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IMPACT OF INDUSTRIALIZATION ON URBANIZATION IN NIGERIA: EVIDENCE FROM ARDL BOUNDS APPROACH

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Abstract

The study investigates the impact of industrialization on urbanization in Nigeria, covering the periods 1990-2023. Data on all the variables used in the study were sourced from World development indicators. ARDL bounds test for cointegration was applied after confirming the existence of mix order of integration of variables for the model of the study via ADF and PP unit root tests. Industrialization was found to be positive and statically significant at one percent level of significant in both long run and the short run indicating that the variable has a positive effect on urbanization in Nigeria during the study period, further results revealed that, urbanization also has a direct link to economic growth, with education and population growth also playing secondary roles during the study period. In view of the outcomes of the study, it recommends that, government should develop a robust data monitoring system to track industrial activities and their environmental impact in Nigeria. Government should also integrate sustainability frameworks into urban development plans to prevent uncontrolled expansion that strains infrastructure and depletes natural resources. The study further recommends that, public education campaigns should also be intensified to raise awareness of the environmental consequences of urbanization and industrialization.

Keywords*:* Industrialization, Urbanization, ARDL approach, Nigeria.

1. Introduction

Industrialization is widely recognized as a fundamental driver of modern economic growth and structural transformation (Barigbon & Idoniboye-Obu, 2022). The degree of industrialization within an economy significantly determines the availability of essential goods and services, poverty reduction, enhances self-sufficiency, and improves living standards. Moreover, it contributes to macroeconomic stability by influencing the balance of payments, facilitating time- and labor-saving innovations, and stimulating complementary sectors, particularly agriculture and services.

Industrialization in Nigeria represents a strategic shift from an agriculturally dominated, largely informal subsistence economy toward a more structured and mechanized system of production. This transformation involves the efficient utilization of natural resources and the replacement of traditional manual labor with capital-intensive processes that can yield higher productivity and economies of scale (Blessing, 2023). Through this process, industrialization is expected to unlock Nigeria's economic potential and establish a foundation for long-term national development. Since the 1960s, industrialization has remained a cornerstone of Nigeria's economic policy agenda. However, the trajectory of industrial development in Nigeria has been far from linear. Following the discovery and subsequent commercialization of oil in the late 1960s, Nigeria's focus shifted toward the petroleum sector, resulting in a gradual neglect of the non-oil industrial base (Blessing, 2023). By the early 1980s, inefficiencies associated with a heavily centralized, state-dominated economic structure contributed to stagnation and declining productivity. In response, the government introduced a series of liberalization reforms aimed at transitioning to a market-oriented, private sector-led model of industrial development (Blessing, 2023).

For Nigeria to actualize the developmental potential of industrialization, it must pursue a more coherent, inclusive, and environmentally conscious industrial policy that not only drives economic diversification but also mitigates the rising environmental costs, particularly the surge in CO_2 emissions associated with industrial growth. Nigeria's rapid industrialization and urbanization have played a central role in shaping the country's economic development, but these processes have also exerted increasing pressure on environmental systems. The urban population rose from 35% in 1990 to 54% in 2022 and is projected to reach 306 million by 2050 (United Nations, 2023). Simultaneously, industrialization driven by ambitious policy frameworks such as Vision 20:2020 has sought to diversify the economy away from oil dependency by strengthening manufacturing and service sectors. These dual transformations have fueled economic expansion, but at a significant environmental cost, notably through rising carbon dioxide (CO_2) emissions and the degradation of ecological systems (World Bank, 2019).

The relationship between industrialization and urbanization is deeply intertwined in Nigeria's economic structure. Rural-urban migration has supplied the labor force necessary to sustain expanding industries, while urban growth has facilitated increased market demand and infrastructure development (Ogunsola & Tipoy, 2022). As urban populations surge, the demand for housing, transport, and basic infrastructure continues to escalate. This growing demand stimulates more industrial production and energy use, thereby compounding environmental pressures. Informal settlements often lacking in proper waste management, efficient energy access, and clean water supply further aggravate urban pollution and health hazards. (Ogunsola and Tipoy, (2022) further revealed that absence of effective urban planning and environmental regulation has allowed these challenges to persist, heightening the risk of long-term ecological instability. Despite widespread acknowledgment of the economic value of industrialization and urbanization, Nigerian development policies have yet to adequately integrate environmental considerations into their design and implementation. The long-term consequences of these growth strategies particularly in terms of CO_2 emissions, environmental degradation, and urban sustainability remain under-researched and insufficiently addressed in national planning frameworks (Ogunsola & Tipoy, 2022).

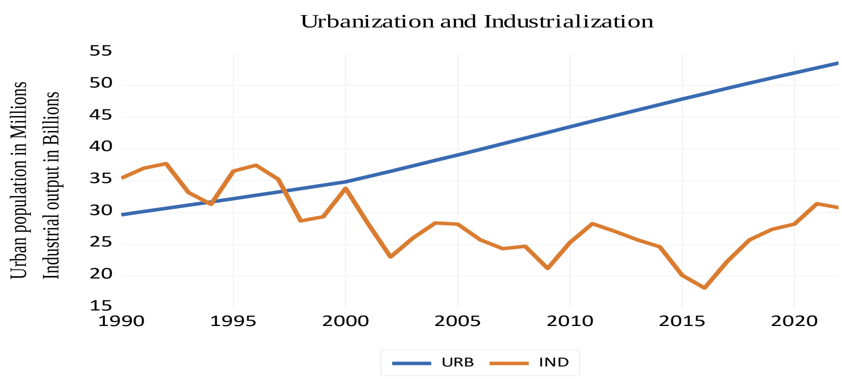

Figure 1. Trend Between Industrialization and Urbanization in Nigeria (1990 – 2023)

(Source: World Development indicator 2025)

The trajectory of Nigeria's industrialization, as illustrated in the figure 1, reveals a markedly volatile pattern characterized by significant fluctuations in industrial output. For instance, the period between 2005 and 2010 witnessed pronounced swings in performance, with alternating phases of growth and contraction. A similar pattern of instability re-emerged between 2012 and 2015, underscoring the influence of both domestic and external variables including erratic government policies, economic instability, inconsistent infrastructure investment, and exposure to global market dynamics. These fluctuations point to deeper structural issues within Nigeria's industrial sector, such as unreliable energy supply, frequent policy reversals, foreign exchange volatility, and persistent infrastructural deficits, all of which hinder sustained industrial advancement.

This fluctuation highlights the urgent need for a more robust and adaptive industrial strategy that emphasizes sustainable long-term investments, consistent regulatory policies, and strategic infrastructure development (Adegoke et al. 2020). Moreover, Nigeria's heavy dependence on petroleum-related industries has rendered its industrial sector highly susceptible to global oil price shocks. This over-reliance not only magnifies output volatility but also limits economic resilience. A viable path forward involves diversifying the industrial base by scaling up investment in non-oil manufacturing, agro-processing, and technology-driven industries to reduce exposure to commodity cycles and foster sustained growth. In contrast to the unstable pattern of industrial output, urban population growth as represented in Figure 1 exhibits a more stable and predictable upward trajectory. From the early 1990s to about 2010, Nigeria's urban population expanded steadily, driven primarily by rural-urban migration, demographic pressures, and increasing economic activity in urban centers (Adegoke et al. 2020).

The empirical data support the view that industrialization and urbanization in Nigeria are deeply interlinked. According to the World Bank (2023), the industrial sector's contribution to GDP increased modestly from 19% in 1991 to 22% in 2022, while the proportion of the urban population rose from 43% to 57% over the same period. This parallel growth indicates a positive correlation between the expansion of industrial output and the rise of urban settlements. Urban areas function as key enablers of industrial activity, offering concentrated pools of labor, access to financial institutions, transportation networks, and infrastructure essential for large-scale production and distribution. Conversely, industrial development acts as a catalyst for urbanization by generating employment opportunities that draw rural migrants to urban centers (Blessing, 2023).

Barigbon and Idoniboye-Obu (2022) posits that since the 1960s, Nigeria has witnessed rapid economic growth, industrialization, and urbanization, transforming it into one of Africa's foremost economies, while these developmental strides have generated significant economic benefits spurring employment creation, infrastructural advancement, and improved living conditions, they have also ushered in profound environmental challenges. Main among these is the substantial rise in carbon dioxide (CO_2) emissions, largely attributable to intensified industrial activity, surging energy consumption, and accelerated urban expansion. The escalation of CO_2 emissions in Nigeria has far-reaching implications: locally, it contributes to deteriorating air quality and public health hazards; globally, it increases the country's share in the intensifying threat of climate change (Ogunleye, et al., 2023).

Akorsu (2023), noted that, accelerating pace of urbanization in Nigeria is driven primarily by high birth rates, internal migration from rural to urban areas, and rapid population growth. Major urban centers such as Lagos, Abuja, and Kano are experiencing explosive population increases, straining housing, transportation, energy infrastructure, and social services, the largely unregulated expansion of these cities has resulted in significant environmental degradation, including widespread deforestation, conversion of agricultural land, congestion, and rising industrial and vehicular emissions (Ogunleye al.,2023). The country faces mounting climate vulnerabilities, including reduced agricultural productivity, freshwater scarcity, and more frequent climate-induced displacement. These outcomes threaten not only food security but also national stability, as climate shocks increasingly undermine rural livelihoods and urban resilience. Moreover, CO_2 emissions contribute to adverse health outcomes, especially among marginalized populations with limited access to healthcare and adaptive infrastructure (Stella, 2023).

2. Literature Review

2.1 Conceptual Definitions

Concept of Industrialization

Industrialization refers to the transformation of an economy from one primarily based on agriculture to one driven by manufacturing and mechanized production (Ikonne & Nwogwugwu, 2020). This transition is characterized by mass production, increased technological innovation, and a more efficient division of labor, ultimately fostering economic growth. Industrialization also plays a crucial role in shaping a country's economic structure, influencing income classifications such as high-income, middle-income, and low-income economies. According to Ikonne and Nwogwugwu (2020), industrialization is driven by multiple factors, including government policies, technological advancements, entrepreneurial initiatives, and market demand for goods and services.

Concept of Urbanization

Urbanization refers to the process by which people migrate from rural areas to cities and towns, leading to the growth and expansion of urban areas. This transformation involves the conversion of natural and rural landscapes into urban environments and is driven by factors such as population growth, economic development, and industrialization (Ackley, 2025). As cities expand, their social, economic, and cultural characteristics evolve, reflecting the historical pattern of human settlement.

2.2 Empirical Review

Empirical studies on the nexus between industrialization and urbanization or other variables are many and the outcome also varied; indicating both the positive and negative relationship among the variables, the differences in results emanated from the use of different control variables, methodology, sample size and study area among others. Beginning with the study conducted by Rodriguez and Martinez (2022) explored how manufacturing industries contributed to São Paulo's rapid urbanization. Their study revealed that the rise of industrial hubs resulted in extensive urban sprawl, increased traffic congestion, and heightened environmental stress. Adebayo et al. (2022) employed Geographic Information Systems (GIS) to analyze the impact of industrialization on Abuja's urban sprawl from 2000 to 2020. Their study revealed that rapid industrial growth resulted in unregulated urban expansion, characterized by deforestation, loss of green spaces, and increasing pollution levels. The study advocated for a balanced approach that promotes industrial growth while preserving the environment and urban sustainability.

Saidu et al. (2021) explored the causal relationship between urbanization, industrialization, and CO2 emissions in Nigeria using the Modified Toda and Yamamoto causality technique for the period 1982–2018. Their findings indicate the presence of bidirectional causality between economic growth and CO2 emissions, as well as between industrialization and economic growth, implying that economic expansion contributes to higher CO2 emissions, while industrial growth is strongly linked to economic development. Additionally, the study identified unidirectional causality running from urbanization to economic growth, urbanization to CO2 emissions, and urbanization to industrialization, highlighting the interconnected nature of these factors. Eze and Okonkwo (2021) investigated the urban expansion and environmental sustainability in developing economies. Their study utilized spatial analysis techniques to assess changes in land use and found that industrial development led to deforestation, land conflicts, and environmental degradation. The study recommended sustainable industrial policies that consider the long-term effects of urban expansion on the environment and socio-economic stability.

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Ahmed and Musa (2020) on assessing the role of industrialization in urban traffic congestion in Lagos. Their study used traffic simulation models to demonstrate that industrial clusters significantly contributed to increased vehicular traffic, longer commuting times, and higher carbon emissions. The findings underscored the need for improved transportation infrastructure and policies to decongest industrial zones. Gomez and Herrera (2020) investigated the effects of industrialization on Monterrey's urbanization. Their study found that industrial clusters attracted a rural workforce, leading to overpopulation in urban centers, excessive demand for services, and environmental degradation. The study emphasized the importance of sustainable urban planning. Adetunji and Bello (2020) examined the relationship between industrial expansion and urbanization in Lagos and Kano, two of Nigeria's most industrialized cities, between 1990 and 2018. Using panel data regression, their study revealed that manufacturing industries attracted rural migrants, leading to increased urban sprawl. The study found that this rapid population growth resulted in housing shortages, poor sanitation, and overburdened social amenities. The authors emphasized the need for integrating industrial policies with urban planning to mitigate the adverse effects of unplanned urbanization.

2.3 Theoretical review

The study on the impacts of industrialization on urbanization in Nigeria is based underpinned by the demographic transition theory, as the theory is based on the population trends of countries around the world. Theory explains the shift from high birth and death rates to lower birth and death rates as countries industrialize and develop (Thompson, 1929). The resulting rapid population growth and rural-urban migration under industrialization leads to urbanization. According to this theory, every country passes through three different stages of population growth. In the first stage, the birth rate and the death rate are high and the growth rate of the population is low. In the second stage, the birth rate remains stable but the death rate falls rapidly. As a result, the growth rate of the population increases very swiftly. In the last stage, the birth rate starts falling and tends to equal the death rate. The growth rate of the population is very slow. The demographic transition theory is superior to all the theories of population because it is based on the actual population growth trends of the developed countries of Europe. Almost all the European countries of the world have passed through the first two stages of this theory and are now in the final stage. Not only this, this theory is equally applicable to the developing countries of the world. The demographic transition is a key driver of urbanization in developing countries like Nigeria.

3. Methodology

In order to determine the impact of industrialization on urbanization in Nigeria, the study employed time series analysis for the periods between 1990 to 2023. The study covered a period of 33 years and the choice of this period is highly informed by the availability of data due to empirical nature of the study and also to confirm with the central limit of 30 minimum observations as justified by the studies of Squalli (2007), Ghosh and Moon (2010) and Musa and Maijama'a et al. (2020) who suggested that 25 to 80 years observations is enough for the application of Autoregressive Distributed Lag (ARDL) Model.

The study is design in such a way that unit root test was used to determine the stationarity of the variables using augmented dickey fuller (ADF) and Philip Perron (PP) unit root tests and due to the inability of these tests to tackle the problems of shocks, structural breaks and drift in the series, their results were compared with Zivot-Andrew structural break test, If the variables are stationarity at either level or first difference or even mixture of the two, ARDL bound test will be applied to determine the long-run relationship between the variables (Sulaiman & Abdul-Rahman, 2018). The data collected for this research were analyzed using the autoregressive distributed lag (ARDL). The diagnostic tests were applied to test the accuracy of the estimated models which includes serial correlation LM test, heteroscedasticity test, and normality test, Ramsey Reset test for specification and stability test. The analysis of the data was done using Eviews version 9 econometrics software.

Model Specifications

To assess the impact of Industrialization on urbanization in Nigeria, this study adopts a model of Ali, Siong and Talha (2016) as formulated in Equation 1

$$GDPt = \gamma + \delta 1 Urbanizationt + \delta 2 Industrializationt + \delta 3 CO2t + \delta 4 EnergyConsumptiont + \eta t \quad (1)$$

In model 1, economic growth is modelled as a function of urbanization, industrialization, and environmental factors such as CO_2 emissions and energy consumption. This model integrates environmental costs into the growth analysis, reflecting the trade-offs between economic expansion and environmental sustainability.

The model 1 was modified to better align with the study objective which is to examine the impact of industrialization on urbanization in Nigeria. Instead of using GDP as the dependent variable, urbanization (URBt) was made the focus to directly capture how industrial growth influences urban expansion. CO_2 emissions and energy consumption were excluded as they are more relevant to environmental outcomes rather than urbanization. Key factors and control variables such as GDP (economic opportunities), education (urban migration drivers) and population growth (natural and migratory urban increase) were included to provide a more comprehensive understanding of urbanization dynamics in Nigeria. Therefore, model 2 is the adopted and modified version of model 1.

$$URB_t = IND_t, GDP_{t,} EDU_{t-i} POP_t \quad (2)$$

Where, URBt is the Urbanization (percentage of the population living in urban areas), INDt is the Industrialization, GDPt is the Economic growth, EDUt is the Education level, POPt is the Population growth. The econometric form of model 2 is presented in the model 3.

URBt = β0t + β1INDt + β2GDP t +β3EDUt + β4POPt + εt (3)

Where β0 is the intercept (Constant term), β1, β2, β3 & β4 are coefficient of the regression line, and ε is the error term. While all other variables are same as define in model 2. Transforming equation (2) in to log form we have:

lnURBt = β0t + β1lnINDt + β2lnGDPt +β3lnEDUt + β4lnPOPt + εt (4)

Techniques of Data Analysis

ARDL Bounds Model

The study employed ARDL approach to cointegration founded by Pesaran and Pesaran (1999) and further modified and developed by Pesaran et al. (2001). The ARDL method is usually applied due to its relative superiority over other methods of cointegration, this is because other methods need variables to be stationary at first difference only or stationary at level only, i.e., if variables are I(0), this means that OLS is the best, but when the variables are I(1) this means that either ECM, VECM or VAR should be applied. On the other hand, ARDL was developed to contain the situations where the variable is I(0), I(1) or combination of I(0) and I(1) variables.

Additionally, ARDL can be used to investigate both the short-run and the long-run relationships among the variables and these variables can have different number of lags. The method also allowed diagnostics checks most especially when using the Microfit Statistical software package.

The ARDL model.

$$lnURB_t = \beta_{0t} + \sum_{i=0}^{m1} \alpha_i \, ln\Delta URB_{t-i} + \sum_{i=0}^{m2} \beta_{1i} \, ln\Delta IND_{t-i} + \sum_{i=0}^{m3} \chi_{1i} \, ln\Delta GDP_{t-i} + \sum_{i=0}^{m4} \delta_{1i} \, ln\Delta EDU_{t-i} + \sum_{i=0}^{m5} \pi_{1i} \, ln\Delta POP_{t-i} = \theta_1 lnURB + \theta_1 lnIND + \theta_1 lnGDP + \theta_1 lnEDU + \theta_1 lnPOP + \mu_t \quad (6)$$

Where ln stands for the natural logarithm sign, β_0 is the drift parameter, $\theta_1 \ldots \theta_4$ are the long-run coefficients, $\chi_1 \ldots X_4$ are the short-run coefficients, Δ is the short run sign, $\sum$ is the summation sign, m is the maximum lag, *t* is the time trend, URB is the urbanization, GDP is the economic growth, IND is the industrialization, EDU is the education level, POP is the population growth and ε is the white noise.

To get the short-run estimates and the value of error correction term which determine the speed of correction back to the equilibrium from disequilibrium point, the Equations 7 and 8 was also suitably specified and calculated.

Short-Run and Error Correction Model

$$ln\Delta URB_t = \beta_{2t} + \sum_{i=0}^{m1} \alpha_i \, ln\Delta URB_{t-i} + \sum_{i=0}^{m2} \beta_{3i} \, ln\Delta IND_{t-i} + \sum_{i=0}^{m3} \chi_{3i} \, ln\Delta GDP_{t-i} + \sum_{i=0}^{m4} \delta_{3i} \, ln\Delta EDU_{t-i} + \sum_{i=0}^{m5} \pi_{3i} \, ln\Delta MPOP_{t-i} + \lambda ECT_{t-1} \quad (7)$$

Where ln represents the natural logarithm sign, χ_0 is the drift parameter, $\chi_1 - \chi_4$ are the short-run values to be estimated, Δ is the short-run sign or the change parameter, δ is the coefficient of error correction term to be estimated, t is the time trend, m is the maximum lag length, $\sum$ is the summation or sigma, ε_t is the error term and all other parameters as defined in the previous Equations.

Long-Run model

$$lnURB_t = \theta_1 lnURB + \theta_1 lnIND + \theta_1 lnGDP + \theta_1 lnEDU + \theta_1 lnPOP + e_t \quad (8)$$

Where ln stands for the natural logarithm sign, β_0 is the drift parameter $\theta_1 \ldots \theta_4$ are the long-run coefficients, and ε is the white noise. While all parameters are define in the model 6

4. Results and Discussion

Table 1: Unit Root Test

	ADF Test Statistics				**PP Test Statistics**			
	Constant		**Trend**		**Constant**		**Trend**	
Variable	**Level**	**First Difference**	**Level**	**First Difference**	**Level**	**First Difference**	**Level**	**First Difference**
lnURBt	-2.166 (0.221)	-3.776 (0.000)***	-3.397 (0.069)*	4.624 (0.000)***	-1.048 (0.723)**	-4.462 (0.006)***	-0.508 (0.978)***	-4.688 (0.000)***
lnINDt	-0.065 (0.945)	-6.892 (0.000)***	-2.036 (0.563)	-6.796 (0.000)***	-0.394 (0.898)	-3.854 (0.006)***	-1.787 (0.687)	-4.102 (0.014)***
lnGDPt	-0.708 (0.830)	-2.936 (0.052) *	-1.584 (0.776)	-4.882 (0.000)***	-0.317 (0.911)	-2.908 (0.055)***	-1.702 (0.727)	-2.853 (0.189)***
lnEDUt	-1.642 (0.450)	-3.845 (0.006)***	-5.637 (0.000)***	-4.052 (0.016)***	-1.566 (0.487)***	-3.841 (0.006)***	-1.256 (0.881)***	-4.045 (0.017)***
lnPOPt	-2.943 (0.051)*	-2.810 (0.070)***	-2.538 (0.308)	-2.532 (0.311)***	-2.092 (0.248)	-4.422 (0.009)***	1.614 (1.000)	-4.507 (0.000)***

Source: Author's computation using EViews12.
Note***, ** and * Denotes 1%,5% and 10% significance level respectively

The results from the Augmented Dickey-Fuller (ADF) Test and Phillips-Perron (PP) Test presented in Table 1 indicate the stationarity properties of five variables: urbanization (lnURB), industrialization (lnIND), gross domestic product (lnGDP), education (lnEDU), and population (lnPOP). The tests were conducted at both the level and first difference forms under two specifications: constant only and constant with trend.

At the level form, most variables exhibit non-stationarity, as their test statistics are not significant at conventional levels (p-values > 0.05). However, education (lnEDU) shows signs of stationarity in some cases, particularly under the trend specification, where it is significant at the 1% level. Population (lnPOP) also shows weak evidence of stationarity at the 10% level under the constant specification in the ADF test, but the results remain inconsistent across tests. These findings suggest that lnURB, lnIND, lnGDP, and lnPOP contain unit roots, meaning their statistical properties change over time and could lead to spurious regression results if used in their level forms. After first differencing, all variables become stationary, as indicated by highly significant test statistics ($p < 0.01$) across both the ADF and PP tests. This confirms that these variables are integrated of order one, I(1), meaning they require differencing to achieve stationarity. The presence of a mixed order of integration supports the use of the Autoregressive Distributed Lag (ARDL) model, as it is suitable for scenarios where variables are a combination of I(0) and I(1) or exclusively belong to either category.

Table 2: Optimum Lag Selection Result

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-751.4	NA	2.35e+	47.280	47.509	47.35
1	-387.97	590.71	1558	26.123	27.497	26.57
2	-314.19	96.836*	8361.*	23.07*	25.594*	23.9*

Source: Author's computation using EViews12

The optimal lag selection results presented in Table 4.4 indicate that Lag 2 is the most suitable choice for Model 1, as it is consistently favored across all selection criteria. The Log Likelihood (LogL) improves significantly as lag length increases, suggesting that including additional lags enhances model fit. The Likelihood Ratio (LR) test shows a substantial improvement from Lag 0 to Lag 1 and further to Lag 2, confirming that adding lags significantly enhances the explanatory power of the model. Additionally, the Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ) all reach their lowest values at Lag 2, signifying the best balance between model fit and complexity. Since ARDL and time series models require an appropriate lag length for accuracy and efficiency, the results confirm that incorporating two lags provides the optimal structure for Model 1, ensuring better estimation and predictive performance.

Table 3. ARDL Bounds Test Result

Model: (lnURBt, lnINDt, lnGDPt, lnEDUt, lnPOPt)			
F-statistic		7.893	
Significance Level	lag (2)	Lower Bound I (0)	Upper Bound I (1)
10%		2.67	3.58
5%		3.27	4.30
1%		4.61	4.66

Source: Author's computation using EViews12

According to the Critical values are obtained from Narayan (2005), the boldness indicates the level of significance at which the F-statistic exceeds the upper bound. I(0) = lower bound, I(1) = upper bound.

The ARDL bounds test is used to determine whether a long-run relationship (cointegration) exists among the variables. The test compares the F-statistic to the critical value bounds at different significance levels (1%, 5%, and 10%).

In this case, the F-statistic is 7.893, which is greater than the upper bound (I(1)) at all significance levels (3.58 at 10%, 4.30 at 5%, and 4.66 at 1%). Since the F-statistic exceeds the upper bound, we reject the null hypothesis of no cointegration and conclude that a long-run relationship exists among the variables lnURB, lnIND, lnGDP, lnEDU, and lnPOP. This finding confirms that these variables move together over time, implying a stable long-term association.

Table 4. ARDL Long Run Results

Dependent variable, lnURB		
Regressors	Coefficient	T-ratio (p values)
IND	0.638	2.058 (0.004)***
LGDP	0.051	2.173 (0.003)***
LEDU	0.197	4.487 (0.000)***
LPOP	0.195	5.514 (0.001)***
C	-2.968	-3.127 (0.009)***

Source: Author's computation using EViews12

The long-run results of the model provide insight into the relationship between urbanization (lnURB) and key explanatory variables: industrialization (IND), economic growth (LGDP), education (LEDU), and population growth (LPOP). All the explanatory variables exhibit positive and statistically significant coefficients at conventional significance levels (1%, 5%, and 10%), indicating their long-term impact on urbanization.

The coefficient of industrialization (IND) is 0.638, with a t-ratio of 2.058 and a p-value of 0.004, signifying a strong positive effect on urbanization. This suggests that as industrial activities expand, urban areas experience increased population growth due to rural-urban migration, consistent with previous studies such as Gomez and Herrera (2020) and Adetunji and Bello (2020), who highlighted how industrialization attracts rural workers, leading to overpopulation and infrastructural strain.

Economic growth (LGDP) also has a positive coefficient of 0.051, with a t-ratio of 2.173 and a p-value of 0.003. This implies that as the economy grows, urbanization increases, though the effect is relatively small compared to industrialization. This aligns with findings from Saidu et al. (2021), who identified a unidirectional causality from urbanization to economic growth in Nigeria. The relatively low magnitude of the coefficient suggests that while economic growth contributes to urban expansion, other factors such as industrialization and population growth play more dominant roles.

Education (LEDU) has a coefficient of 0.197, with a t-ratio of 4.487 and a p-value of 0.000, indicating a significant and strong positive impact on urbanization. This finding implies that as educational attainment increases, urbanization accelerates, possibly due to the concentration of educational institutions and employment opportunities in urban centers. The result is in line with studies like Mukhtar and Sani (2021), who found that industrial hubs attract a highly educated labor force, thereby intensifying urban migration.

Population growth (LPOP) has a coefficient of 0.195, with a t-ratio of 5.514 and a p-value of 0.001, demonstrating a significant influence on urbanization. This suggests that population increases naturally contribute to urban expansion, as seen in previous studies such as Okafor et al. (2023), who noted that Nigeria’s urban expansion has outpaced infrastructure development, leading to challenges such as housing shortages and environmental degradation.

The constant term (C) is negative (-2.968) with a t-ratio of -3.127 and a p-value of 0.009, indicating that in the absence of the explanatory variables, urbanization would decline. This negative intercept highlights the necessity of industrial, economic, and demographic factors in driving urban expansion.

Overall, the long-run model results suggest that industrialization is the primary driver of urbanization, followed by education and population growth, while economic growth plays a secondary role. These findings are in line with existing literature that emphasizes the strong link between industrial development and urban expansion. However, the implications of these findings underscore the need for integrated urban and industrial policies to mitigate potential challenges such as overpopulation, housing shortages, and environmental degradation.

Table 5. ARDL Short Run Result

Dependent variable, lnURB

Regressors	Coefficient	T-ratio (p values)
C	-0.084	-0.102 (0.707)
LURB	-0.028	-0.504 (0.619)
IND	-1.321	-0.054 (0.957)
LGDP	-0.001	-0.254 (0.801)
LEDU	0.005	9.882 (0.000)***
LPOP	0.034	0.380 (0.919)

LURB (-1)	-0.269	-3.616 (0.001)***
LEDU(-1)	-0.001	-2.829 (0.010)***
LEDU(-2)	-0.007	-12.171 (0.000)***
LPOP(-1)	1.145	3.725 (0.001)***
LPOP(-2)	0.651	2.127 (0.045)**
COINTEQ*	-0.218	-20.912 (0.000)***

Source: Author's computation using EViews12

The short-run estimation results provide insights into the immediate effects of key economic variables on urbanization (lnURB). Among the regressors, education (LEDU) emerges as a crucial determinant, exhibiting a positive and highly significant coefficient, indicating that improvements in education contribute to increased urbanization in the short term. However, its lagged values (LEDU (-1) and LEDU (-2)) show negative and significant effects, this could be possibly due to improved opportunities in rural areas.

Population (LPOP) also plays a significant role, with its current and lagged values (LPOP (-1) and LPOP (-2)) exerting strong positive influences on urbanization. This suggests that urban population growth has a persistent effect, reinforcing the trend of increasing urbanization over multiple periods. The error correction term (COINTEQ*) is negative and highly significant, confirming the existence of a stable long-run relationship between the variables. Its coefficient of -0.218 indicates that approximately 21.8% of any deviation from the long-run equilibrium is corrected in each period, implying a moderate speed of adjustment toward equilibrium.

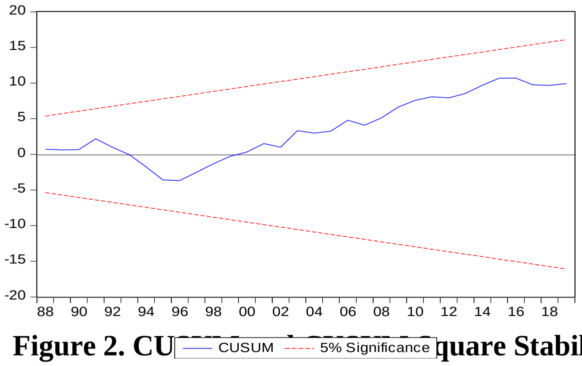
Conversely, industrialization (IND) and GDP (LGDP) do not exhibit significant short-run effects on urbanization, suggesting that economic growth and industrial expansion may take longer to influence urban settlement patterns. Additionally, the lagged urbanization variable (LURB(-1)) is negative and significant, indicating a tendency for urbanization to self-correct over time, possibly due to infrastructural or economic constraints that limit continuous urban expansion. These findings highlight the complex dynamics of urbanization, where population growth and education drive short-term changes, while other economic factors may exert influence primarily in the long run.

Table 6. ARDL Diagnostic Test Results

Test Statistics	F Version
A. Serial Correlation	F(2,12) = 1.137 (0.352)
B. Functional form	F(1,13) = 1.949 (0.186)
C. Normality	0.030 (0.985)
D. Heteroskedasticity	F(6,14) = 1.224 (0.326)

Source: Author's computation using EViews12

The diagnostic tests were conducted to assess the validity and robustness of the estimated model by checking for issues such as serial correlation, model misspecification, non-normality, and heteroskedasticity. The serial correlation test produced an F-statistic of 1.137 with a p-value of 0.352, indicating no significant presence of serial correlation in the residuals, meaning that errors are not systematically related over time. The functional form test, using the Ramsey RESET test, yielded an F-statistic of 1.949 with a p-value of 0.186, suggesting that the model is correctly specified and does not suffer from omitted variable bias. The normality test resulted in a test statistic of 0.030 with a p-value of 0.985, confirming that the residuals follow a normal distribution, thereby satisfying a key assumption for regression analysis. Additionally, the heteroskedasticity test produced an F-statistic of 1.224 with a p-value of 0.326, indicating that the variance of residuals remains constant and heteroskedasticity is not a concern. Overall, these diagnostic tests confirm that the model is well-specified, free from major econometric issues, and provides reliable estimates for inference.



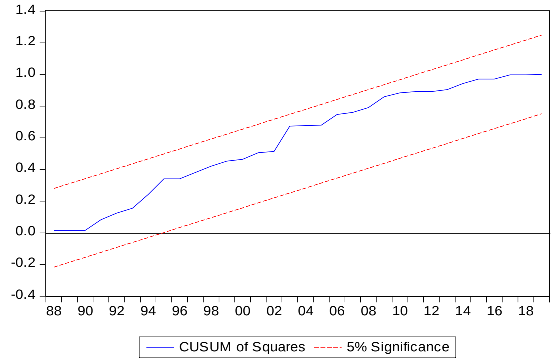


Figure 2. CUSUM and CUSUM Square Stability Test.

The CUSUM and CUSUM square test is performed to assess the stability or instability of the model at 5% level of significance. Because if the plot of the CUSUM and CUSUM square statistic falls in between the upper and lower critical bands of the 5% level of significance in essence, we say the model is Stable due to blue line stand in between the upper and lower red lines. The results, plotted in Figure 2 and figure 3, show that the sequence of the CUSUM and CUSUM square tests statistics stay within two red lines of upper bound and lower bound of the 5% level of significance. This meaning that, the blue line did not cross or even touch either of the red line. As a result, we accept the null hypothesis of the coefficient stability of the model, or in other words, the CUSUM and CUSUM square tests suggests that the model in the study is stable. Therefore, the figure 2 and figure 3 indicates that errors were stable within the study period since the CUSUM and CUSUM of square lines were within the five percent boundaries.

5. Conclusion and Recommendations

The study analyzed the impact of industrialization on urbanization in Nigeria, covering the period 1990 to 2023. Data on the entire variables used in the study were sourced from World Bank data base (WDI, 2025). ARDL bounds test for cointegration was applied after confirming the existence of mix order of integration of variables for the models of the study via ADF and PP unit root tests. The results shows that the coefficient of industrialization is positive and statically significant at one percent level of significant in the long run indicating that the variable has a strong positive effect on the urbanization in Nigeria. Furthermore, the short run result also revealed that the coefficient of industrialization is positive and statistically significant at one percent level of significance implying that the variable has a significant positive impact on urbanization in Nigeria. The results were in consistent with the finding of Gomez and Herrera (2020) and Adetunji and Bello (2020), who highlighted how industrialization attracts rural workers, leading to overpopulation and infrastructural strain. The study concludes that, urbanization trends in Nigeria has a direct and strong link with industrial expansion and economic growth, with education and population growth also playing secondary roles during the study period. In view of the outcomes of this research it is recommended that, government should integrate sustainability frameworks into urban development plans to prevent uncontrolled expansion that strains infrastructure and depletes natural resources. Public education campaigns should also be intensified to raise awareness of the environmental consequences of urbanization and industrialization. The study further recommended that, government should also develop a robust data monitoring system to track industrial activities and their environmental impact in Nigeria.

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