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ARDL Inference for Some Macroeconomic Variables on Nigeria Unemployment Rate

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ABSTRACT

This research investigates the impact of foreign direct investment (FDI), government expenditure (GE), and inflation rate (IR) on the unemployment rate (UR) in Nigeria through the application of an Autoregressive Distributed Lag (ARDL) model. The study encompasses four ARDL models that analysed the effect of FDI on UR, GE on UR, IR on UR, and the combination of FDI, GE, and IR on UR over the period 1985-2021. Initial assessments involve a rolling correlation to test the significance of signals between each predictor variable and UR. Subsequently, the research employs the ARDL bounds test methodology to examine cointegration among FDI and UR, GE and UR, and IR and UR. Additionally, an Error Correction Model (ECM) is utilized to explore the causal relationship between these economic variables. The Augmented Dickey Fuller unit root test suggests that the variables attain stationarity at first differences (I(1)). Also, in determining the stability of the estimated parameters, the cumulative sum (CUSUM) of squares chart was applied. The results from the first model revealed that FDI at first lag significantly impacted on UR negatively at 5% in the long run but at current value of FDI the impact is insignificantly negative in the short run. However, the second and third models results revealed a positive insignificant impact of GE and IR, respectively, on UR at 5%. The fourth model results revealed that FDI at lag one negatively and positively influences UR in the long run and short run, respectively. However, GE and IR had positive but insignificant impact on UR at 5%. The CUSUM of square charts for the four models indicated an unstable parameter estimates during the sampled period. The study concludes that UR is not influenced by GE and IR in both the long run and short run but FDI influences UR positively and negatively both in the long run and short run, respectively.

KEYWORDS

Macroeconomic variables; Autoregressive distributed lag; Bounds test; Co-integration; Error correction model

Introduction

Unemployment has been one of the most challenging issues faced by most developed and developing countries (Nigeria) and resulting to socio-economic problems. In justifying this assertion, Akeju and Olanipeun (2014) noted that one of the great-

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est challenges of the Sub-Saharan African economies today is the high rate of unemployment that has maintained a rising trend over the years. This rising state of unemployment in Nigeria is known by many with its biting presence on an average Nigerian. Unemployment rate in Nigeria rose from 27.1% to 33.3% from December 2018 to March 2021, according to the National Bureau of Statistics, (NBS). The NBS explained that the number of unemployed Nigerians rose to 23.19 million in the fourth quarter of 2020 on the back of job losses occasioned by the outbreak of Covid-19 pandemic and its stifling impact on businesses during the period (Egwuatu 2021). The unemployed youth population is about 20.3 million, about 4.5 million new entrants into the labour market annually, 2.2 million primary school leavers not proceeding to secondary school, one million secondary school leavers not proceeding to the tertiary level and roughly 600,000graduates annually, not finding any placement after graduation. This tend to put the nation in great danger, as world bank survey in 2011 reported that 40 percent of those who join militancy movement indicated that they are motivated by unemployment, while 50 percent of those involved in criminal activities are also stimulated by unemployment. Unemployment has been recognized as a key variable that causes danger to the Government of a nation (Philip et al., 2013). Unemployment is a multidimensional phenomenon; because it affects economic activity of a country as well as social structure of societies. So these two dimensions create complexity and impose adopting extensive analysis to solve this problem. The main objective of every policy maker either from fiscal policy or monetary policy is to attain high economic growth. There are many determinants responsible for detaining growth rate of a country. One of them is high rate of unemployment. The rate of unemployment cannot be overemphasized as it has been recognized as one of the danger for economic development. This shows that various macroeconomic policies by government have been unable to achieve, sustained a reduction in unemployment and sustained growth as the economy has plunged into recession recent time. This might not be unconnected to the failure in the macroeconomic management. The essence of macroeconomic management underlines the rationale for the existence of government as a vital economic agent. Following the oil boom of the late 1970s, there was mass migration of people, especially the youth, to the urban areas seeking for jobs (Yelwa et al., 2015). In examining unemployment, various people around the world collaborate and many studies have proved the existent of unemployment showing a negative impact on the Government of a nation (Nigeria). These include the works of Alhdiy et al. (2015) and Fuad (2011). Other significant studies by Farouk et al. (2021a) and (2021b), Agog et al. (2021), and David et al. (2023) revealed a steady increase of Nigeria unemployment rate where inflation and interest rates play a major factor in the steady increase. Similarly, in Nigeria, many studies in this regard have shown that the Ordinary Least Square (OLS) and the Error Correction Model (ECM) has been the frequently applied method of analysis even when the order of integration does not support the application of it. The effect of unemployment on Nigerian government remain understudy despite evidences have shown that shock which increases unemployment is likely to increase. Government being the front runner in providing employment to the citizen, factors that come to play in this regard are variables that can have adverse impact on the economy. This span from government expenditure rate in the economy, the level of investment outside the country which should attract investors to not only boost the economy reserves but create jobs, and the level of inflation in the country which determines not only the purchasing power of the people but influences the rise or drop-in unemployment rate. Since Unemployment in Nigeria continue to increase, this work seeks to study unemployment rate using Autoregressive Distribution Lag model (ARDL) to see the impact of government expenditure (GE), Foreign Direct Investment (FDI), and Inflation rate (IR) on unemployment in Nigeria.

1. MATERIALS AND METHODS

The study employs a secondary source of data. The annually time series data was collected from the National Bureau of statistics, Central Bank of Nigeria (CBN), World Bank Development Indicators and other journals and articles which covers the period 1985-2021. This study uses both descriptive and econometric analysis. The descriptive approach used is to show the trend and variation of FDI, GE, IR, and UR to give a clear view on how the variables change over time in Nigeria. In addition, the econometric approach used is to investigate the directional impact of FDI, GE, and IR on UR. The Auto-Regressive Distributed Lag (ARDL), bounds test methodology for testing the existence of cointegration between the variables and Error Correction Model (ECM) are used to investigate the causal bond between FDI and UR, GE and UR, and IR and UR.

1.1. *Model Specification*

On a general form, the model specification is a formulation of UR as a function of variability (relationship) with FDI, GE and IF. The representation of the model specification is presented below as follows

$$UR = \phi\,(FDI, GE, IR) \qquad \phi_1, \phi_2, \phi_3, \tag{1}$$

A priori expectation of FDI, GE, and IR for this study is negative or less than zero. This is because in the long run these variables effect on UR is paramount. If they go higher than required threshold of tolerance their impact will definitely be of concern. On the near-run the effect could be positive and greater than zero but it's not a reliable point to classify FDI, GE and IR impact as adverse. Theoretically, it is expected that a low and stable GE, FDI, and IR supports UR and vice versa.

1.2. *ARDL Models*

1.2.1. Model I: ARDL Model for UR and GE

Based on the model specification as formulated in equation (1), the first research model is a formulation of the ARDL model which captures UR and GE. Therefore, our first research model is given as,

$$\Delta \ln{(UR)}_t = \beta_0 + \beta_1 \ln{(UR)}_{t-1} + \beta_2 \ln{(GE)}_{t-1} + \sum_{i-1}^{j} \theta_{1i} \Delta \ln{(UR)}_{t-1} \tag{2}$$

Where, Δ is the 1st difference operator, ln(UPR) is the logarithm of unemployment rate, β_0 is the intercept, β_1 and β_2 are constant elasticity coefficient with respect to logarithm of UR and GE and ϵ is the error term. The apriori expectations for the model parameters are $\beta_0 > 0$, $\beta_1 > 0$, and $\beta_2 < 0$.

1.2.2. Model II: ARDL Model for UR and FDI

Based on the model specification as formulated in equation (1), the second research model is a formulation of the ARDL model which captures UR and FDI under study. The second research model is given as,

$$\begin{aligned}\Delta \ln (UR)_t = \beta_0 + \beta_1 \ln (UR)_{t-1} + \beta_2 \ln (FDI)_{t-1} + \sum_{i-1}^{j} \theta_{1i} \Delta \ln (UR)_{t-i} \\ + \sum_{i-1}^{j} \theta_{2i} \Delta \ln (FDI)_{t-i} + \varepsilon_t\end{aligned} \tag{3}$$

All parameters' descriptions are the same except for β_2 which is a constant elasticity coefficient for logarithm of FDI.

1.2.3. Model III: ARDL Model for UR and IR

Based on the model specification as formulated in equation (1), the third research model is a formulation of the ARDL model which captures UPR and IR variables under study. The third research model is as follows,

$$\Delta \ln (UR)_t = \beta_0 + \beta_1 \ln (UR)_{t-1} + \beta_2 \ln (IR)_{t-1} + \sum_{i-1}^{j} \theta_{1i} \Delta \ln (UR)_{t-i} \tag{4}$$

All parameters' descriptions are the same except for β_2 which is a constant elasticity coefficient for logarithm of IR.

1.2.4. Model IV: ARDL Model for All Variables

Based on the model specification as formulated in equation (1), the fourth research model is a formulation of the ARDL model which captures all variables under study. The fourth research model is given as,

$$\begin{aligned}\Delta \ln (UR)_t = \beta_O + \beta_1 \ln (UR)_{t-1} + \beta_2 \ln (GE)_{t-1} + \beta_3 \ln (FDI)_{t-i} + \beta_4 \ln (IR)_{t-i} \\ + \sum_{i-1}^{j} \theta_{1i} \Delta \ln (UR)_{t-1} + \sum_{i-1}^{j} \theta_{2i} \Delta \ln (GE)_{t-i} + \sum_{i-1}^{j} \theta_{3i} \Delta \ln (FDI)_{t-i} + \sum_{i-1}^{j} \theta_4 \Delta \ln (IR)_{t-i} + \varepsilon_t\end{aligned} \tag{5}$$

1.3. ***Bounds Test***

Next is the bounds test hypothesis for testing the long-run effect between the autonomous variable and the repressor variable dependent on the F-test, which tests the consolidated significance of the boundary estimates at one period slacked level of the factors in equation (2). The test hypothesis is $H_0 : \beta_1 = \beta_2 = 0$ verse $H_1 : \beta_1 \neq \beta_2 \neq 0$. The asymptotic scattering of acute values is gotten for circumstances where entirely repressors are strictly $I(1)$ and $I(0)$ or jointly cointegrated. Pesaran & Pesaran (1999) and Pesaran et al. (2001) reported two arrays of acute values. The two arrays of acute values give acute value bounds for categorizing the repressors into purely $I(1)$, $I(0)$ or jointly cointegrated. Conversely, Pesaran & Pesaran (1999) and Pesaran et al. (2001) arrays of acute values were for large sample sizes. A correction was made and offered by Narayan (2005) for sample with small sizes vacillating from n = 31. The null hypothesis of no cointegration is, not accepted if the computed F-statistic value is greater than the upper bound of the acute values. If the bounds test confirms the presence of a cointegration bond among the factors, then, it implies that there is a far-haul bond between the predictor and repressor variables, that is, among UR and FDI, UR and GE, and UR and IR (David et al., 2024). In determining the long-run relationship, an error correction model is to be established and implemented.

1.4. ***Error Correction Model (ECM)***

In this work, the ECM within bivariate relationship system is used to examine the direction of impact between UR and GE, FDI, and IR respectively. Also, the ECM has an interesting property of capturing the velocity of adjustment of growth and the independent variables considered for this research. The ECM is chosen over other alternative techniques because of its favorable response to both large and small samples. For this research three ECM are presented where each represents a model.

1.4.1. Model I: UR against GE

If UR and GE are co-integrated, the bivariate co-integration in ECM can be represented in the following form,

$$\Delta \ln UR_t = a_o + \sum_{i-1}^{n} a_{1i} \Delta \ln UR_{t-i} + \sum_{i-1}^{n} a_{2i} \Delta \ln GE_{t-i} + a_3 EC_{t-1} + \mu_t \tag{6}$$

where, EC_{t-1} is a one period slacked error adjustment term (EAT) captured from the integration regression, UR_t is the unemployment at time t and GEt is government expenditure at time t.

1.4.2. Model II: UR against FDI

If UR and FDI are co-integrated, the bivariate co-integration in ECM can be represented in the following form,

$$\Delta \ln UR_t = a_o + \sum_{i-1}^{n} a_{1i} \Delta \ln UR_{t-i} + \sum_{i-n}^{n} a_{2i} \Delta \ln FDI_{t-i} + a_3 EC_{t-i} + \mu_t \tag{7}$$

where, FDI_t is foreign direct investment at time t.

1.4.3. Model III: UPR against IR

If UR and IR are co-integrated, the bivariate co-integration in ECM can be represented in the following form.

$$\Delta \ln UR_t = a_o + \sum_{i-1}^{n} a_{1i} \Delta \ln UR_{t-i} + \sum_{i-1}^{n} a_{2i} \Delta \ln IR_{t-i} + a_3 EC_{t-1} + \mu_t \tag{8}$$

where, IR_t is foreign direct investment at time t.

1.4.4. Model IV: UR against GE, FDI, and IR

If UR against GE, FDI and IR are co-integrated, the bivariate co-integration in ECM can be represented in the following form.

$$\begin{aligned}\Delta \ln UR_t = a_o + \sum_{i-1}^{n} a_{1i}\Delta \ln UR_{t-i} + \sum_{i-1}^{n} a_{2i}\Delta \ln GE_{t-i} + \sum_{i-1}^{n} a_{3i}\Delta \ln FDI_{t-i} \\ + \sum_{i-1}^{n} a_{4i}\Delta \ln IR_{t-i} + a_5 EC_{t-1} + \mu_t\end{aligned} \tag{9}$$

where, all variables are as defined in (6), (7), and (8).

1.5. *Unit Root Test*

The Unit root test also known as the stationarity test, is a statistical test that is used to determine the order of integration. The Augmented Dickey-Fuller (ADF) test and the Phillips-Perrons (PP) test are commonly used unit root tests. In this study we will employ the ADF test to determine the order of integration of the variables.

1.6. *Unit Root Test*

In this study the lag selection is employ. The lag selection is an estimator of out-of-sample prediction error and thereby relative quality of statistical model for a given set of data, given a collection of the Akaike Information Criteria (AIC) estimate the quality of each model, relative to each of the other model's selection.

$$AIC = -2ln(L) + 2k \tag{10}$$

where, L = likelihood and k = the number of parameters in the model.

2. RESULTS AND DISCUSSIONS

An initial analysis of FDI, GE, IR, and UR were computed. Table 1 displays the descriptive statistic of the variables, were the mean, standard deviation, minimum and maximum values of the economic variables under study are presented in Table 4.1. The results show that the values of FDI ranges from 0.19 to 8.84 with a mean value of 2.81, GE ranges from 0.91 to 9.44 with a mean value of 4.178, IR ranges 5.4 to 72.84 with a mean value of 19.12, UR ranges from 3.2 to 9.8 with a mean value of 4.93. UR shows a positive Skewness while IR, UR are highly leptokurtic since the kurtosis is greater than three (3). The result of Jarque-Bera statistic revealed that the FDI and GE were normally distributed since the p-value is greater than or equal to 0.05 while IR and UR were not normally distributed as the p-value less than 0.05.

Table 1. Descriptive Statistics of Series 1985 to 2021

	FDI	**GE**	**IR**	**UR**
Mean	2.805405	4.177684	19.11892	4. 930811
Median	1.88	4.4033	12.56	4.03
Maximum	8.84	9.4483	72.84	9.79
Minimum	0.19	0.9112	5.39	3.2
Std. Dev.	2.585161	2.927739	17.44135	1.838575
Skewness	0.975967	0.474347	1.775607	1.56745
Kurtosis	2.756988	1.791099	4.84641	4.050374
Jarque-Bera	5.964859	3.640586	24.69804	16.85177
Probability	0.05067	0.161978	0.000004	0.000219
Sum	103.8	154.5743	707.4	182.44
Sum Sq. Dev.	240.5901	308.5796	10951.23	121.6929
Observations	37	37	37	37

Table 2 shows the unit root tests of the variables. The table shows the ADF test results and the Phillips-Perron test results. The null hypothesis is that the series has a unit root. The ADF unit root test was used to test if the variables meet this condition. The ADF results exhibited in Table 2, show that all variables are stationary. However, they become stationary at first differences. Therefore, all variables are integrated of order one, that is, they are I(1). This means that the ARDL model can be used to test for the co-integration between the variables.

Table 2. Unit Root Test - Augmented Dickey Fuller

Variables	t-statistics	P-value	Integration order
UR	-6.313089	0.0000	I(1)
FDI	-8.990469	0.0000	I(1)
GE	-6.47373785	0.0000	I(1)
IR	-5.691705	0.0000	I(1)

Figure 1 shows the empirical plots of the study variables. The result of the plot displays that UR is on a geometric increase, FDI and IR on a stationary pattern while GE depicts an exponential decrease.

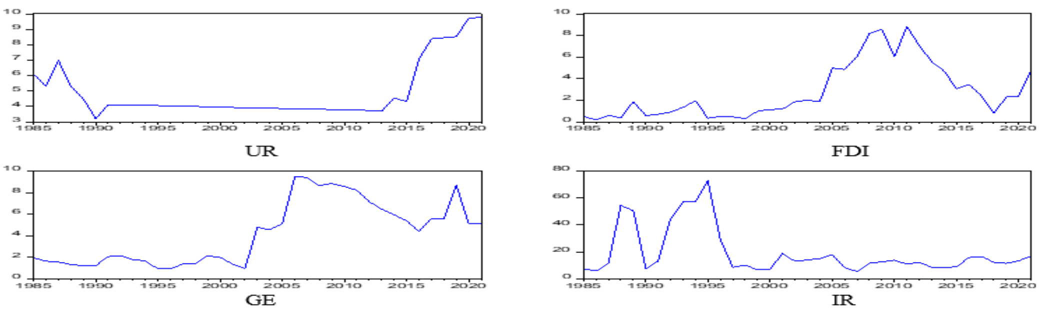

Figure 1. Empirical plots of UR, FDI, GE and IR

2.1. *Rolling Correlation of UR and FDI, UR and GE, and UR and IR*

In this part of the research, Table 3 presents the outcomes of the Rolling Correlation (RC) for UR and FDI, UR and GE, and UR and IR. The rolling correlation is useful to test the significance of signals before moving onto further analysis of the ARDL bounds testing. To test the existence of a signal against noise, Engle and Granger (1987) proposed a Monte Carlo test approach based on the standard deviations of rolling correlations. In this test, the standard deviations of empirical rolling correlations are compared to those of two correlated white noise series replicated many times with the same magnitude of correlation as the empirical series.

Table 3. Rolling Correlation Width for UR and FDI, UR and GE, and UR and IR

Rolling Correlation Width for UR and FDI				
Width	SD Rolling Correlation	Confidence Interval	5% CI	95% CI
3	0.6894386		0.7509051	0.652661
5	0.4011584		0.557092	0.416081
7	0.2695259		0.4758054	0.319003
10	0.168214		0.4058421	0.241331
Rolling Correlation Width for UR and GE				
Width	SD Rolling Correlation	Confidence Interval	5% CI	95% CI
3	0.6750715		0.7514409	0.651261
5	0.4927917		0.551845	0.424917
7	0.4343692		0.4715998	0.316225
10	0.4181927		0.4039116	0.244169
Rolling Correlation Width for UR and IR				
Width	SD Rolling Correlation	Confidence Interval	5% CI	95% CI
3	0.6248493		0.7509689	0.653082
5	0.4251424		0.5549633	0.623126
7	0.3872874		0.4692743	0.232205
10	0.2727464		0.3919562	0.2413395

The rolling correlation standard deviations (SDs) in Table 3 are inside the limits for the widths 3, 5, 7, and 10, for UR, FDI, UR and GE. Thus, the signal between the UR and FDI, UR and GE, and UR and IR are not significant for wider window lengths; hence, the rolling correlations between series are superfluous. But their rolling correlations SDs are inside the limits for the widths 3, 5, 7 and 10. In Figure 2, the dashed red lines show the limits of the 95% confidence interval for the mean of the average rolling correlations over the time points, which is shown by the horizontal solid line.

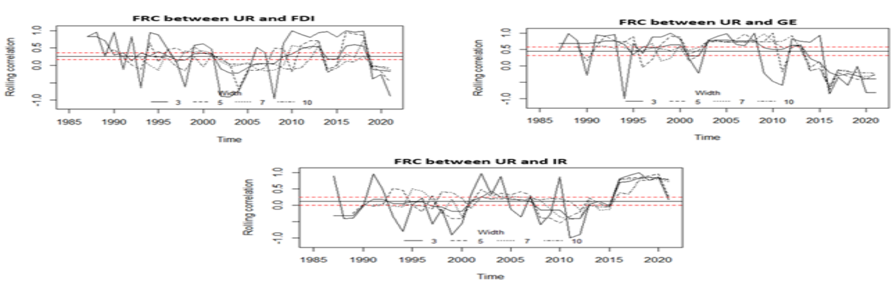

Figure 2. Rolling Correlation between UR and FDI, UR and GE, and UR and IR

2.2. *Research Model I*

In this section, the outcomes of the Bounds Test (BT), the ARDL model estimates, ECM, and and CUSUM of Squares for UR and FDI estimated parameter stability are presented.

2.2.1. Bounds Test for UR and FDI

The Bounds Test (BT) result is to examine the existence of co-integration between UR and FDI. The result of the bound test for the relationship between UR and FDI from the study indicates that the calculated F-statistic is 23.7921. This value surpasses the higher bounds I(1) acute value of 6.16 at 5% significance level (SL). This suggests that UR and FDI are cointegrated. Thus, it can be inferred that there exists a long relationship between UR and FDI.

Table 4. Bounds Test for UR and FDI Relationship

F-Bounds Test		**Null Hypothesis: No levels relationship**		
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
F-statistic	23.79	10%	4.24	5.00
K	1	5%	5.26	6.16
		1%	7.63	8.83

2.2.2. ARDL Model for UPR and FDI

The ARDL Model selection for UR and FDI is ARDL (1, 1) as displayed in Figure 3 below because it has the smallest AIC value. The result in Table 5a below displays that there are negative impacts of the first lag of FDI on UR at 5% level of significance which implies that FDI will quiet upset UR in the subsequent year. Also, the first lag of UR is negative and insignificant at 5% SL. From the result obtain in Table 5b, the R-square is 0.649721 implying that about 65% of the total variation of UR can be explained by the FDI. The short run ECM having the predictable coefficient of the slacked value of the residual (ECM_{t-1}), -1.122480 is negative and significant at 5% SL. This implies that approximately 112.25% of the deviation from the long run balance in the preceding year adjusts by the current year. The short run coefficient reveals that the coefficient of the current FDI has a negative impact but not significant on UR. Which indicate that a unit increase in current FDI will tip to a corresponding fall in UR.

Table 5a. Long Run Error Correction Model for UR and FDI

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
UR(-1)	-0.122480	0.163559	-0.748845	0.4594
FDI	-0.032418	0.028538	-1.135962	0.2644
FDI(-1)	-0.084083	0.026552	-3.166694	0.0034*
C	0.066459	0.029331	2.265856	0.0304
R-squared: 0.243819				
F-statistic: 3.439298				
Prob(F-statistic): 0.028273				
Durbin-Watson stat: 2.033147				

Table 5b. Estimated Short Run (ARDL) Model for UR and FDI

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.066459	0.025266	2.630329	0.013
D(FDI)	-0.032418	0.018583	-1.744524	0.0907
CointEq(-1) *	-1.12248	0.160238	-7.005085	0.0000*
R-squared	0.649721			
F-statistic	30.60534	Durbin-Watson stat		2.033147
Prob(F-statistic)	0			

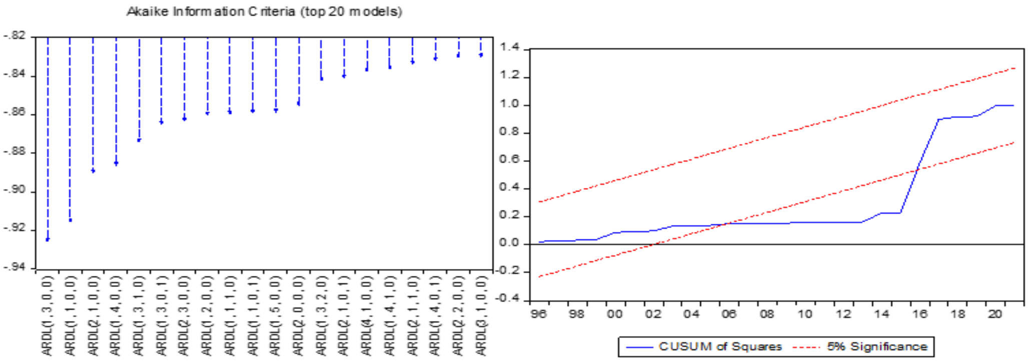

Figure 3. ARDL Model and CUSUM of Squares for UR and FDI

The CUSUM test reveals that the parameters of the UR and FDI in the ARDL model are unstable. This can be seen that the CUSUM of squares line go outside the area among the two acute lines at 5% SL. This CUSUM of square parameter stability tests designate that the parameters are changing during the sample period (1985-2021). This may be as a result of some government economic policies that affected UR or FDI negatively in a particular year or some years within the studied sample period. Also, the Durbin-Watson value in Table 5b which is (2.033) indicates that the selected model has no serial autocorrelation.

2.3. *Research Model II*

In this section, the outcomes of the BT, the ARDL model estimates, ECM, and CUSUM of Squares for UR and GE estimated parameter stability are presented.

2.3.1. Bounds Test for UR and GE

The result of the BT for the relationship between UR and GE presented in Table 6 indicates that the calculated F-statistic is 19.34204. This value is greater than the higher bounds I(1) acute value of 5.73 at 5% SL. This entails that UR and GE are cointegrated. Thus, it can be said that there is a long run relationship between UR and GE since the F-Statistic computed = 19.34204 is higher at 5% than higher bound 5.73 at 5% SL.

Table 6. Bounds Test for UR and GE Relationship

Null Hypothesis: No levels relationship				
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	19.34204	10%	4.04	4.78
K	1	5%	4.94	5.73
		1%	6.84	7.84

2.3.2. ARDL Model for UR and GE

The ARDL Model selection for UR and GE is ARDL (1, 0) since it has the smallest AIC value. The outcome in Table 7a displays that there is no significant effect of GE on the UR, entailing that the current GE has no significant contribution to UR. Also, the first lag of UR has huge impact on UR signifying that the presence of UR would quite upset UR in the next 1 year.

Table 7a. Estimated Long Run (ARDL) Model for UR and GE

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.025431	0.027699	0.918107	0.3652
UR(-1)	-1.078297	0.173643	-6.209836	0.0000*
GE	0.000884	0.037613	0.023513	0.9814

Table 7b. Short Run Error Correction Model for UR and GE

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.025431	0.026829	0.947889	0.3501
CointEq(-1)*	-1.078297	0.170801	-6.313187	0.0000*
R-squared	0.539647			
F-statistic	39.85633		DW-statistic	1.962040

The ECM in Table 7b displays that the projected coefficient of the slacked value of the residual (ECM_{t-1}) is -1.078297 which is negative. This indicates that the model would easily adjust to equilibrium.

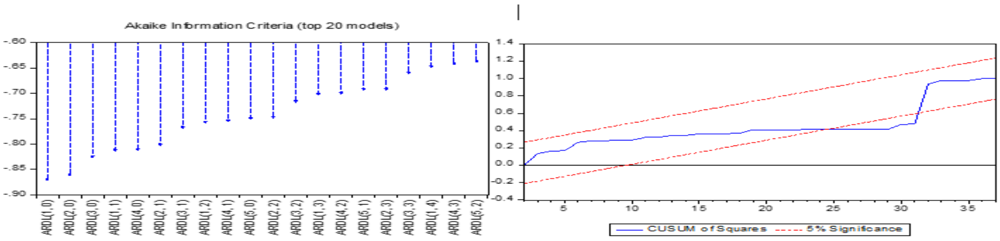

Figure 4. ARDL Model and CUSUM of Squares for UR and GE

The CUSUM test indicates that the parameters of the UR and GE in the ARDL model is not stable since the CUSUM of squares line go outside the area among the two acute lines at 5% SL. This CUSUM Square stability tests indicate that the parameters are changing during the sample period (1985-2021). This may be as a result of some government socioeconomic policies that affected UR or GE negatively in a particular year or some years within the studied sample period. Also, the Durbin-Watson value in Table 7b which is (1.96204) indicates that the selected model has no serial autocorrelation.

2.4. ***Research Model III***

This part of the research presents the outcomes of the BT, the ARDL model, and the ECM for UR and IR. Also, the estimated parameter stability test charts are presented.

2.4.1. Bounds Test for UR and IR

Table 8 shows the BT for IR equation. The F-statistic of 6.600926 is higher than the acute F-statistic of 5.73 5% SL. This indicates that IR have long run bond.

Table 8. Bounds Test for UR and IR

Null Hypothesis: No levels relationship				
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	6.600926	10%	4.04	4.78
K	1	5%	4.94	5.73
		1%	6.84	7.84

2.4.2. ARDL Model for UR and IR

Among the models evaluated, ARDL (2, 0) having the small AIC values. However, the CUSUM test of parameter stability for this model shows that the model parameters are changing as clearly seen from the CUSUM line, it did not stay within 5% confidence limits. This may be as a result of some government policies on the economy that affected UR or IR or negatively in a particular year or some years within the studied sample period. The result in the Table 9a displays that the IR is positively insignificant on unemployment rate at 5% SL.

Table 9a. Estimated Long Run (ARDL) Model for UR and IR

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.023005	0.029088	0.790857	0.4350
UR(-1)	-0.928627	0.256760	-3.616711	0.0010*
IR	0.016337	0.033501	0.487647	0.6292
D(UR(-1))	-0.172374	0.181046	-0.952102	0.3484

Table 9b. Short Run Error Correction Model for UR and IR

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.023005	0.027274	0.843457	0.4054
D(UR(-1))	-0.172374	0.167528	-1.028929	0.3115
CointEq(-1)*	-0.928627	0.251553	-3.691574	0.0009*
R-squared	0.563770			
F-statistic	20.67786			
Prob(F-statistic)	0.000002			
DW-statistic	1.726072			

The ECM indicates that the projected coefficient of the slacked value of the residual (ECM_{t-1}) is -0.928627. This indicates that approximately 92.86% of the divergence from short run steadiness in the prior year adjusts for by the present year.

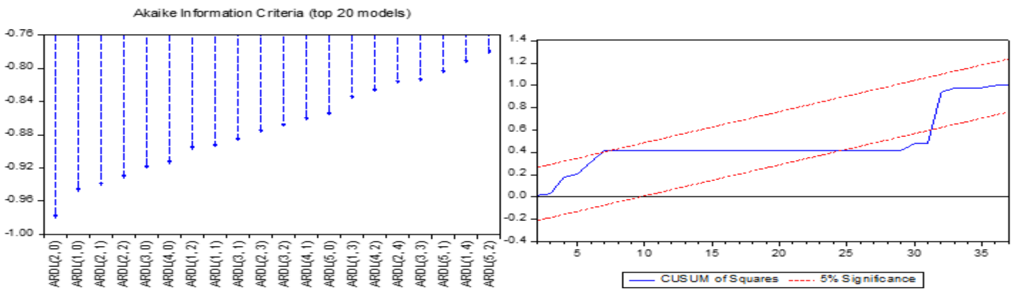

Figure 5. ARDL Model and CUSUM of Squares for UR and IR

2.5. *Research Model IV*

This part of the research presents the outcomes of the Bounds Test, the ARDL model, and the ECM for UR, FDI, GE, and IR. The estimated parameter stability tests and recursive charts are presented.

2.5.1. Bounds Test for UR, FDI, GE, and IR

The outcome of the BT for the relationship between UR, FDI, GE, and IR as shown in Table 10 indicates that the calculated F-Statistic is 9.7077. This value tops the higher bounds acute value of 4.35 at the 5% SL. This implies that UR, FDI, GE, and IR are co-integrated. Thus, we conclude that a long run relationship exists between UR, FDI, GE, and IR.

Table 10. Bounds Test for UR, FDI, GE, and IR

Null Hypothesis: No levels relationship				
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	9.707672	10%	2.72	3.77
K	3	5%	3.23	4.35
		1%	4.29	5.61

2.5.2. ARDL Model for UR, FDI, GE and IR

Table 11a. Estimated Long Run (ARDL) Model for UR, FDI, GE, and IR

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.082606	0.035173	2.348609	0.0267
UR(-1)	-1.200455	0.202418	-5.930573	0.0000*
FDI(-1)	-0.199514	0.074231	-2.687731	0.0124*
GE	0.002755	0.033521	0.082179	0.9351
IR	0.027352	0.033483	0.816892	0.4214
D(FDI)	-0.046648	0.029689	-1.571204	0.1282
D(FDI(-1))	0.072281	0.053810	1.343264	0.1908
D(FDI(-2))	0.040058	0.030499	1.313418	0.2005

Table 11b. Short Run Error Correction Model for UR, FDI, GE, and IR

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.082606	0.027015	3.057843	0.0051
D(FDI)	-0.046648	0.025041	-1.862861	0.0738
D(FDI(-1))	0.072281	0.034834	2.075047	0.0480*
D(FDI(-2))	0.040058	0.023108	1.733518	0.0948
CointEq(-1)*	-1.200455	0.182409	-6.581121	0.0000*
R-squared	0.680307			
F-statistic	15.42804			
Prob(F-statistic)	0.000001			
DW-statistic	1.815513			

The BT in Table 10 reveals the presence of cointegration and long run bond between UR versus FDI, GE, and IR. So the ECM model will be of lag interval of (1, 3). The long run coefficients displays that in the long run, the coefficient of FDI is negative and has a great bearing on UR. But GE and IR were positive and have no significant impact on UR at 5% significance level. The ECM coefficient for UR shows negative sign and highly significant as seen in Table 11b which display how rapidly the variables congregate to steadiness. This further approves the actuality of a stable long-run link among the factors with their several significant slacks. The coefficient of EC1 = -1.200455, point toward deviation from the short run on FDI is modified by 120.05% in the next one year.

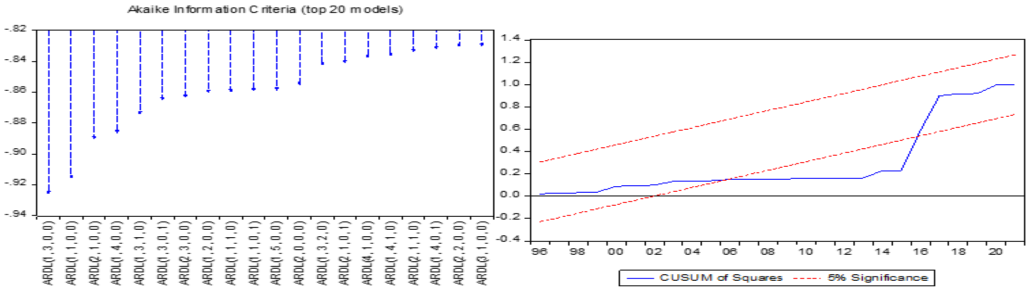

Figure 6. ARDL Model and CUSUM of Squares for All Variables

The CUSUM test indicates that the parameters of UR, FDI, GE, and IR in the ARDL model were unstable since the CUSUM of squares line fall outside the two critical lines at 5% SL. The stability test conducted using the CUSUM of Squares indicates that the parameters are wavering during the sampled period (1985-2021). This may be as a result of some government social and economic policies that affected UR, FDI, GE, or IR negatively in a particular year or some years within the studied sample period.

3. Conclusions

The bond between the designated Nigerian macroeconomic variables bared that while the impact of FDI and IR is significantly important in making UR improved with the use of its present rate to elucidate UR, historical rates of UR, FDI, and GE are also important factors to be deliberated on. In the relationship between UR and FDI, FDI is highly influential in determining UR. Also, the relationship between UR and IR reveals evidence of significance influence in determining UR. A combination of the FDI, GE, and IR on UR reveals that FDI and IR at first lag had significant effect on UR. Since the bounds test shows evidence of cointegration between UR and the three economic variables (FDI, GE, and IR), it means the model which has all these variables is selected. The CUSUM of square charts for all the four models indicated that all estimated parameters were unstable during the sampled studied period of 1985 to 2021

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