates recorded from 1st September to 31st December 2020 is given Figure 5.

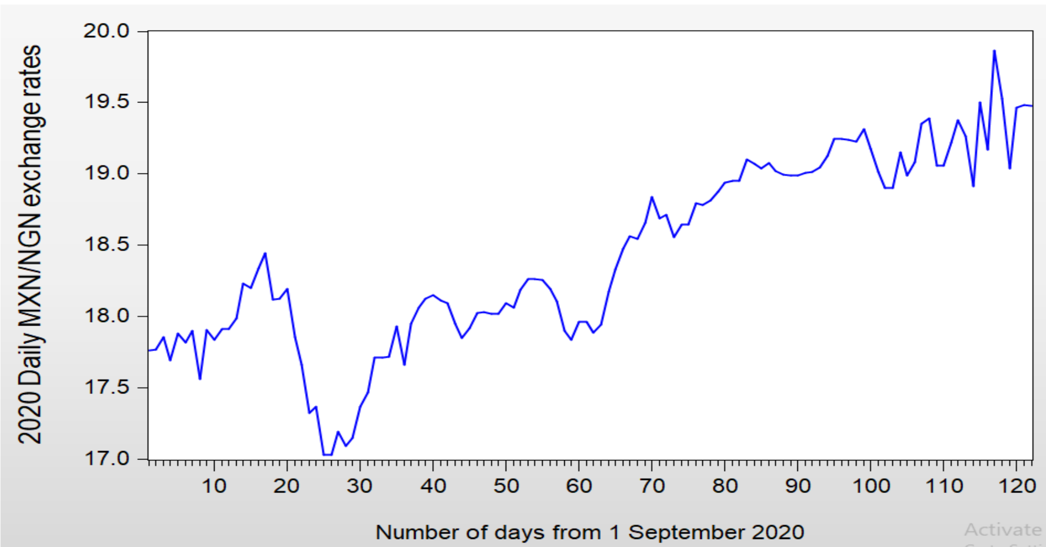


Figure 5: Time Plot of 2020 Daily MXN/NGN Exchange Rate

The time plot in Figure 5 suggests that the 2020 daily MXN/NGN exchange rate is a non-stationary series. The result of a unit root test conducted on the 2020 daily MXN/NGN pre-intervention exchange rate is given in Table 5.

Table 5: Unit Root Test for the 2020 Daily MXN/NGN Exchange Rate

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.760558	0.7144
Test critical values:	1% level	-4.078420	
	5% level	-3.467703	
	10% level	-3.160627	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MXNN1)
Method: Least Squares
Date: 03/17/22 Time: 14:45
Sample (adjusted): 2 80
Included observations: 79 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MXNN1(-1)	-0.085782	0.048724	-1.760558	0.0823
C	1.496308	0.855890	1.748247	0.0845
@TREND("1")	0.001620	0.000914	1.773719	0.0801

R-squared	0.048033	Mean dependent var	0.014924
Adjusted R-squared	0.022981	S.D. dependent var	0.145651
S.E. of regression	0.143967	Akaike info criterion	-1.001226
Sum squared resid	1.575221	Schwarz criterion	-0.911247
Log likelihood	42.54841	Hannan-Quinn criter.	-0.965177
F-statistic	1.917345	Durbin-Watson stat	2.083944
Prob(F-statistic)	0.154040		

The probability value of 0.7144 indicates that indeed the 2020 daily MXN/NGN pre-intervention exchanged rate collected is non-stationary.

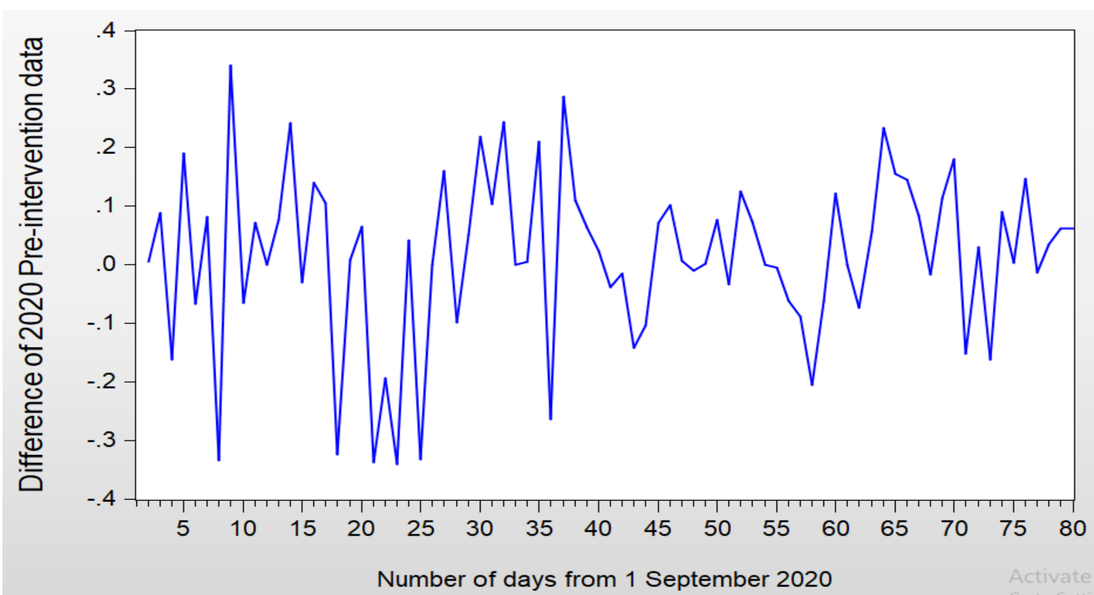


Figure 6: Time Plot of the Differenced 2020 Daily MXN/NGN Pre-intervention Exchange Rate

Figure 6 shows the time plot of 80 differenced 2020 daily MXN/NGN pre-intervention exchange rates recorded within the pre-intervention period 1st September to 19st November 2020. Figure 6 reveals that the 2020 Daily MXN/NGN pre-intervention exchange rate became stationary after first differencing.

Table 6: Unit Root Test for the Differenced 2020 Daily MXN/NGN Pre-intervention Exchange Rate

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.455724	0.0000
Test critical values:	1% level	-3.516676	
	5% level	-2.899115	
	10% level	-2.586866	

*MacKinnon (1996) one-sided p-values.

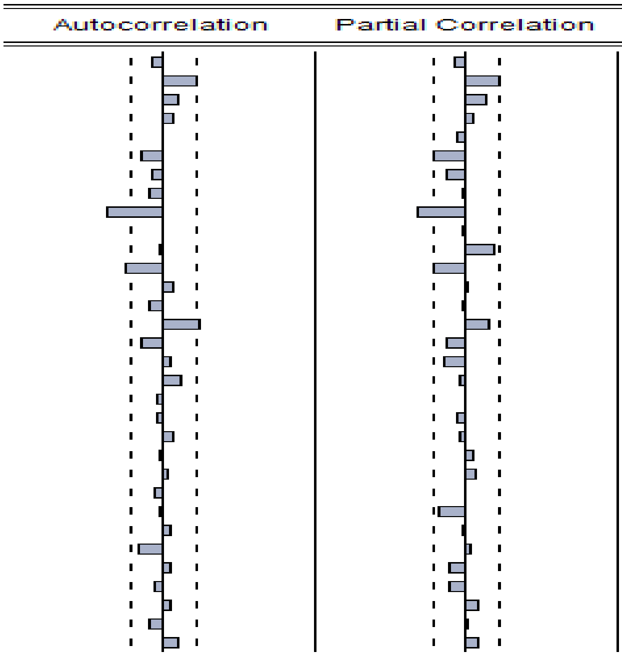
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DMXNN1)
Method: Least Squares
Date: 03/17/22 Time: 14:53
Sample (adjusted): 3 80
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DMXNN1(-1)	-1.081740	0.114401	-9.455724	0.0000
C	0.016211	0.016731	0.968909	0.3357

R-squared	0.540538	Mean dependent var	0.000726
Adjusted R-squared	0.534492	S.D. dependent var	0.215538
S.E. of regression	0.147058	Akaike info criterion	-0.970675
Sum squared resid	1.643577	Schwarz criterion	-0.910247
Log likelihood	39.85632	Hannan-Quinn criter.	-0.946484
F-statistic	89.41072	Durbin-Watson stat	1.956645
Prob(F-statistic)	0.000000		

The probability value of 0.000 obtained in the unit root test as shown in table 6 confirms that the 2020 daily MXN/NGN pre-intervention exchange rate collected became stationary after first differencing. Again the differenced 2020 daily MXN/NGN pre-intervention exchange rate produced a white noise fit as shown in Table 7.

Table 7: The Correlogram of the differenced 2020 Daily MXN/NGN Pre-intervention Exchange Rata



	AC	PAC	Q-Stat	Prob
1	-0.082	-0.082	0.5467	0.460
2	0.236	0.231	5.1891	0.075
3	0.104	0.146	6.0981	0.107
4	0.075	0.043	6.5755	0.160
5	-0.004	-0.056	6.5766	0.254
6	-0.149	-0.216	8.5194	0.202
7	-0.077	-0.133	9.0426	0.250
8	-0.086	-0.024	9.7017	0.287
9	-0.370	-0.323	22.237	0.008
10	-0.002	-0.010	22.237	0.014
11	-0.024	0.196	22.293	0.022
12	-0.258	-0.218	28.634	0.004
13	0.067	0.021	29.064	0.006
14	-0.083	-0.011	29.748	0.008
15	0.246	0.165	35.801	0.002
16	-0.142	-0.134	37.843	0.002
17	0.043	-0.150	38.033	0.002
18	0.129	-0.026	39.782	0.002
19	-0.034	-0.007	39.903	0.003
20	-0.032	-0.057	40.013	0.005
21	0.076	-0.045	40.645	0.006
22	-0.024	0.045	40.708	0.009
23	0.031	0.076	40.818	0.012
24	-0.065	0.005	41.316	0.015
25	-0.010	-0.187	41.327	0.021
26	0.056	-0.015	41.711	0.026
27	-0.168	0.025	45.182	0.016
28	0.056	-0.111	45.575	0.019
29	-0.059	-0.108	46.017	0.023
30	0.045	0.096	46.279	0.029
31	-0.086	0.013	47.267	0.031
32	0.103	0.097	48.716	0.030

Having achieved stationarity in the 2020 daily MXN/NGN pre-intervention exchange rate which have a white noise fit as shown in Table 7. ARMA model were fit to the exchange rates and the result given in Table 8.

Table 8: ARIMA Models for the Difference 2020 MXN/NGN Pre-intervention Exchange Rate

Dependent Variable: DMXNN1
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 03/17/22 Time: 15:00
Sample: 2 80
Included observations: 79
Failure to improve objective (non-zero gradients) after 31 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AR(1)	-0.778210	0.108165	-7.194626	0.0000
AR(9)	-0.220654	0.290696	-0.759054	0.4503
AR(10)	-0.462834	0.306945	-1.507874	0.1360
MA(1)	0.712425	0.237566	2.998848	0.0037
MA(9)	-0.209654	0.367182	-0.570980	0.5698
MA(10)	0.162646	0.296043	0.549400	0.5844
SIGMASQ	0.015245	0.003792	4.020823	0.0001

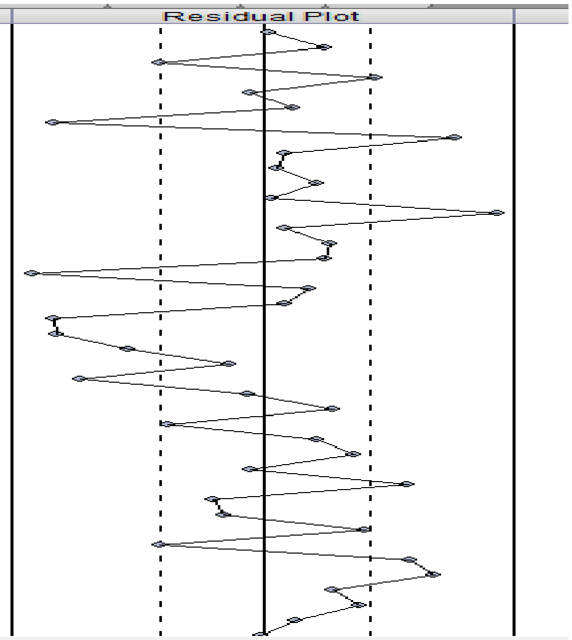
R-squared	0.272160	Mean dependent var	0.014924
Adjusted R-squared	0.211506	S.D. dependent var	0.145651
S.E. of regression	0.129334	Akaike info criterion	-1.096678
Sum squared resid	1.204359	Schwarz criterion	-0.886727
Log likelihood	50.31876	Hannan-Quinn criter.	-1.012565
Durbin-Watson stat	1.771424		

Inverted AR Roots	.85-.30i	.85+.30i	.47+.77i	.47-.77i
	-.11+.90i	-.11-.90i	-.65+.67i	-.65-.67i
	-.96+.22i	-.96-.22i		
Inverted MA Roots	.66-.16i	.66+.16i	.50+.59i	.50-.59i
	.01+.84i	.01-.84i	-.56+.72i	-.56-.72i
	-.96-.27i	-.96+.27i		
	Estimated MA process is noninvertible			

From Table 8, the AR (1) and MA (1) components of the ARIMA model were significant with probability values 0.000 and 0.0037 respectively. The observed 2020 daily MXN/NGN post-intervention exchange rate, the fitted values and their corresponding residuals are given in Table 9.

Table 9: The 2020 Daily MXN/NGN Post-intervention Exchange Rate with the Fitted Values and Residuals

obs	Actual	Fitted	Residual
2	0.00580	0.00086	0.00494
3	0.08790	0.01095	0.07695
4	-0.16190	-0.03212	-0.12978
5	0.19030	0.05222	0.13808
6	-0.06690	-0.05084	-0.01606
7	0.08130	0.04655	0.03475
8	-0.33440	-0.07560	-0.25880
9	0.34080	0.10548	0.23532
10	-0.06520	-0.09087	0.02567
11	0.07140	0.05401	0.01739
12	0.00000	-0.06721	0.06721
13	0.07680	0.06595	0.01085
14	0.24280	-0.04276	0.28556
15	-0.03070	-0.05669	0.02599
16	0.14090	0.06036	0.08054
17	0.10450	0.02751	0.07699
18	-0.32480	-0.03934	-0.28546
19	0.00830	-0.04832	0.05662
20	0.06570	0.03894	0.02676
21	-0.33780	-0.07682	-0.26098
22	-0.19300	0.06294	-0.25594
23	-0.34010	-0.17330	-0.16680
24	0.04230	0.08666	-0.04436
25	-0.33260	-0.10537	-0.22723
26	0.00000	0.02030	-0.02030
27	0.16090	0.07681	0.08409
28	-0.09810	0.01979	-0.11789
29	0.05260	-0.01280	0.06540
30	0.21850	0.10548	0.11302
31	0.10310	0.11999	-0.01689
32	0.24460	0.06766	0.17694
33	0.00000	0.06127	-0.06127
34	0.00480	0.05287	-0.04807
35	0.20980	0.08367	0.12613
36	-0.26410	-0.13333	-0.13077
37	0.28680	0.10606	0.18074
38	0.10970	-0.09795	0.20765
39	0.06400	-0.02084	0.08484
40	0.02370	-0.09320	0.11690
41	-0.03840	-0.07829	0.03989
42	-0.01530	-0.01087	-0.00443



Forecasts of the difference series are obtained by multiplication of each actual above by -0.7782

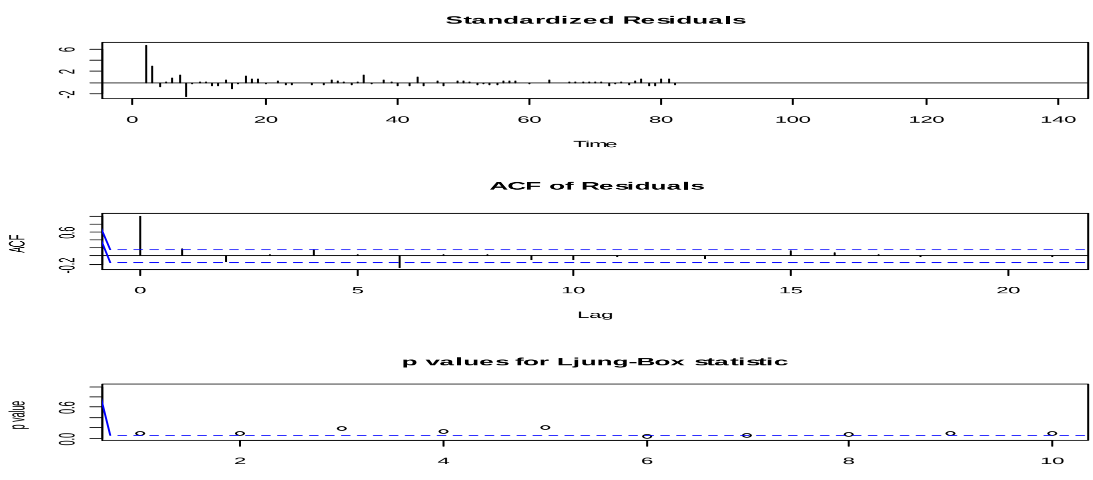


Figure 7: Display of p-value, residual ACF and standardized model adequacy of MXN/NGN with intervention.

The MXN/NGN exchange rate exhibited non-stationarity, as evidenced by the data presented in Figures 1. The pre-intervention series exhibited non-stationarity, as evidenced by Figures 2 and 5. The pre-intervention series achieved stationarity using first-order differencing, as illustrated in Figures 3 and 6. This statement suggests that there is a linear relationship between the exchange rates of MXN and NGN. The results of the unit roots tests run on the exchange rate series indicate that the null hypothesis of non-stationarity cannot be rejected, as evidenced by the p-values of 0.1793 and 0.7144, as presented in Tables 1 and 5, respectively. However, the outcomes of the unit root test performed on the exchange rates after differencing indicate the rejection of the null hypothesis, suggesting stationarity. This conclusion is supported by the p-values of 0.0000 and 0.000 derived from Tables 2 and 6, respectively.

The residuals of the ARIMA model applied to pre-intervention exchange rates of MXN/NGN exhibit characteristics of a white noise series, as evidenced by the findings presented in Tables 3 and 7. This finding is consistent with the findings reported by Newaz (2008), Appiah and Adetunde (2011), Onasanya and Adeniji (2013), and Ajao et al. (2017). The computed coefficients of covariance for the transfer function of the intervention analysis yielded significant p-values. Similarly, the intervention analysis of the MXN/NGN exchange rate for 2016 & 2020, the coefficients had p-values of 0.000 and 0.000, respectively. Model checking, which is often referred to as diagnostic check or residual analysis, holds significant significance in the process of model construction. The evaluation of the fitted model's adequacy is determined.

CONCLUSION

However, this study is constrained by its reliance on an intervention model that implies the pre-intervention exchange rate adheres to an ARIMA model. The non-stationarity of the MXN/NGN exchange rates, as well as their pre-intervention series, was evident based on the observed data. However, the exchange rates exhibited stationarity after being differenced for the first time. This study posits that the exchange rate between the Mexican Peso (MXN) and Nigerian Naira (NGN) was exclusively influenced by the economic downturn experienced in Nigeria during the years 2016 and 2020. Hence, the intervention is described as a step function.

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