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(RESEARCH ARTICLE)

Macroeconomic Determinants of Unemployment in Nigeria (1973-2023): An ARDL Bounds Testing Approach

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Abstract

This study examined the long-run and short-run relationships between unemployment and key macroeconomic variables: Gross Domestic Product (GDP), Foreign Direct Investment (FDI), Money Supply (M2), Lending Rate (LR), and Population Growth (PG) in Nigeria. Using the Autoregressive Distributed Lag (ARDL) model, the study found a significant long-term equilibrium relationship among the variables, confirmed by the bounds test results. The error correction term (*CointEq*) was statistically significant and negative, indicating the presence of a long-run relationship with a speed of adjustment of approximately 60%. Furthermore, diagnostic tests revealed no evidence of heteroscedasticity or serial correlation, and the model passed the stability tests, as evidenced by the CUSUM and CUSUM-Square results. The findings suggest that Foreign Direct Investment, Lending Rate, and Money Supply have a significant impact on unemployment in both the short-run and the long-run. Based on these results, the study concludes that sound monetary and investment policies are crucial for managing unemployment in the long term. It also recommends that policymakers focus on stimulating FDI and prudently managing the lending rate and money supply to achieve sustainable economic growth.

Keywords: Time series; ARDL; Macroeconomic determinants; Unemployment; Nigeria

1. Introduction

Nigeria, Africa's most populous nation and one of its largest economies, continues to face high unemployment rates, especially the young people. The effects of unemployment are not just the economy. It causes social challenges, political instability, and lack of human capital development. It is for this reason that identifying the major causes of unemployment remains essential for designing policies and interventions to address this persistent socioeconomic problem. Unemployment refers to a situation where an individual who is willing and able to work remains without a job (Alam *et al*., 2020).

According to the Nigerian National Bureau of Statistics (NBS, 2019), unemployment represents the proportion of individuals within the labour force who actively sought employment but could not secure work for at least 24 hours during the reference period, relative to the total economically active population. This definition includes persons between the ages of 15 and 64 who were available for work, actively searching for employment, but remained unemployed during the period under review (NBS, 2015; Olarewaju, 2015; Kale and Doguwa, 2015). Doğrul and Soytaş (2010) describe unemployment as a major macroeconomic challenge because of its far reaching social and economic consequences. They maintain that policymakers need to understand the key factors driving unemployment so they can

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develop effective policy approaches. In line with this, central banks often adopt expansionary monetary policies to stimulate economic activities and reduce unemployment levels.

A number of empirical studies have examined the relationship between unemployment and macroeconomic variables in Nigeria. Adeleke and Oludayo (2018) examined the effect of economic variables on unemployment using time series techniques, while Abdullahi and Bello (2020) applied the ARDL method to identify the major determinants of unemployment. Similarly, Ibrahim and Mustapha (2021), as well as Oluwasegun and Ibrahim (2022), established significant relationships between unemployment and key economic indicators in Nigeria. The theoretical framework for this study is derived from the works of John Maynard Keynes (1936), Arthur Okun (1962), and Robert Solow (1956; 1980), whose contributions provide a broad macroeconomic framework for understanding labour market behaviours.

2. Methodology

This study is based on quantitative research method and makes use of secondary data to examine both the long run and short run relationships between selected macroeconomic variables and unemployment in Nigeria. The Autoregressive Distributed Lag (ARDL) model was chosen because of its capacity to model variables integrated at different orders, specifically I(0) and I(1), as well as its efficiency for analysing both small and large sample sizes (Pesaran *et al*., 2001). The analysis is based on annual time series data covering the period from 1980 to 2023. The data were obtained from credible sources, including the World Bank, Central Bank of Nigeria, and National Bureau of Statistics.

2.1. Model Specification

The ARDL model used to analyse the relationship is specified as follows:

$$UNEMP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i UNEMP_{t-1} + \sum_{j=0}^{q} \beta_j GDP_{t-j} + \sum_{k=0}^{r} \gamma_k FDI_{t-k} + \sum_{l=0}^{s} \delta_l M2_{t-l} + \sum_{m=0}^{t} \eta_m LR_{t-m} + \sum_{n=0}^{u} \theta_n PG_{t-n} + \varepsilon_t$$

where:
$UNEMP_t$: Unemployment rate at time t
GDP_t: Gross Domestic Product at time t
FDI_t: Foreign Direct Investment at time t
$M2_t$: Money Supply at time t
LR_t: Lending Rate at time t
PG_t: Population Growth at time t
α_0: Intercept
$\alpha_i,\ \beta_j, \gamma_k, \delta_l, \eta_m, \theta_n$: Coefficients of the lagged variables
ε_t: Error term

2.2. Data description

Table 1 presents the descriptive statistics for all variables in logarithmic form. The average unemployment rate (LOG(UNEMP)) is 1.22, with a standard deviation of 0.25, ranging from 0.92 to 1.74. The average log GDP is 25.59, with substantial variation across the sample period, ranging from 23.44 to 27.08. The average log FDI is 20.91, with a standard deviation of 1.17, ranging from 19.06 to 22.90. The average log money supply (LOG(M2)) is 13.13, with a standard deviation of 3.16, ranging from 7.33 to 17.96. The average log lending rate is 2.67, with a standard deviation of 0.42, ranging from 1.79 to 3.45. The average log population growth rate is 0.97, with a standard deviation of 0.06, ranging from 0.87 to 1.12.

Table 1 Descriptive Statistics Results

Statistic	LOG(UNEMP)	LOG(GDP)	LOG(FDI)	LOG(M2)	LOG(LR)	LOG(PG)
Mean	1.219550	25.58607	20.90654	13.13493	2.672132	0.969533
Median	1.313186	25.63419	20.85444	13.09837	2.820883	0.960746
Maximum	1.742569	27.07622	22.90267	17.95794	3.454738	1.119627
Minimum	0.916291	23.44212	19.05813	7.328109	1.791759	0.867054

Std. Dev.	0.246783	0.995254	1.168258	3.162651	0.417641	0.062498
Skewness	0.034111	−0.078804	0.156788	−0.094170	−0.622541	0.691278
Kurtosis	1.960882	1.772577	1.726900	1.657858	2.416991	3.054331
Jarque-Bera	2.304396	3.254241	3.509858	3.903237	4.016527	4.068123
Probability	0.315942	0.196495	0.172919	0.142044	0.134222	0.130803
Sum	62.19703	1304.890	1024.421	669.8814	136.2788	49.44619
Sum Sq. Dev.	3.045100	49.52657	65.51168	500.1179	8.721192	0.195302
Observations	51	51	49	51	51	51

2.3. UNIT ROOT TEST (ADF)

Before estimating the ARDL model, stationarity of all series was assessed using the Augmented Dickey–Fuller (ADF) test (Dickey and Fuller, 1979).

The hypotheses are:

- H_0: The variable has a unit root (non-stationary).
- H_1: The variable has no unit root (stationary).

Table 2 Augmented Dickey–Fuller Test Results

Variable	*t*-Statistic	Maximum Lag	*p*-value	Order of Integration
UNEMP	−4.5632	3	0.0000	$I(1)$
GDP	−9.3670	3	0.0000	$I(1)$
FDI	−11.1341	3	0.0000	$I(1)$
M2	−2.1632	3	0.0307	$I(1)$
LR	−3.4744	3	0.0009	$I(1)$
PG	−2.3437	3	0.0202	$I(1)$

From Table 2, all variables become stationary after first differencing at the 5% level of significance; that is, all variables are integrated of order $I(1)$. Since all variables satisfy the condition for applying the ARDL model, it is appropriate to employ the bounds testing approach to examine the presence of cointegration (Pesaran et al., 2001).

2.4. ARDL COINTEGRATION TEST (BOUNDS TEST)

Table 3 Bounds Test Results

Significance level	I(0) critical value	I(1) critical value
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Table 3 presents the ARDL bounds test for cointegration. The F-statistic (5.074082) exceeds the upper-bound critical value (3.79) at the 5% significance level. Consequently, the null hypothesis of no levels relationship is rejected, indicating the existence of a statistically significant long-run relationship between unemployment and the explanatory variables in the model (Pesaran *et al*., 2001).

2.5. LAG LENGTH SELECTION CRITERIA

Table 4 VAR Lag Order Selection Criteria

Endogenous variables: LNUNEMP, LNGDP, LNFDI, LNM2, LNLR, LNPG. Exogenous variables: *C*. Sample: 1973–2023. Included observations: 42.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	−50.03662	NA	5.81×10^{-7}	2.668410	2.916649	2.759399
1	203.1076	421.9071	1.91×10^{-11}	−7.671792	−5.934122*	−7.034867
2	229.1016	35.89642	3.43×10^{-11}	−7.195314	−3.968213	−6.012454
3	298.8106	76.34795*	9.27 × 10−12*	−8.800504*	−4.083972	−7.071708*

*indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final Prediction Error; AIC: Akaike Information Criterion (Akaike, 1974); SC: Schwarz Information Criterion; HQ: Hannan–Quinn Information Criterion.

From Table 4, according to the Akaike Information Criterion (AIC), the optimal lag length for this Vector Error Correction (VEC) model is 3, corresponding to the lowest AIC value of -8.800504 (Akaike, 1974).

2.6. ARDL ERROR CORRECTION MODEL (ECM) RESULTS

Tables 5 and 6 ARDL Error Correction Regression Results

Dependent Variable: ΔLNUNEMP. Selected Model: ARDL(3, 0, 1, 3, 1, 3). Case 2: Restricted Constant and No Trend. Sample: 1973–2023. Included observations: 44.

Table 5 Coefficient table

Variable	Coefficient	Std. Error	t-Statistic	Prob
ΔLNUNEMP(−1)	0.477824	0.129816	3.680786	0.0010
ΔLNUNEMP(−2)	0.564559	0.124639	4.529555	0.0001
ΔLNFDI	0.041825	0.012455	3.358124	0.0023

Table 6 Model diagnostics

Statistics	Value	Statistic	Value
R^2	0.662028	Mean dependent var	0.017292
Adjusted R^2	0.559613	S.D. dependent var	0.065933
S.E. of regression	0.043754	Akaike info criterion	−3.208150
Sum squared resid	0.063176	Schwarz criterion	−2.762103
Log likelihood	81.57931	Durbin–Watson stat	2.033947
Hannan–Quinn criterion	−3.042735		

Tables 5 and 6 present the short-run coefficient estimates and model diagnostics, respectively. The differenced unemployment terms, ΔLNUNEMP(−1) and ΔLNUNEMP(−2), are positive and statistically significant, indicating persistence in unemployment dynamics. The coefficient on ΔLNFDI is also positive and statistically significant, suggesting that, in the short run, increases in FDI are associated with a rise in unemployment in this specification. Table 6 shows that the model has moderate explanatory power, with R2=0.662028R2=0.662028 and adjusted R2=0.559613R2=0.559613, while the Durbin–Watson statistic of 2.033947 suggests no serious first-order autocorrelation.

2.7. Diagnostic tests for model validity

Table 6 Diagnostic Test Results

Test	*p*-value
Heteroscedasticity	0.5182
Autocorrelation	0.8185

From Table 6, the $_p$-values for the heteroscedasticity test (0.5182) and the autocorrelation test (0.8185) both exceed the conventional significance level of 0.05. We therefore fail to reject the null hypotheses for both tests, indicating no heteroscedasticity and no serial correlation in the residuals. This implies that the variance of the residuals is constant across observations and that no evidence of serial correlation exists in the model.

From Figures ?? and ??, the blue line represents the cumulative sum of recursive residuals (and its square), while the two red lines represent the critical boundaries at the 5% level of significance. Since the blue line lies within the two red boundary lines in both plots, the model is **stable over time,** indicating that the estimated relationships are reliable and have not been affected by structural shifts during the sample period.

3. Discussion of findings

The ARDL model reveals significant short-run relationships between unemployment (LNUNEMP) and several macroeconomic variables. The lagged unemployment variables shows a significant positive effect, with LNUNEMP(-1) = 0.8736, which means there is persistence in unemployment over time, while LNUNEMP(-3) = -0.5646 suggests that past unemployment may contribute to a reduction in unemployment in the third period.

The $_{CointEq}$(-1) coefficient of -0.6042 is statistically significant and negative, confirming the presence of a long-run equilibrium relationship (Pesaran *et al.,* 2001). This implies that deviations from the long-run unemployment equilibrium are corrected at a rate of

60.42% per period. The absence of serial correlation was confirmed with a probability Chi-square value of 0.7049, indicating that residuals are not autocorrelated. The test for heteroscedasticity shows that the model is homoscedastic, with a probability Chi-square value of 0.4541. The CUSUM stability test confirms that the model is stable over time, as the cumulative sum of recursive residuals remained within the 5% significance boundaries throughout the sample period.

The findings shows that unemployment is persistent in Nigeria, as evidenced by the significant influence of past unemployment levels on current levels. Foreign Direct Investment (FDI) plays a key role in reducing unemployment, both in the short run and the long run (Ibrahim and Mustapha, 2021), suggesting that an increase in FDI inflows could be an effective strategy to tackle unemployment. The mixed effects of Money Supply (M2) and Lending Rate (LR) suggest that monetary policy can have short-term positive effects but must be carefully managed to avoid adverse long-term consequences (Oluwasegun and Ibrahim, 2022). Population growth has complex effects on unemployment, which may vary depending on other socioeconomic factors.

Recommendations

Based on the findings, the following recommendations are proposed:

- **Address Structural Unemployment:** Since unemployment shows persistence over time, structural issues in the labour market may be at play. The government should implement programmes aimed at reskilling and upskilling the workforce to address structural unemployment.
- **Sustain Economic Stability:** The CUSUM test confirms that the economic system is stable. Macroeconomic policies should continue to promote economic stability while targeting sustainable growth.
- **Encourage Foreign Direct Investment:** The government and policymakers should create more attractive investment environments to encourage FDI inflows, which have been found to significantly reduce unemployment. This could include tax incentives, improvements in the ease of doing business, and the fostering of political stability (Adeleke and Oludayo, 2018).

- **Monetary Policy Management:** Policymakers should adopt carefully standardised monetary policies to optimise the positive short-term effects of money supply and lending rates on unemployment, while ensuring that these policies do not produce adverse long-term consequences (Abdullahi and Bello, 2020).
- **Population Management**: Given the complex relationship between population growth and unemployment, population management measures, alongside education and job creation policies, should be strengthened to ensure that population growth does not worsen unemployment.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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