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INFERENCE FROM MODELLING FDI AND UNEMPLOYMENT RATE IN NIGERIA

Ikwuoche John David & Danjuma Idi
Federal University Wukari, Nigeria
davidij@fuwukari.edu.ng; idanjumawatsaji@gmail.com

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Abstract

This research investigates foreign direct investment (FDI) impact on the unemployment rate (UPR) in Nigeria by employing an Autoregressive Distributed Lag (ARDL) model. The study made use of data from the period 1985-2021. Initial assessment of the data involved the application of rolling correlation to test the significance of signals between FDI and UPR. Subsequently, the research employs the ARDL bounds test methodology to examine cointegration among FDI and UPR. Additionally, an Error Correction Model (ECM) is utilized to explore the causal relationship between these economic variables in the short run. The Augmented Dickey Fuller unit root test suggests that the variables attain stationarity at first differences (I(1)). The findings indicate that at 5% FDI significantly impacted on UPR in the long run but not in the short run where it was significant at 10%. Also, the selected best fitted model for the sampled period is ARDL(1, 1) but the plot of the cumulative sum squared chart showed that the parameter estimates were unstable for the sampled period. The results suggest more investment in FDI is necessary for reducing Nigeria unemployment rate in the long run and stabilizing it in the short run.

Keywords: Macroeconomics, ARDL, Bounds test, Co-integration, ECM

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INTRODUCTION

Unemployment has been one of the most challenging issue 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 greatest 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 percent to 33.3 percent from December2018 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 labor 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 in analyzing this previous studies even when the order of integration do 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. Since Unemployment in Nigeria continue to increase, this work seeks to study Unemployment rate using Autoregressive Distribution Lag model (ARDL) to see the impact Foreign Direct Investment (FDI) on Unemployment in Nigeria.

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 1985-2020. This study uses both descriptive and econometric analysis. The descriptive approach used is to show the trend and variation of FDI and UPR 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 on UPR. The Auto-Regressive Distributed Lag (ARDL), bounds test methodology for testing the existence of cointegration between the variables and Error Correction Model (ECM) is used to investigate the causal bond between FDI and UPR,.

Model Specification

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

$$UPR = \phi(FDI) \qquad \phi < 0 \tag{1}$$

A priori expectation of FDI for this study is negative or less than zero. This is because in a far-run these variables effect on UPL 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 impact as adverse. Theoretically, it is expected that a low and stable FDI supports UPR and vice versa.

ARDL Model for UPR and FDI

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

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

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 UPR and *FDI* and ε is the error term. The apriori expectations for the model parameters are $\beta_0 > 0$, $\beta_1 > 0$, and $\beta_2 < 0$.

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 repressor's 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 & Shin (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 long run bond between the predictor and repressor variables, that is, among UPR and FDI. In determining the long-run relationship, an error correction model is to be established and implemented.

Error Correction Model (ECM)

In this work, the ECM within bivariate relationship system is used to examine the direction of impact between UPR and FDI. 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. If UPR and FDI are co-integrated, the bivariate co-integration in ECM can be represented in the following form,

$$\Delta UPR_t = a_o + \sum_{i-1}^{n} a_{1i}\Delta UPR_{t-i} + \sum_{i-n}^{n} a_{2i}\Delta \ln FDI_{t-i} + a_3 EC_{t-i} + \mu_t \quad (3)$$

where, EC_{t-1} is a one period lag error adjustment term (EAT) captured from the integration regression, UPR_t is the unemployment rate at time t and FDI_t is foreign direct investment at time t.

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.

Stationarity of the return series is one of the major assumptions in financial time series modelling. This assumption can be checked using the ADF unit root test (Dickey & Fuller, 1997 and David *et al.*, 2024). Let,

$$x_t = \phi_1 x_{t-1} \tag{4}$$

$$x_t - x_{t-1} = \phi_1 x_t - x_{t-1}$$

$$\Delta x_t = (\phi_i - 1) x_{t-1} \tag{5}$$

$$\Rightarrow \phi_1 - 1 = 0$$

$$\phi_1 = 1. \tag{6}$$

The test of hypothesis is given as;

$$H_0: \phi_1 = 1$$

$$H_1: \phi_1 < 1.$$

The test statistic (*t*-ratio) is given as;

$$\frac{\phi_1^n - 1}{std(\phi_1)} = \frac{\sum_{t=1}^{S} P_{t-1} e_t}{\sigma^2 \sqrt{\sum_{t=1}^{S} P_{t-1}^2}} \tag{7}$$

where, $\phi_1 = \frac{\sum_{t=1}^{S} p_{t-1} p_t}{\sum_{t=1}^{S} p_{t-1}^2}$ and $\hat{\sigma}^2 = \frac{\sum_{t=1}^{T} (p_t - \hat{\phi}_1 p_{t-1})^2}{S-1}$. $P_0 = 0$, S is the sample size, and ϕ_1 for each factors.

The null hypothesis is rejected if the calculated value of *t* is greater than *t* critical value.

Model Selection

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 models election.

AIC = -2ln (L) +2k (8)

where, L is the likelihood and K is number of parameters in the model.

RESULTS

An initial analysis of FDI and UPR 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. The results indicates that the values of FDI ranges from 0.19 to 8.84 with a mean value of 2.81 and Unemployment rate UPR ranges from 3.2 to 9.8 with a mean value of 4.93. The FDI and UPR revealed to be positive skewed, but UPR is highly leptokurtic since the kurtosis is greater than three (3). The result from the Jarque-Bera test for normality revealed that the FDI is normally distributed since the generated p-value is greater than or equal to 0.05 while UPR is not normally distributed since its p-value is less than 5%.

Table 1. Descriptive Statistics of the Series 1985 to 2021

	FDI	**UPR**
Mean	2.805405	4. 930811
Median	1.880000	4.030000
Maximum	8.840000	9.790000
Minimum	0.190000	3.200000
Std. Dev.	2.585161	1.838575
Skewness	0.975967	1.567450
Kurtosis	2.756988	4.050374
Jarque-Bera	5.964859	16.85177
Probability	0.050670	0.000219
Sum	103.8000	182.4400
Sum Sq. Dev.	240.5901	121.6929
Observations	37	37

Table 2 shows the unit root tests of the variables. The table shows the ADF 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 (ADF)			
Variables	***t*-statistics**	**p-value**	**Integration order**
UPR	-6.313089	0.0000	I(1)
FDI	-8.990469	0.0000	I(1)

Figure 1 shows the empirical plots of the study variables. The result of the plot displays that UPR is on a geometric increase, FDI and IFR on a stationary pattern while GOE is on a exponential decrease.

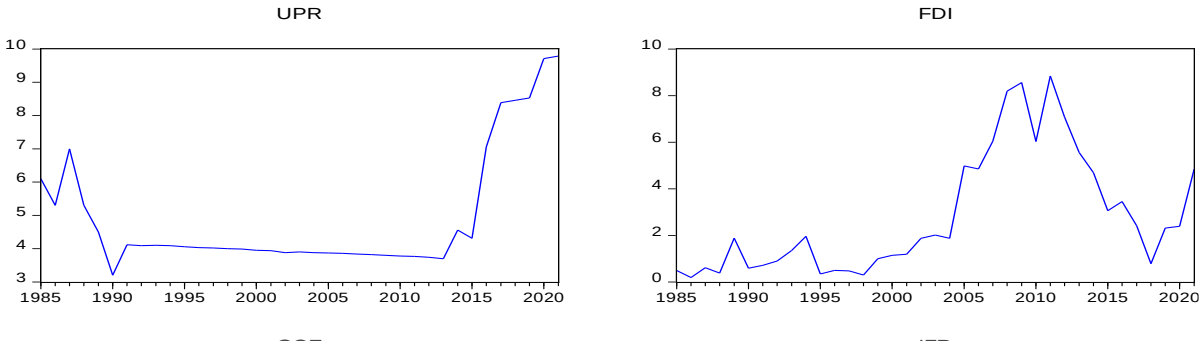

Figure 1: Empirical Plots of UPR and FDI

Rolling Correlation of UPR and FDI

In this part of the research, Table 3 presents the outcomes of the Rolling Correlation (RC) for UPR and FDI. The RC 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 RC. In this test, the standard deviations of empirical RCs are compared to those of two correlated white noise series replicated many times with the same magnitude of correlation as the empirical series. The RC standard deviations (SDs) in Table 3 are inside the limits for the widths 3, 5, 7, and 10, for UPR and FDI. Thus, the signal between the UPR and FDI are not significant for wider window lengths. Therefore, the RCs between series are superfluous. But their RC 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 RCs over the time points, which is shown by the horizontal solid line.

Table 3. Rolling Correlation Width for UPR and FDI

Rolling Correlation Width for UPR and FDI	Width	SD Rolling Correlation	Confidence Interval	
			5% CI	95% CI
	3	0.6894386	0.7509051	0.6526613
	5	0.4011584	0.5570920	0.4160807
	7	0.2695259	0.4758054	0.3190030
	10	0.1682140	0.4058421	0.2413312

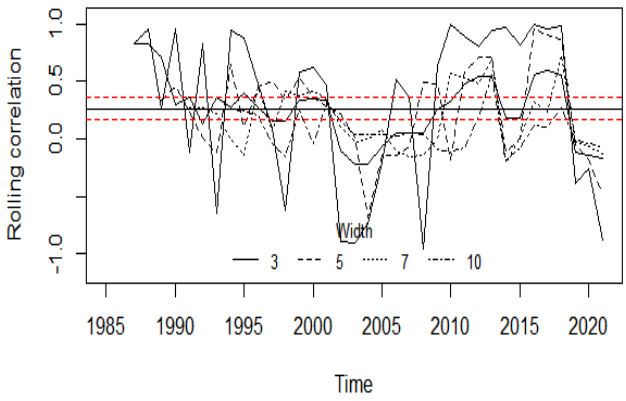

Figure 2: Plot of RC between UPR and FDI

Research Model Results

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

Bound Test for UPR and FDI

The bound test result is to examine the existence of co-integration between UPR and FDI. The result of the bound test for the relationship between UPR 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 UPR and FDI are cointegrated. Thus, it can be inferred that there exists a long relationship between UPR and FDI.

Table 4. Bounds Test for UPR and FDI Relationship

F-Bounds Test		**Null Hypothesis: No levels relationship**		
Test Statistic	**Value**	**Signif.**	I(0)	I(1)
F-statistic	23.7921	10%	4.235	5
K	1	5%	5.26	6.16
		1%	7.625	8.825

ARDL Model for UPR and FDI

The ARDL Model selection for UPR and FDI is ARDL (1, 1) as displayed in Figure 3 below since it has the smallest AIC value. The result in Table 5a below displays that there is a negative impacts of the first lag of FDI on UPR at 5% SL which implies that FDI will quiet upset UPR in the subsequent year. Hence, as FDI increases by a unit at lag one, there is a unit decrease in UPR. Also, the first lag of UPR is negative and insignificant at 5% SL. Also, the fitted long run model R-square value of 0.2438% indicates that the model total explained variation of URP by FDI is less than 25%. Table 5b presents the short run ECM and the model R-square value of 0.649721 implies that about 65% of the total variation of UPR is explained by FDI. The short run ECM having the predictable coefficient of the lagged value of the residual (ECM_{t-1}), -1.122480 is negative and significant at 5% SL. This implies that approximately 112.248% of the deviation from the long run balance in the preceding year adjusts by the current year. The short run ECM coefficients reveal that the coefficient of the current FDI has a negative insignificant impact on UPR at 5% but significant at 10%. Which indicate that a unit rise in current FDI will tip to a corresponding fall in UPR in Nigeria.

Table 5a. Estimated Long Run ARDL Model for UPR and FDI

Variable	**Coefficient**	**Std. Error**	***t*-Statistic**	**Prob.***
UPR(-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	Durbin-Watson stat.		2.033147
Prob(F-statistic)	0.028273			

Table 5b. Estimated Short Run Error Correction Model for UPR and FDI

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.*
C	0.066459	0.025266	2.630329	0.0130
D(FDI)	-0.032418	0.018583	-1.744524	0.0907
CointEq(-1)	-1.122480	0.160238	-7.005085	0.0000
R-squared	0.649721			
F-statistic	30.60534	Durbin-Watson stat.		2.033147
Prob(F-statistic)	0.000000			

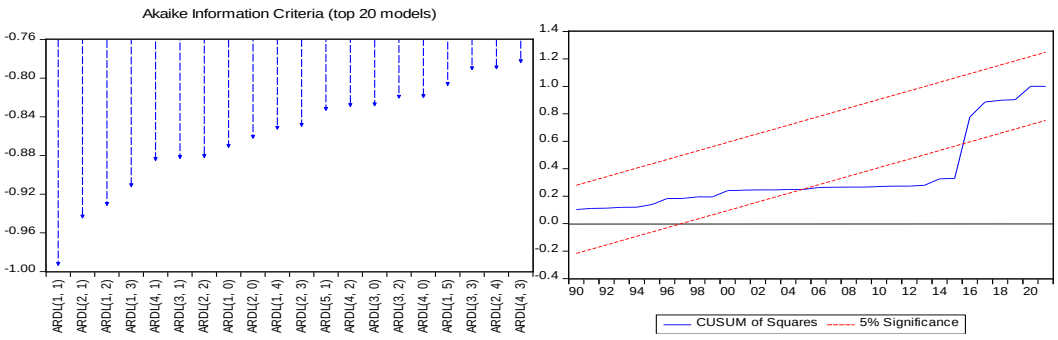

Figure 3: ARDL Model and CUSUM of Squares for UPR and FDI

The CUSUM test reveals that the parameters of the UPR 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 (1985-2020). Also, the Durbin-Watson value of 2.033 in Table 5a and 5b indicates that the selected model has no serial autocorrelation.

DISCUSSION

In this study, an Autoregressive Distributed Lag (ARDL) model with application of bounds test for cointegration between UPR and FDI were performed. The bonds test showed that a long run relationship exists between the rate of unemployment and FDI. The ARDL long run model fitted clearly showed that FDI at lag one significantly impacted on UPR. It was observed that a one unit rise in FDI decreases UPR by a unit. The total variation explained by the long run ARDL model was 25%. However, in the short run error correction model,

the results obtained showed that FDI in the short run has no significant impact on UPR at 5% SL but it does impacted on UPR at 10% SL and the total variation explained by the model is approximately 65% which is high and indicates the short run model is adequate. To capture the speed of adjustment of UPR and FDI, the error correction model (ECM_{t-1}) fitted showed the predictable coefficient of the lagged value of the residual (ECM_{t-1}) is negative and significant at 5% SL. This implies that approximately 112.248% of the deviation from the long run balance in the preceding year adjusts by the current year. Based on the AIC goodness of fit test and plot shown in Figure 3, an ARDL (1, 1) model was selected as the best fitted model due to its lowest AIC value. Also, Figure 3 presents the cumulative sum (CUSUM) square plot for parameter stability test for UPR versus FDI. The CUSUM Square parameter stability test for the fitted model showed that the projected parameter values are unstable during the sample period of 1985 to 2020 which the study was based.

CONCLUSION

In this research, ARDL modeling approach through the bonds test for co-integration and error correction modeling were explored. The results obtained clearly revealed the importance of FDI in reducing the rate of unemployment in Nigeria in the long run. However, in the short run it was observed that FDI is important in reducing UPR at 10% SL as oppose the long run at 5%. The selected best fitted model for the research sample period of 1985 to 2020 was found to be ARDL(1, 1) and the estimated parameters were unstable for the sampled period based on the CUSUM chart revelation. Based on the results it is recommended that the government of Nigeria should increase their investment in foreign markets because it ameliorates the rate of unemployment in the long run and can as well be helpful in stabilizing the rate of increase in the short run.

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