10.2478/vjes-2025-0014

From Demography to Development: Investigating the Manufacturing Pathway to Growth in Nigeria

Joseph Nwabueze AMAEFULE[1,] * and Astor Idris ABUH[2]

[1] Department of Economics, McPherson University, Seriki Sotayo, Abeokuta, Nigeria, https://orcid.org/0000-0001-7451-6905, josephamaefule@gmail.com, amaefulejn@mcu.edu.ng
[2] Department of Business Administration, McPherson University, Seriki Sotayo, Abeokuta, Nigeria, https://orcid.org/0000-0003-4911-1177 e-mail: astora@mcu.edu.ng
***** Correspondence: josephamaefule@gmail.com, amaefulejn@mcu.edu.ng

Abstract

Nigeria's rapid population growth and persistent industrial underperformance have raised concerns about the country's growth trajectory. Previous research often analyses these variables independently, thereby missing their potential synergy. This research explores whether population growth can spur economic growth when channeled through the manufacturing sector's absorptive capacity. Using annual data between 1981 and 2024, the study utilizes the Autoregressive Distributed Lag (ARDL) approach with an interaction term (Population Growth × Manufacturing Output) controlled by inflation, exchange rate, and gross capital formation. The findings show that population growth and manufacturing output have independent negative long-run effects on GDP. Their interaction revealed a positive and significant effect, implying that population pressure can sustain growth when supported by strong manufacturing sector output. Inflation and exchange rate volatility were found to destabilize output significantly. The study concludes that Nigeria's population is a development asset only if supported by a strong manufacturing base. It recommends that integrated demographic-industrial policy, improved infrastructure and credit access, and macroeconomic stabilization to translate the demographic dividend into a long-run growth.

Keywords: *ARDL Model, Economic Growth, Interaction, Manufacturing Sector output, Population Growth*

JEL Classification: P23, O14, J11, C32

1. Introduction

Nigeria is undergoing one of the most dynamic sub-Saharan demographic changes, with a total fertility rate of 5.08 children per woman in 2023 and a per capita population growth rate of approximately 2.5% [World Bank, 2024], while such growth is theoretically augmenting the domestic consumer market and labour force. However, it becomes a strain if the economy cannot absorb the additional population productively. Historically, the manufacturing sector has proven to be a reliable generator of jobs and long-term growth. Nigeria, however, is confronted with a paradox: despite the country's youth population and abundance of natural resources, the manufacturing industry contributes only 9.3% to GDP while employing just 11% of the labor force [National Bureau of Statistics, 2023; Amaefule, Babasanya, Okuneye, & Shonubi, 2025].

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Power outages, exchange rate volatility, inadequate infrastructure, and dependence on imports still inhibit industrial development. While previous studies have investigated the role of population growth in economic growth [Tartiyus et al 2015; Dao, 2012] or the contribution of manufacturing production to GDP [Evbuomwan et al, 2021], few studies have considered the role played by population growth in affecting or moderating the nexus between manufacturing and growth. Abrupt population growth may increase aggregate demand and provide a low-cost labor force, perhaps stimulating manufacturing production. However, it may decrease per capita productivity if growth overtakes employment generation and capital accumulation [Kebbi, 2023]. This analytical disconnect raises the question central to this study. To what extent does population growth in Nigeria intensify or supports the capacity of its manufacturing sector to propel economic growth.

2. Literature Review and Theoretical Framework

In the last two decades, the interactions between population dynamics and industrialization have received academic attention, especially among developing economies where young populations and manufacturing dreams meet. A number of studies have attempted to analyze the direct and combined impacts of population expansion and outputs in the manufacturing sector on economic expansion; however, the extent of such analysis and policy implications drawn are inconsistent, particularly within the Nigerian economy. Mazeli et al. (2024), in a study from 1981 to 2022, investigated the disaggregated effects of manufacturing sub-sectors on economic growth in Nigeria. Using OLS estimation techniques, they revealed that manufacturing sub-sectors such as cement, food, and textiles had statistically significant positive effects on GDP, while others such as motor vehicle assembly exercised negative pressure. The implications of this study are twofold: first, manufacturing is not a monolithic category; and second, sectoral specialization matters when industrial contributions are optimized to national income.

To this, the contribution of Evbuomwan et al. (2021) is added in identifying electricity consumption, exchange rate stability, bank lending, and capacity utilization as prominent determinants of Nigeria's manufacturing output variability. Their study reaffirmed that macro factors are the determining factors in industrial performance, and the identification of the need for coordinated policy interventions. Further advancing this narrative, Effiong et al. (2024) applied an ARDL framework to examine the effect of fiscal policy and interest rates on Nigeria's manufacturing sector performance. The study found that capital expenditure had a long-run positive effect on industrial output but feedback responses to interest rates were intricate. The contribution of the study lies in its policy implication: a judicious mix of capital-intensive infrastructure spending and interest-rate intervention can create more favorable conditions for manufacturing growth.

Okeke et al. (2023) corroborated this by examining the effects of central macroeconomic variables, lending rate, inflation, and exchange rate, on Nigeria's manufacturing sector through a growth model method. They found that exchange-rate volatility and inflation were the major constraints on manufacturing-sector stability, while guaranteed access to credit could facilitate growth. This study also called for targeted monetary policy reforms to addressing such structural imbalances.

Complementing these results, Amaefule and Maku (2019) applied an ARDL model to investigate the influence of national savings, inflation, and exchange rate movement on Nigeria's industrial sector. The study confirmed that while national domestic savings had a positive long-run effect, inflation and exchange rate volatility wreaked havoc

on sectoral productivity. The study emphasizes macroeconomic stability and internal capital formation as prerequisites for sustainable industrial development. After that, Babasanya, et al (2020) investigated the joint effect of labour force and national savings on the productivity of manufacturing. In their study, also using ARDL analysis, they found that an increase in the labor force alone is no guarantee of manufacturing performance unless complemented by sufficient savings and capital deepening. These findings have significant policy implications for countries like Nigeria, where labour supply tends to outstrip job creation in the formal industrial sector.

From a demographic perspective, Mukhtar (2023) employed an ARDL approach to examine the relationship among economic development, population dynamics, and social change in Nigeria. The study emphasized that population growth could be a driver of development if harnessed effectively through education investments and job-creating activities. However, in the absence of industrial absorptive capability, the population explosion would lead to economic stagnation and rising unemployment.

At the global level, Bazaluk et al. (2024) examined the determinants of growth in Turkey and Bangladesh. Despite not being Nigerian-centric, their work identified interdependent contributions of population dynamics, institutional quality, and industrial structure in determining growth results. The research is highly relevant for benchmarking, as the two nations share Nigeria's population strain and development challenges. Adding still more credibility to the thesis of development through industry, Sammut and Yam (2024), say manufacturing is still at the forefront of driving inclusive growth in emerging economies. Using global panel data, authors argue manufacturing continues to be a strong growth driver, especially when complemented by rising domestic demand and a growing workforce.

These studies provide robust empirical tests for the argument that demography and manufacturing are complementary aspects of national development. However, the overarching intuition is that there are no interaction-based empirical models that formally account for how population growth constrains the impact of manufacturing output on economic growth. The studies reviewed respectively assess these variables in isolation or with unidirectional causality models. This is an important deficiency of literature, especially for policy design in countries like Nigeria where industrial and demographic policies are usually isolating themselves.

This study is based on Endogenous Growth Theory, particularly the model of Romer (1986), in which economic growth is more a function of domestic factors such as innovation, human capital, and knowledge spillovers than of exogenous technological change. According to this theory, a country's productivity can be improved by deliberate investment in activities such as manufacturing that enhance learning-by-doing and economies of scale.

When demographic variables are brought in, the theory is also consistent with the notion of the demographic dividend, whereby a rising working-age population can be a prime driver of growth if matched with investment in employment-generating activities. The manufacturing sector, given its labour-intensity and scope for structural transformation, provides a natural means for such growth. However, the realization of this potential depends on the extent to which the manufacturing sector can absorb excess labor, raise productivity, and boost output to meet growing domestic demand.

Hence, this study's theoretical foundation is in the contention that population growth does not automatically lead to economic prosperity except as mediated by

productivity in the sectors and institutional efficiency. By submitting the interaction between demographic and manufacturing variables to empirical scrutiny, this study extends the theoretical boundaries of endogenous growth models to more accurately reflect the realities of developing economies such as Nigeria.

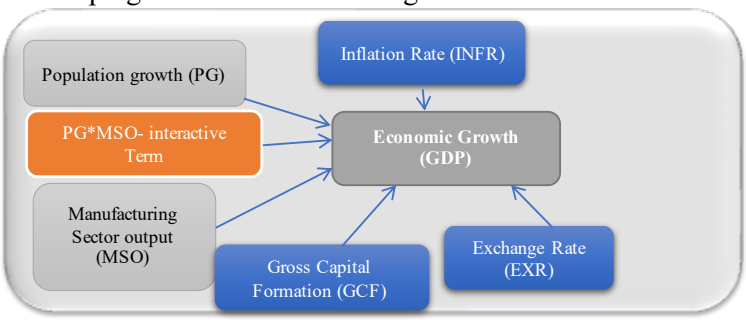


Figure 1. Conceptual Framework showing the Population–Manufacturing–Growth nexus

(Source: Authors' Compilation, 2025.)

Figure 1 provides a comprehensive view of how demographic dynamics affect industrial production in the context of Nigeria's economic growth. Most notable is the relationship between population growth and manufacturing production, both of which are hypothesized to have direct effects on economic performance, as captured by real GDP growth. However, in addition to their standalone impact, this study includes an interaction term (PG × MSO) to capture the moderating or conditional effect of demography on the manufacturing sector's contribution to economic growth. This term allows for a consideration of whether the effectiveness of manufacturing production in driving growth is facilitative or restrictive based on population growth rate.

To enhance the model's explanatory power and ensure the robustness of the results, three macroeconomic control variables are employed: inflation rate (INF), exchange rate (EXR), and gross capital formation (GCF). They are selected as they have been found to influence macroeconomic stability and sectoral productivity.

3. Methodology

The study uses a quantitative, time-series study design with the Autoregressive Distributed Lag (ARDL) Bounds Testing Method of cointegration by Pesaran et al. (2001). This is appropriate considering the mixture of stationary levels of the variables (I(0) and I(1)) and its ability to handle small samples. The analysis employs Nigeria's annual time series data from 1981 to 2023, such as GDP per capita growth (economic growth proxy), population growth rate, manufacturing sector output (% of GDP), Interaction term (population growth × manufacturing output), and control variables: inflation rate, gross capital formation, and exchange rate. Data are sourced from the World Bank's World Development Indicators (WDI), the Central Bank of Nigeria Statistical Bulletin, and the National Bureau of Statistics (NBS).

Model Specification

Using the Endogenous Growth Theory of Romer and empirical evidence, the model adopted was built on Amaefule & Maku (2019) and Babasanya et al. (2020) for

developing ARDL with respect to savings, labour, and manufacturing, Effiong et al. (2024) and Mukhtar (2023) to add fiscal, demographic, and industrial in ARDL modeling that was extended conceptually by Sammut & Yam (2024) for cross-country interactive relevance. Therefore, the functional relationship of the model is:

$$GDP = f(PG, MSO, PG \times MSO, INF, EXR, GCF)$$

Where:

GDP = Economic Growth (per capita GDP growth) PG = Population Growth
MSO = Manufacturing Sector Output PG × MSO = Interaction term (moderating effect)
INF = Inflation Rate EXR = Exchange Rate
GCF = Gross Capital Formation

The basic ARDL(p,q_1,q_2,…,q_k) model is adapted from Pesaran, et al (2001) to incorporate short-run dynamics as well as long-run relationships.

Long-Run ARDL Model Equation:

$$GDP_t = \beta_0 + \beta_1 PG_t + \beta_2 MSO_t + \beta_3(\mathrm{PG} \times \mathrm{MSO})_t + \beta_4 INFR_t + \beta_5 EXR_t + \beta_6 GCF_t + \mu_t$$

ARDL Error Correction Model (ECM) Representation:

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^{p} \propto_{1\mathrm{i}} (\Delta GDP_{\mathrm{t-i}}) + \sum_{j=0}^{q1} \propto_{1\mathrm{j}} (\Delta PG_{\mathrm{t-j}}) + \sum_{K=0}^{q2} \propto_{1\mathrm{k}} (\Delta MSO_{\mathrm{t-j}}) +$$
$$\sum_{l=0}^{q3} \propto_{1\mathrm{l}} (\Delta(\mathrm{PG} \times \mathrm{MSO})_{\mathrm{t-j}}) + \sum_{m=0}^{q4} \propto_{1\mathrm{m}} (\Delta INFR_{\mathrm{t-j}}) + \sum_{n=0}^{q5} \propto_{1\mathrm{n}} (\Delta EXR_{\mathrm{t-j}}) +$$
$$\sum_{O=0}^{q6} \propto_{1\mathrm{o}} (\Delta GCF_{\mathrm{t-j}}) + \Phi ECT + £_t$$

Where:

GDP = Economic Growth (increase in per capita GDP)
PG = Population Growth (Annual %) MSO = Manufacturing Sector Output (% of GDP)
PG × MSO = Interaction term (moderating effect). INF = Inflation Rate
EXR = Exchange Rate (real Exchange rate Δ = Operator for first difference
GCF = Gross Capital Formation (% of GDP)
ECT_{t-1} = Error Correction Term from the long-run equation
ϕ = Coefficient of speed of adjustment (expected to be negative and significant for cointegration)
$£_t$ = Error term

3.1. Estimation Techniques

The study employed a systematic estimation process, using the ADF and PP unit root tests as a starting point to assess the stationarity of the variables, none of which were order-two integrated. The Bounds Test for cointegration was then employed to confirm that there existed a long-run relationship among the variables, a fact that justified the application of the ARDL method. After cointegration testing, then the ARDL model was estimated to separate short-run and long-run effects. The Error Correction Term (ECT) accounted for the speed of convergence towards equilibrium. Breusch-Godfrey serial correlation, and White heteroskedasticity test were conducted to determine the validity of the model.

4. Empirical Results and Discussion

Table 1 provides a comprehensive summary of the descriptive statistics and normality diagnostics for the key variables used in this study, covering the period from 1981 to 2024. The mean value of real GDP growth stands at 0.395, with a high standard deviation of 5.047, indicating significant fluctuations in Nigeria's economic performance over the study period. Population growth (PG), with a mean of 2.612% and a relatively low

standard deviation of 0.236, suggests a stable and steadily increasing demographic trend in Nigeria.

Table 1.

Descriptive Statistic and Normality Test (N=44)

	Mean	Std. Dev.	Jarque-Bera	Probability
GDP	0.395	5.047	15.778	0.000
PG	2.612	0.236	7.679	0.023
MSO	14.309	4.863	4.103	0.129
INF	19.401	16.232	3.137	0.234
GCF	33.008	20.070	2.209	0.316
EXR	144.440	112.476	2.759	0.254

Source: Author's compilation, (2025)

Manufacturing sector output (MSO) recorded a mean of 14.309 and a standard deviation of 4.863, indicating moderate variability likely tied to policy inconsistency, infrastructural challenges, and exchange rate fluctuations that affect input costs. Inflation (INF), gross capital formation (GCF), and exchange rate (EXR) exhibit substantial dispersion, as indicated by their large standard deviations (16.232, 20.070, and 112.476, respectively), suggesting structural instability in Nigeria's macroeconomic indicators during the period. The Jarque-Bera (JB) test for normality indicated that MSO, INF, GCF, and EXR are normally distributed, whereas GDP and PG are not.

Table 2.

Correlation Matrix

Correlation	GDP	PG	MSO	INF	GCF	EXR
GDP	1.000					
PG	-0.003	1.000				
MSO	-0.467	0.084	1.000			
INF	-0.200	-0.086	0.433	1.000		
GCF	-0.568	0.554	0.067	0.165	1.000	
EXR	-0.488	0.175	0.458	-0.144	0.554	1.000

Source: Authors' compilation (2025)

A critical look at the values in Table 2 indicates that none of the correlation coefficients exceed 0.70, implying no evidence of multicollinearity among the independent variables. This validates the inclusion of all variables in the ARDL model without concerns for distortion due to linear dependence

Table 3.

Unit Root Test: Augmented Dickey-Fuller Test (ADF) and Phillips-Perron Test

	Augmented Dickey-Fuller Test (ADF)			**Phillips-Perron (PP) test statistic**		
Var.	Level	1st Diff	Order of Int.	Level	1st Diff	Order of Int
GDP	-3.401**	-	I(0)	-4.535***		I(0)
PG	-1.777	-5.461***	I(1)	-1.042	-5.461***	I(1)
MSO	-1.375	-4.492***	I(1)	-1.382	-7.805	I(1)
INF	-3.057**	-	I(0)	-2.915**	-	I(0)
GCF	-3.397**	-	I(0)	-3.359**	-	I(0)
EXR	-2.150	-4.483***	I(1)	-1.951	-4.361***	I(1)

Source: Author's compilation, (2025)

*Where ***1%, **5%, and *10% level of significance*

The ADF and PP tests in Table 3 reveal that GDP, INF, and GCF were stationary at level I(0) series, while PG, MSO, and EXR were stationary at first difference I(1) series. Since the level of integration differs among the variables, the study employs the Autoregressive Distributive Lag (ARDL) approach to determine the relationship between the variables.

Table 4.

VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-786.1683	NA	1.50e+08	38.69114	38.98370	38.79767
1	-564.9676	356.0792	34942.05	30.29110	32.63159*	31.14338
2	-489.6220	95.56036*	11963.85	29.00595	33.39437	30.60397
3	-420.3304	64.22142	8346.972*	28.01612*	34.45246	30.35988*
** 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						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Source: Author's compilation, (2025)

The lag selection criteria in Table 4 indicate that the most appropriate choice of lag length is 3 based on AIC, HQ, and FPE. This supports the use of lagged values in the ARDL model, improving its ability to capture dynamic effects between the variables. Following this, the ARDL bound cointegration test was conducted to confirm long-run cointegration among the variables

Table 5.

ARDL Bounds Test

Test Statistic	Value	K
F-statistic	7.357249	6
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.12	3.23
5%	2.45	3.61
2.5%	2.75	3.99
1%	3.15	4.43

Source: Authors compilation, (2025)

The result of the Bounds Cointegration Test, as shown in Table 5, is the computed value of the F-statistic equal to 7.36, which is much larger than the upper critical bound value of 4.43 under the 1% significance level. This result confirms that the null hypothesis of no long-run relationship among the variables in the model is rejected. This implies that there is a long-run cointegration among the variables.

Table 6.

Autoregressive Distribution Lag (ARDL) Model Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Short run Coefficients				
D(PG)	-18.805	30.061	-0.626	0.538
D(PG(-1))	-22.690	50.280	-0.451	0.656

D(PG(-2))	105.794	43.449	2.434	0.023
D(MSO)	-5.834	4.144	-1.408	0.173
D(MSO(-1))	-5.628	6.786	-0.829	0.415
D(MSO(-2))	17.444	6.386	2.732	0.012
D(PG × MSO)	2.091	1.554	1.346	0.191
D(PG × MSO(-1))	2.002	2.562	0.781	0.443
D(PG × MSO(-2))	-6.328	2.383	-2.656	0.014
D(INF)	-0.151	0.049	-3.056	0.006
D(GCF)	-0.259	0.150	-1.725	0.098
D(EXR)	-0.005	0.013	-0.417	0.681
ECT-1)	-1.144	0.167	-6.837	0.000
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
PG	-36.535	19.976	-1.829	0.080
MSO	-9.518	4.251	-2.239	0.035
PG × MSO	3.764	1.628	2.312	0.030
INF	-0.132	0.043	-3.103	0.005
GCF	-0.227	0.136	-1.672	0.108
EXR	-0.023	0.008	-2.838	0.009
C	105.288	54.140	1.945	0.064

Dependent Variable: GDP *Source: Authors compilation, (2025)*

The empirical model estimation in Table 7 shows that, in the short run, the second lag of population growth (PG) has a statistically positive impact on GDP growth, indicating that past trends of population increase output with some lag. Similarly, the second lag of MSO is positive and significant, indicating that industrial output contributes to economic growth after some lag, possibly reflecting the delayed effects of capital investment and policy action in the real sector. But the short-run interaction term (PG × MSO) indicates a significant negative effect, suggesting that high population growth may reduce the positive effect of manufacturing output in the first place, due to absorptive and infrastructural constraints. The Error Correction Term (ECT), as expected, is negative and statistically significant (–1.144) as it indicates strong convergence towards long-run equilibrium.

On the long-run estimates, growth in population and output in the manufacturing sector have adverse effects on GDP if considered independently. The negative coefficient on PG aligns with previous research by Mukhtar (2023) and Okeke et al. (2023), which reveal that population growth, without accompanying economic planning, infrastructure investment, and job opportunities, becomes a liability rather than an asset. Similarly, the negative MSO can be attributed to Nigeria's historically underperforming manufacturing industry, which has been characterized by low rates of capacity utilization, technology backwardness, and dependency on imported raw materials (Evbuomwan et al., 2021).

The interaction term in the long-run (PG × MSO) is positive and strongly significant, confirming the study's central hypothesis: that economic growth may be powered by population growth if suitably channeled through a dynamic and absorptive manufacturing sector. This aligns with the hypothesis of demographic dividend (Bloom et al., 2003) and is empirically confirmed by Bazaluk et al. (2024), who found that industrial capacity mediates the effect of demographic growth on macroeconomic performance. Inflation and exchange rate volatility also have negative long-run implications, as reported in the literature by Amaefule and Maku (2019) and Babasanya et al. (2020), who point out

that macroeconomic instability is detrimental to production and consumption, thereby inhibiting growth.

Table 7.

Post Estimation

Test	F-statistic	P-value
Normality (Jarque-Bera)	2.416	0.299
Breusch-Godfrey Serial Correlation LM	0.145	0.866
Heteroskedasticity Test: Breusch-Pagan-Godfrey	1.004	0.488
Ramsey RESET Test	0.465	0.503

Source: Author's Compilation, 2025

The performance of the ARDL model was confirmed using diagnostic tests. Breusch-Godfrey test for serial correlation reported a p-value much higher than 0.05, indicating that there is no autocorrelation in the residuals. The White test also indicated homoskedastic residuals, which confirmed the validity of the standard errors and statistical inference. Furthermore, Ramsey RESET test did not reject the null hypothesis of correct specification, indicating that the functional form of the model is appropriate.

Conclusion and Recommendations

This study examined how population growth and manufacturing sector output interact to influence Nigeria's economic growth from 1981 to 2024. The ARDL analysis revealed that while both population growth and manufacturing output individually indicate negative long-run impacts on GDP, their interaction is positive and significant. This indicates that population growth can become an economic asset when effectively integrated with a vibrant and absorptive manufacturing sector. Furthermore, the analysis confirmed that inflation and exchange rate instability remain critical constraints to sustainable growth. The existence of cointegration and a stable adjustment mechanism underscores the importance of aligning demographic trends with industrial capacity. Thus, Nigeria's economic development depends not only on population management or industrial expansion in isolation but on the strategic alignment of both within a stable macroeconomic environment. The study contributes significantly to development literature by highlighting that demographic pressure, often perceived as a challenge, can become a growth-enhancing asset when supported by a productive industrial base. This insight addresses a critical gap in existing Nigerian empirical research, where most studies treat population and industrial dynamics as isolated growth drivers. Hence, the following recommendations were proposed:

1. There should be deliberate actions to integrate population management efforts with the development of the manufacturing sector through targeted education, vocational training, and workforce planning.
2. There should be policy (ies) to improve infrastructure, reduce energy costs, and expand access to credit for manufacturers, especially small and medium enterprises.
3. Implement inflation-targeting policies and maintain exchange rate stability to lower production costs and improve investor confidence.
4. Support job-creating industrial policies that absorb the growing workforce, especially in labor-intensive manufacturing sub-sectors, should be promoted.

Disclosure statement

We hereby declare that the results from this study are not in any way influenced by external factors or misconduct, such as the trade of financial incentives for positive results.

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