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Industrialization and economic growth in Nigeria, 1990 – 2024

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This research seeks to examine the nexus between industrialization and economic growth in Nigeria. The specific purpose of the study is to analyze the effects of manufacturing output, mining, electricity supply, construction, water/sewage/waste management, and labor force participation on Nigeria's real gross domestic product growth rate. This study adopts an ex-post facto research design. The period covered spans from 1990 to 2024. Data were collected as annual time series secondary data from the Central Bank of Nigeria (CBN) statistical bulletin (various years), World Development Indicators, and World Energy Statistics from the International Energy Agency. The data were analyzed using the Error Correction Model. Additional tests conducted include unit root, cointegration, and autocorrelation tests. The research employs an econometric approach. The results reveal that manufacturing, mining, electricity supply, construction, and water/sewage/waste management had a negative effect on economic growth in Nigeria in the short run. However, only the effects of manufacturing, electricity, construction, and waste management on the Nigerian economy were statistically significant. In conclusion, industrialization has a negative effect on Nigeria's economic growth. Nigeria's industrialization efforts have not yielded the expected positive effects on the economy, leading to declining outputs in manufacturing, mining, electricity supply, construction, and water/sewage/waste management sectors. When electricity supply and distribution to the industrial sector are adequately enhanced, coupled with increased productive capacity, Nigeria's economy will be on the path to long-term growth.

Keywords: Construction, Electricity supply, Labour force participation, Manufacturing, Mining.

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Contents

Contribution of this paper to the Literature
Previous studies have linked industrialization to either economic growth or development. Evidence available to researchers reveals that none of the previous studies used a combination of manufacturing sector output, energy supply, agricultural output, exchange rate, and labor force participation as proxies for industrialization.

1. Introduction

African countries gained their independence in the 1960s, and this period coincided with the promotion of industrial development and growth as a major target for African countries. Countries in Africa at the time viewed industrial sector development as a way of growing local capacity and decreasing their reliance on developed nations in Europe and America. African countries were held by one strong belief that developing their vast agrarian land would boost industrial development and create a progressive economy (Isiksal & Odoh, 2023).

In Nigeria, rudimentary industrial activities existed right from the pre-colonial era, but these were more agro-based, i.e., concentrated in the agricultural sector, which provided raw materials in exchange for foreign goods with the Europeans during the colonial era. Nigeria was dependent on agriculture up to 1972, when oil became the major foreign exchange earner in the country. During this period, the nation's foreign earnings were below 20% of Gross Domestic Product as a result of low-quality industrial goods, whereas almost all the capital goods were imported (Bakare-Aremu & Osobase, 2015). At this period, about 63% to 80% of the nation's gross domestic product (GDP) was from the exportation of primary agricultural products. The level of industrial activities in the country was very low, and most commercial activities were established and controlled by foreign companies such as the United Africa Company (UAC) Ltd, John Holt, Paterson Zochonis (PZ), Companies Francaise de l'Afrique Occidentale (CFAO), Societe Commerciale de l'Afrique Occidentale (SCOA), and the Union Trading Company (Bakare-Aremu & Osobase, 2015). These companies engaged in trade and commercial activities, especially in the importation and distribution of foreign-manufactured goods (Ekpo, 2014).

To stimulate economic growth, a series of industrial development policies and initiatives have been initiated, including import-substitution industrialization, export-promotion strategies, and foreign private investment industrialization (Ayodele & Falokun, 2023). Furthermore, policy reform measures such as industrialization policies and structural adjustment programs have been devised and executed, resulting in substantial public investment in the industrial sector. From the 1970s to the 1990s, the Nigerian government embarked on a series of investment projects, such as the iron and steel plant at Ajaokuta, steel rolling mills at Warri, Kaduna, and Oshogbo, aluminum smelter plant at Ikot Abasi, crude oil refineries at Port Harcourt, Warri, and Kaduna, petrochemical and fertilizer factories at Port Harcourt, cement industries at Calabar and Nkalagu, machine tool, sugar plants, and marble industries, petrochemical gas plant at Akwa-Ibom (Okorontah and Uruakpa (2023).

Nigeria's economic indices at various stages of industrialization have remained unimpressive for more than thirty years. High imports of industrial inputs, declining capacity utilization, high production costs, low value added, a slow rate of output growth, a lack of job creation, and poor connections with other economic sectors are some of the characteristics of Nigeria's industrial sector (Obioma & Ozughalu, 2020). In 2022, the industrial sector's annual growth rate as a percentage of GDP was 30.8%; in 2023, it increased slightly to 32.2% (Central Bank of Nigeria, 2023). Ekpo (2014) also observed that the industrial sector's share of GDP in Nigeria is far less than what is obtainable in other countries. With manufacturing sector output contributing a little less than 12.7% to GDP in 2023 (Central Bank of Nigeria, 2023), Nigeria's industrialization prospects are still on the rise.

Nigeria boasts as one of the top five largest economies in Africa, with a population in excess of 200 million as of the end of 2023, and a GDP of over $500 billion World Bank (2024). Nigeria is the continent's biggest oil exporter and is home to large natural gas reserves, as noted by World Bank (2024). According to World Bank (2024), the Nigerian economy has recorded considerable acceleration in growth; real GDP grew by 6.3 percent, 7.6 percent, and 7.4 percent in 2019, 2020, and 2021 respectively. Many analysts believe the industrial sector (manufacturing and extractive) holds an undeniably key role in Nigeria's economic development, given that this sector is responsible for about 85 percent of foreign exchange earnings (Central Bank of Nigeria, 2023). There is a need to investigate Nigeria's industrial development pattern and how this affects economic growth.

1.1. Statement of the Problem

Despite the vast array of human and natural resources available in the country, one may question why the expected level of economic growth has not been achieved. According to Kpou (2024), Nigeria is a major exporter of natural liquefied gas and crude oil worldwide, but the possibility of having self-consumption seems a tedious problem. It has been a supplier of power energy (electricity) to some neighboring countries like Benin and the Niger Republic, but the nation's industrial consumption of such energy appears very low. Electric power, transportation, technological innovations, and good market facilities with effective communication systems, which are major aids to industrialization worldwide, are lacking in the country. How much the industrial sector has contributed to growth in the Nigerian economy, given the current state of the drivers of industrialization, such as infrastructure and power, remains to be ascertained in this research.

Furthermore, since Nigeria gained its independence, a great deal of research has been conducted on the country's industrialization. Everyone seems to agree that the industry has performed poorly over the years. Nigeria's industrial sector has been characterized by high import content of industrial inputs, falling capacity utilization, high production costs, poor value added, declining output growth, and low employment generation, according to Obioma and Ozughalu (2020). According to Metieh and Mgbomene (2025), inflation is a major factor contributing to poor employment, which impacts investment in Nigeria. The average annual growth rate of industrial output as a proportion of GDP over the study period was around 28%, which is far higher than what is achieved in many emerging nations. The production of the agricultural sector as a proportion of GDP was 22% during the same period, surpassing the combined contribution of the industrial and manufacturing sectors, while the output of the manufacturing sector as a percentage of GDP was less than 15% (Central Bank of Nigeria, 2023).

Policies derived from existing research of this kind are crucial, given the current shift in emphasis toward measures that would industrialize the Nigerian economy.

Once more, the outflow of multinational corporations from the Nigerian market motivates the researcher to examine the connection between specific elements of the industrial sector and economic growth in Nigeria. According to Nairametrics (2023), 767 manufacturing enterprises in Nigeria closed their doors in 2023 alone. Additionally, a 2023 assessment by the Manufacturing Association of Nigeria indicates that 335 businesses in Nigeria's industrial sector faced significant difficulties. Therefore, this study investigates how industrialization influences Nigeria's economic growth.

1.2. Objectives of the Study

The general objective of this study is to investigate the effects of industrialization on the growth of the Nigerian economy. The specific objectives are to:

i. Investigate the relationship between manufacturing sector output and economic growth in Nigeria.
ii. Analyze the effect of the mining sub-sector output on Nigeria's economic growth.
iii. Investigate the extent to which electricity supply has affected Nigeria's economic growth.
iv. Evaluate the effect of the construction sub-sector output on Nigeria's economic growth.
v. Determine how output from water supply, sewage, and waste management has affected economic growth in Nigeria.
vi. Examine the relationship between the labour force participation rate and economic growth in Nigeria.

1.3. Research Hypotheses

In line with the research objectives specified above, the following research hypotheses, stated in their null forms, will provide further guidance to the research.

H_{01}: There is no significant relationship between manufacturing sector output and economic growth in Nigeria.
H_{02}: There is no significant relationship between the mining sub-sector and economic growth in Nigeria.
H_{03}: There is no significant effect of electricity supply on economic growth in Nigeria.
H_{04}: Construction sub-sector output has no significant effect on Nigeria's economic growth.
H_{05}: Water supply, sewage and waste management do not significantly affect Nigeria's economic growth.
H_{06}: There is no significant effect of labour force participation on Nigeria's economic growth.

The unit scope of this research is industrialization and economic growth of Nigeria. This study covers the period 1990-2024. This period is selected because of the availability of data and the suitability of the year span for fitting an econometric model. The variables for this study include real gross domestic product growth rate (dependent variable), while manufacturing output, mining output, energy/electricity supply, construction sub-sector output, water/sewage/waste management output, and labor force participation rate were employed as independent variables.

2. Literature Review

The literature review is subdivided into three distinct but complementary parts. First is the conceptual review, which stems from the conceptual framework. Second is the theoretical framework, and third is the empirical review. Based on these various aspects of the literature review, the gap in the literature is established.

2.1. Conceptual Review

The conceptual issues are discussed in detail under this heading. The conceptual clarifications revolve around the meaning of industrialization, the drivers of industrial sector growth, which include the manufacturing sector, the agricultural sector, energy supply, the labour market, and a sustained exchange rate. These concepts are shown in the framework below.

Figure 1 illustrates the conceptual framework of the study, showing the nexus between the industrialization variables and the economic development of Nigeria.

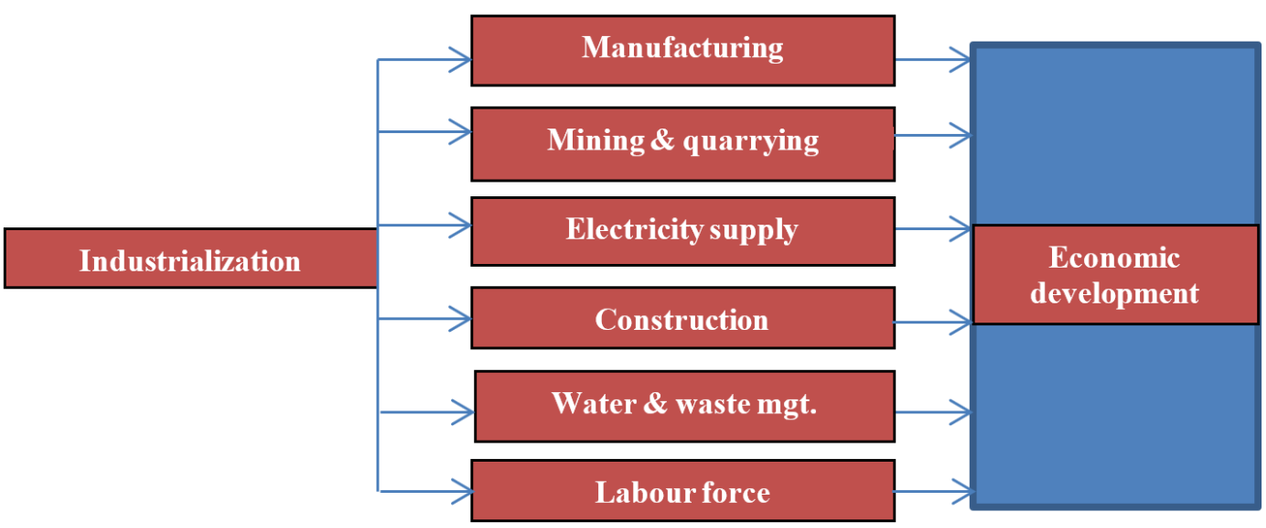

Figure 1. Conceptual framework.

2.1.1. Industrialization

Establishing and growing industries in a certain location, region, or nation is referred to as industrialization (Obioma & Ozughalu, 2020). It entails the establishment of several enterprises around the nation. A nation's numerous industries lead to the production of a wide variety of goods. Therefore, industrialization is the process of increasing a nation's ability to create a wide range of commodities, including the extraction of raw materials and the production of semi-finished and finished items. Industrialization, according to Anyanwu, Oyefusi, Oaikhenan, and Dimowo (1997) and Ekpo (2014) is the process of turning raw materials into (a) consumer goods, (b) new capital goods that enable the production of more consumer goods, including food, using the same human resources, and (c) social overhead capital, which, when combined with human resources, offers new services to both individuals and businesses.

2.1.2. Drivers of Industrialization in Nigeria

The contribution of a robust industrial sector to output growth, employment generation, and ultimately, enhanced standards of living cannot be overemphasized. The Nigerian industrial sector has been plagued by several impediments, which have resulted in sub-optimal performance, thereby making its contribution to gross domestic product (GDP) and employment generation remain far below potential. To unlock the huge potentials of the sector, several variables account for the growth of the industry, and they are discussed within the context of this research.

(a) Manufacturing Sector Output: Manufacturing sector output refers to the total production made by the manufacturing sector within a particular year, expressed in monetary terms (Egbulonu, Dim, & Agba, 2018). The market value of the products from the manufacturing sector sustains the value of the economy, and these products that drive the industrial sector are purely manufactured goods and services. Similarly, manufacturing is the process or business of producing goods in factories with machines. In Nigeria, the index of manufacturing production, estimated at 108.1 (1990=100), rose by 1.6% from the level in 2022, while the average capacity utilization of the manufacturing sector showed a marginal improvement, with a 1.1 percentage point increase to 57.9% in 2023. The improved performance in the cement sub-sector accounted for the growth in the manufacturing sector, including petroleum refining, sugar and confectionery, electronics and electrical components, and motor vehicle assembly. Afolabi and Laseinde (2019) remarked that industrialization sets the condition to achieve sustainable economic growth in all economies. It can also be stated that the dynamic benefits of the manufacturing sector are activating economic transformation in this modern-day economy, which is directly responsible for speeding up investment capital in the agricultural sector and the overall economy (Afolabi & Ogoh, 2017).

(b) Energy/Electricity Supply Boost: Industrialization without proper and constant electricity is like a skeletal framework without fresh blood, which is improper for moving or work. Whereas, for any meaningful industrialization process to take place in any economy, electricity supply and demand must remain uncompromising elements of the process, as blood and flesh are very meaningful to the human body for life to exist. Electric power consumption was used in the study, and it measures the production of power plants and combined heat and power plants, less transmission, distribution, and transformation losses, and own use by heat and power plants (World Bank, 2024).

According to data from the National Bureau of Statistics (2023) total installed electricity generation capacity stood at 12,232 MW in 2023, compared with 9,937 MW in 2022. The increase in generation capacity was a result of the completion of the generation plants at Omotosho, Ihovbor, and Geregu power plants (Okezie, Nwosu, & Marcus, 2017). A disaggregation of the installed capacity showed that thermal power and hydropower accounted for 84.5 and 15.5 percent, respectively. Further analysis indicated that the erstwhile power holding company of Nigeria (PHCN) had 81.8 percent of the total installed capacity. Meanwhile, the independent power plants (IPP) accounted for the remaining capacity (Central Bank of Nigeria, 2023). Energy consumption: at 160.3 (1990=100), the index of energy consumption fell by 10.7% compared with a decline of 5.2% recorded in 2022 (National Bureau of Statistics, 2023). In absolute terms, aggregate energy consumed in 2013 stood at 13.40 million tons of coal equivalent (toe), compared with 16.6 million (toe) in the preceding year, representing a decline of 19.1%.

(c) Mining and quarrying sub-sector: With increasing demand for energy and low-carbon technologies, an unprepared extractive industry is likely to struggle to meet rapid increases in demand for minerals and metals for production. Mining involves the extraction of naturally occurring minerals such as coal, ores, crude petroleum, and natural gas (National Bureau of Statistics, 2023). Excluding crude petroleum and natural gas activities, mining and quarrying, including coal mining, metal ores, quarrying, and other minerals, jointly contributed about 0.09% to the national GDP during the period from 2010 to 2024. This was a steady rise over the period; from the ₦51,877.80 million recorded in 2010, output grew by ₦7,691.54 million or 14.83% in 2011 to reach ₦59,569.34 million that year.

The National Bureau of Statistics (2023) noted that there are about thirty-four minerals that have been identified in the country, of which only 13 are being actively mined, processed, and marketed. These include coal (which has an export potential of 15 million tonnes per annum valued at US$1 billion), kaolin, baryte, limestone, dolomite, feldspar, glass sand, gemstones (haphazard), gold (in small quantities), iron ore, lead-zinc, tin and its associated minerals, and recently gypsum. The remaining twenty-one (21) minerals, although in demand, are untapped, creating significant potential for industrialization in Nigeria, which can contribute to economic development.

(d) Construction Sub-sector: All over the world, the construction industry is continually growing. This industry is primarily concerned with the development of civil engineering works and heavy infrastructural provisions (roads, bridges, railways, etc.), residential and commercial real estate, and their maintenance (National Bureau of Statistics, 2021). Thus, the continual growth can be explained by the dynamism of development and the need to accommodate social and demographic changes that happen over time. Factors such as migration and urbanization, a rising middle class with their demands for better living conditions (better houses, road networks), and societal needs for social infrastructure all combine to give the sector the impetus for growth. According to the National Bureau of Statistics (2021) demands for real estate and housing, the provision of infrastructure to support

an increasing population size, the need to open up communities to foster inter-state and inter-regional trade and movement, etc., have posed a great impetus for the growth of the construction sector in Nigeria.

(e) Water Supply, Sewage, and Waste Management: According to Iyaji (2021) and Mgbomene (2024), the economic development witnessed in Nigeria has, to some extent, contributed to the problem of water pollution. The primary sources of water pollution in Nigeria today include waste discharged into water bodies from domestic sewage, industrial effluents containing organic pollutants, and wastes from chemicals, heavy metals, and mining activities. The major water-polluting industries are refineries, fertilizer production, pesticides, chemical manufacturing, leather processing, pulp, and paper industries (Fajana, 2019). Globalization and its tactics of concentrating industries in African countries have also created the problem of solid and hazardous waste in Nigeria. In fact, solid waste generates air and water pollution in urban areas where industries are concentrated in Nigeria. As a result of globalization, urbanization, and industrialization, there is an emerging problem of unregulated urban growth lacking facilities such as waste collection, transportation, treatment, and disposal, which pollutes the atmosphere and water resources. Rotting garbage and blocked drains, characteristic of many countries including Nigeria in the current era of globalization, spread communicable diseases and pollute water resources (Andrew, 2022). Therefore, it is evident that industrialization, water, and waste management are cross-cutting issues among key sectors in Nigeria, and to achieve meaningful economic development, water, sewage, and waste management must be effectively addressed.

(f) Labour Force Participation: For this study, the labour force comprises people aged 15 and older who supply labour for the production of goods and services during a specified period. It includes people who are currently employed and people who are unemployed but seeking work,, as well as first-time job-seekers (World Bank, 2024). Although there is no doubt that labour force participation can lead to increased labour supply for industrial production in Nigeria, investment in private industries also spurs labour force participation because it not only acts as a stimulus but also "leads the way" to industrialization (Yecho & Ityonzughul, 2020).

2.2. Theoretical Framework

This study is hinged on two theories. They include the unbalanced growth theory and the Solow growth theory. The unbalanced growth theory is propounded by Hirschman (1958). He said that a deliberate unbalancing of the economy according to a pre-designed strategy is the best way to activate growth in an underdeveloped nation. This theory assumes that, when a strategic sector is fully developed, it causes the growth of other sectors and the economy will lead to new investment opportunities and so pave the way for further economic development, as such growth stems from leading sectors of the economy to the followers (Jhingan, 2012). This theory was adopted by Nigeria in the 1970s, the selective credit policies. Furthermore, one of the fundamental requirements for growth is that income and capital should be used to fully utilize existing resources so that economic growth can be enhanced. Thus, the full development of a strategic sector causes other sectors to develop, and one ingredient for development or growth to occur is the infusion of capital and labor. Following the two theories, this study specifies as follows:

$$Y = f(K, L) \quad (1)$$

Where, Y = Output, K = Input of capital and L = Labour, (Chamberlin & Yuem, 2006).

However, the model was modified to fit in the present study by using the function.

$$Y = f(Xi) \quad (2)$$

Where Y = GDP (proxy of economic growth) and Xi = the products of capital and labour requirements for industrialization from various sectors.

2.3. Empirical Review

The review of related studies is aptly shown in Table 1 below, which highlights the key elements of previous studies while also identifying some gaps in these studies.

Table 1. Summary of empirical literature review.

Author and date	Study	Outcome/Finding	Method	Gap
Afolabi and Ogoh (2017)	Relationship between industrial output and economic growth in Nigeria	An increase in industrial output coupled with agricultural output increases its value added to the economy.	ARDL model	Labour, mining, sewage/waste and electricity factors were not considered in their model.
Obioma, Anyanwu, and Kalu (2017)	Effect of industrial development on economic growth in Nigeria	Positive but insignificant impact of industrial output on economic growth.	ARDL model	Labour, mining, sewage/waste, and electricity factors were not considered in their model.
Afolabi and Laseinde (2019)	Impact of manufacturing sector output on economic growth in Nigeria	Positive effect of manufacturing sector output on RGDP.	ARDL and Granger causality techniques	Labour, mining, sewage/waste, and electricity factors were not considered in their model.
Attiah (2019)	Impact of manufacturing and the service sectors on the economic growth of developed and developing countries	Significant and positive relationships were found between manufacturing output and GDP.	Multiple regression analysis	Labour, mining, sewage/waste, and electricity factors were not considered in their model.
Sahar (2020)	Effect of industrialization on the economic growth of Pakistan	The study revealed a direct relationship between industrial output and GDP in Pakistan.	ARDL model	The study was not carried out in Nigeria
Kida and	Impact of	Crude petroleum and	Error correction	The variables of the study

Angahar (2020)	industrialization on economic growth in Nigeria	natural gas, manufacturing, and solid minerals significantly contributed to economic growth.	model (ECM).	concentrated only on the oil industry.
Yecho and Ityonzughul (2020)	Challenges affecting the complementary role of agriculture to industrialization in Nigeria.	Through agriculture, industrialization enhances sustainable development in Nigeria.	Discussion method	The research was not empirical as no data were analyzed
Abomaye-Nimenibo (2021)	Impact of industrial policy reforms on economic transformation and diversification of Nigeria	Human capital, labour input, and capital stock do not contribute significantly to economic growth.	Multiple regression analysis	The variables were good, but manufacturing and mining output as critical industrialization drivers were not considered.
Usman and Lazarus (2021)	Impact of industrialization on economic growth in Nigeria	Labour-industrial output ratio also contributes negatively to per capita GDP.	Multiple regression technique	Manufacturing and mining output, as key drivers of industrialization, were not considered.
Ibitoye, Ogunoye, and Kleynhans (2022)	Impact of industrialization on the growth of Nigeria's economy	Industrial output and FDI increased growth while interest rate and exchange rate decreased growth.	Error correction and Granger causality tests	The study did not include manufacturing/mining output and even labour utilization as drivers of industrialization.
Isiksal and Odoh (2023)	Relationship between GDP, agriculture, industry, and the services sector in Nigeria	The results revealed that agriculture, industry, and services had a significant positive relationship with GDP.	Ordinary least squares regression and Granger causality	The variables of industrialization were aggregate.
Okorontah and Uruakpa (2023)	Nigeria's industrial policy and economic performance	The manufacturing sub-sector has not contributed enough towards the economic growth of Nigeria.	Robust least square estimates	The study did not consider labor and electricity as specific industrialization variables.
Ekpo (2014)	An analytical exploration of Nigeria's industrial sector performance and policies from 1960 to 2023.	The Nigerian manufacturing sector, in particular, had performed below expectations.	Systematic literature review	No data were analyzed
Oyeku (2024)	Relationship between labor force dynamics and economic growth in Nigeria	Labor force, gross fixed capital formation, and female primary school enrollment have positive and significant long-term effects on economic growth.	Autoregressive distributed lag	Other drivers of industrialization, such as manufacturing, mining, electricity, sewage, and waste management, were not considered.
Ibeaja and Amadi (2024)	Effects of restructuring the industrial sector on economic growth in Nigeria	Manufacturing, crude petroleum, and natural gas had a positive and significant impact on economic growth in Nigeria.	ECM and ARDL model	The study did not consider the labour and power sectors as drivers of industrialization.
Ajmair (2024)	Impact of industrialization on Pakistan's GDP	All components of the industrial sector positively affected GDP.	ARDL model	The study was not carried out in Nigeria.

It is evident from the above empirical literature review that there are disparities in the results of different investigations linking industrialization to economic growth and development. For example, Ibeaja and Amadi (2024); Oyeku (2024) and Isiksal and Odoh (2023) found industrialization and its associated variables to have a positive and significant effect on the economic development of Nigeria. On the contrary, there is a non-significant effect of industrialization on the economy of Nigeria (Ekpo, 2014; Okorontah & Uruakpa, 2023). Attiah (2019) also found divergence in the study of the impact of the manufacturing sector and economic growth among developing and advanced countries, as the author finds a more pronounced significance among developing countries; as against the result of a pronounced significant effect of the industrial sector on economic growth for poorer nations. While these studies appear comprehensive, they are non-exhaustive. Thus, conducting a contemporary study will fill perceived gaps in the literature in terms of the period of data coverage, as this present research intends to extend the data up to 2023. In addition, while previous studies have linked industrialization to economic development and growth, none of the works used a combination of the following variables: manufacturing sector output, energy supply, agricultural output, exchange rate, and labour force participation. Analyzing the nexus between industrialization and economic growth from the perspective of these variables is an effort to narrow the variable gap and produce new findings.

3. Research Methodology

The research design employed in this study is the *ex-post facto* research design. The adoption of the *ex-post facto*

design is because it is most suitable for secondary data analysis, as it involves a study that analyzes already existing data to determine their specific effect on one or a set of other data. Annual time series data sourced from the Central Bank of Nigeria (CBN) statistical bulletin (various years) were used for the analyses. The study covered the period 1990–2024. Other sources of data include the World Development Indicators and World Energy Statistics from the International Energy Agency. The data were analyzed using the Error Correction Model. This is justified since the data are time series and have been found to be integrated at first difference, i.e., the data are stationary at first difference (Egbulonu et al., 2018).

3.1. Model Specification

The model for this research is adopted from the Solow growth theory with the infusion of the unbalanced theory. However, the contemporary model of Okorontah and Uruakpa (2023) was examined and modified to suit our purpose. The model of Okorontah and Uruakpa (2023) established a functional relationship between the Gross Domestic Product (dependent variable), manufacturing sector output, oil export, and non-oil export (independent variables). However, by modifying their model, this study adopts the real gross domestic product growth rate instead of GDP; in addition, it considers outputs from key sub-sectors that comprise the industrial sector while also introducing the labour force participation rate as an intervening variable. The model is specified as follows:

$$RGDPGR = f(Industrialization) \quad [3]$$

By expanding the right-hand side, we obtain:

$$RGDPGR = f(MAN, MIN, ESS, CON, WSW, LAB) \quad [4]$$

Where:

RGDPGR = Real Gross Domestic Product growth rate (Year %).
MAN = Manufacturing sector output proxied by manufacturing value added (% of GDP).
MIN = Output of the mining and quarrying sub-sector (% of GDP).
ESS = Energy supply proxied by electricity supply (KWh/capita).
CON= Output of the construction sub-sector (% of GDP).
WSW = Output of water supply, sewage and waste mgt. sub-sector (% of GDP).
LAB = Labour force participation rate.

The mathematical form of the model includes the time variant, as well as the coefficients and error terms, as follows.

$$RGDPGR_t = \beta_0 + \beta_1 MAN_t + \beta_2 MIN_t + \beta_3 ESS_t + \beta_4 CON_t + \beta_5 WSW_t + \beta_6 LAB_t + \varepsilon_t \quad [5]$$

Where:

β_0 =Intercept of the model.
β_1 –β_6 =Unknown coefficients of the model to be estimated.
ε_t =Stochastic error term.
t =Period of study i.e. 1990 – 2023.

By standardizing the data, we assume a log-linear function and take the natural logarithm of both sides of the linear model as follows.

$$lnRGDPGR_t = \beta_0 + \beta_1 lnMAN_t + \beta_2 lnMIN_t + \beta_3 lnESS_t + \beta_4 lnCON_t + \beta_5 lnWSW_t + \beta_6 lnLAB + \varepsilon_t \quad [6]$$

Where 'ln' represents the natural logarithm of the associated variables.

Based on the above model, this study expects the following findings.

a. Manufacturing sub-sector output should have a positive relationship with RGDP growth rate, i.e., $\beta_1 > 0$.
b. Mining sub-sector output should have a positive relationship with RGDP growth rate, i.e., $\beta_2 > 0$.
c. Energy supply should have a positive relationship with RGDP growth rate, i.e., $\beta_3 > 0$.
d. Construction sub-sector should have a positive relationship with RGDP growth rate, i.e., $\beta_4 > 0$.
e. Water supply, sewage, and waste management sub-sector should have a positive relationship with RGDP growth rate, i.e., $\beta_5 > 0$.
f. Labour force participation rate should have a positive relationship with RGDP growth rate, i.e., $\beta_6 > 0$.

Table 2 presents the Descriptive statistics of the data used in the analysis.

Table 2. Descriptive statistics.

	RGDP	MAN	MIN	ESS	CON01	WSW	LAB
Mean	45184.33	4430.21	13097.35	118.80	1413.50	55.081	32.008
Median	42044.78	3708.51	13246.85	125.44	1045.38	30.215	31.575
Maximum	75142.39	6684.22	16742.15	156.80	2680.22	184.400	46.300
Minimum	21462.73	2898.47	9845.97	74.49	442.274	13.002	18.91
Std. dev.	20421.43	1477.83	2075.78	28.37	879.291	50.751	6.707
Skewness	0.155139	0.538	0.004	-0.2616	0.359	1.148	0.051
Kurtosis	1.378	1.542	1.610	1.462	1.398	3.055	2.643
Jarque-Bera	3.864	4.651	2.396	3.738	4.369	7.475	0.200
Probability	0.145	0.098	0.302	0.154	0.113	0.224	0.905

4. Data Analysis and Discussion

The average value for real gross domestic product for the period was ₦45.184 trillion, and this covered the period 1990 through 2024. For other indicators of industrialization, manufacturing and mining have average figures of ₦4,430.2 and ₦13,097 trillion, respectively. The average electricity supply per capita was 118.8 kWh, while the maximum for the period was 156.8 kWh. The maximum percentage of labour force utilization by the industrial sector was 46.3%, while the maximum manufacturing, mining, and construction outputs were ₦6,684.2 trillion, ₦16,742 trillion, ₦2,680 trillion, and ₦184 million, respectively.

An examination of the skewness shows that all the data are right-tailed, i.e., they are positively skewed, except for electricity supply, which shows a negative slope. However, the negative skewness of electricity supply did not affect the other variables since they have standard deviations that are not very far from the mean. Thus, the positive elasticity of the data is confirmed by the skewness of the distribution, which suggests lengthy right tails.

The Jarque-Bera statistic shows that the data are normally distributed, since their *p-values* are greater than the 0.05 critical value. The null hypothesis of the Jarque-Bera test assumes that the data are not normally distributed. This implies that the data have a very lengthy right tail with high skewness to the right. This necessitates the logging of the data in order to normalize the distribution to be a normal distribution.

Table 3 shows the summary of the unit root test which ascertains the stationarity of the time series data.

Table 3. Summary of unit root test.

Variables	ADF test statistics		Decision rule	Order of integration
	@Level	@1st difference		
RGDP	-2.8032 0.2062) *	-8.2102 (0.0000) *	Stationary at 1st difference	I(1)
MAN	-1.0811 (0.9172)	-4.8814 (0.0022) *	Stationary at 1st difference	I(1)
MIN	-1.2669 0.8787) *	-5.9728 (0.0001) *	Stationary at 1st difference	I(1)
ESS	-1.6698 0.7420) *	-6.6344 (0.0000) *	Stationary at 1st difference	I(1)
CONS	-2.2805 (0.4315)	-4.4697 (0.0062) *	Stationary at 1st difference	I(1)
WSW	1.0965 (0.9999)	-3.8598 (0.0260)	Stationary at 1st difference	I(1)
LAB	-2.6956 (0.2447)	-4.4649 (0.0086)	Stationary at 1st difference	I(1)
Critical value at 5% level = -2.9484 Critical value at 5% 1st difference = -2.9511				

The unit root test above shows that real GDP (RGDP), manufacturing output (MAN), mining output (MIN), electricity supply (ESS), construction (CONS), water supply and waste management (WSW), and labour force participation rate (LAB) were stationary at first difference, i.e., their statistical properties after first differencing were found to be constant over the time period studied. In other words, the variables are said to be integrated of order one I(1).

The end point of the stationarity test carried out above is that we have an I(1) order of integration throughout, and as such, we adopt the Johansen cointegration test to ascertain the existence of a long-run relationship among the variables. This was affirmed in the works of Egbulonu (2019) and Pesaran, Shin, and Smith (2001).

The long-run property of the data is ascertained using the Johansen cointegration test. The hypothesis of the Johansen test states that

H_0: There is no long run relationship existing amongst the variables.

H_1: There is long run relationship amongst the variables.

The test is summarized below.

Table 4. Summary of the Johansen cointegration test.

Hypothesized No. of CE Eqns.	Trace statistic	0.05 critical value	Max-eigen statistic	0.05 critical value
None *	189.9241	0.0000	63.57628	0.0003
At most 1 *	126.3478	0.0001	41.75573	0.0321
At most 2 *	84.59211	0.0021	31.79669	0.0868
At most 3 *	52.79542	0.0160	24.03945	0.1333
At most 4	28.75597	0.0656	15.24123	0.2723
At most 5	13.51473	0.0972	12.02750	0.1096
At most 6	1.487235	0.2226	1.487235	0.2226

The Trace statistic in Table 4 above has four (4) cointegrating equations at 5% level of significance. This is evidenced in the critical values which are less than 0.05 at None, at most 1, at most 2, at most 3, and at most 4. Therefore, we reject the null hypothesis of no long-run relationship since there is at least one significant probability value and conclude that there is a long-run relationship between industrialization variables and the economic growth rate in Nigeria. Since we have confirmed the existence of a long-run relationship among the variables, we estimate the short-run parameters of the model using the error correction model (Egbulonu, 2019; Pesaran et al., 2001).

Table 5 presents the short run coefficients of the model also called the error correction model (ECM).

Table 5. Short-run error correction model.

Variable	Coefficient	Std. error	t-statistic	Prob.
C	80.574	44.491	1.811	0.090
MAN	-1.810	0.369	-4.907	0.006
MIN	-0.086	0.047	-1.839	0.086
ESS	-0.030	0.013	-2.310	0.039
CON01	-8.678	3.463	-2.506	0.024
WSW	-6.495	2.061	-3.152	0.035
LAB	0.254	0.185	1.369	0.191
ECM(-1)	-0.148	0.038	-3.869	0.016
R-squared	0.730	Durbin-Watson stat		1.909
Adjusted R-squared	0.605	F-stat.		5.807

The short-run estimates above have a speed of adjustment of 14.81 percent annually. This means that the model corrects its previous period's disequilibrium at an estimated speed of 14.81 percent every year. Furthermore, the coefficients of manufacturing sub-sector output and mining sub-sector output are negative in the short-run

period. This means that manufacturing sub-sector output and mining sub-sector decrease the economic growth rate by 1.0, 0.810, and 0.086 units in the short period, respectively.

Manufacturing sector output has a negative impact on economic growth by -1.810 units, which implies that the negative short-run effect of manufacturing sector output on the economic growth rate in Nigeria was significant.

The short-run effect of the mining sub-sector on the Nigerian economy is negative, decreasing it by -0.086 units. This implies that the mining sub-sector in Nigeria contributes negatively to the economy, but the negative contribution has not been found to be significant.

There is a significant negative effect of electricity supply on economic growth in Nigeria. By implication, the short-term effect of electricity supply on the Nigerian economy is negative, decreasing it by -0.0302 units. The negative effect of electricity supply on the economy was very significant.

The construction sub-sector decreases Nigeria's economic growth rate significantly by -8.678 units.

The effect of water, sewage, and waste management on the economy was negative and significant, which implied that there was a decreasing effect of water supply, sewage, and waste management on the economic growth rate in Nigeria, and the decreasing effect was significant.

Labour force participation rate increased the economic growth rate in Nigeria by 0.254 units, but the positive effect it exerts on the economy was not significant.

The intercept of the short-run model is positively estimated at 80.574, which indicates that, holding the industrialization variables constant, there will be a positive movement in the real GDP growth rate in the short run period. This underscores the driving force of the stochastic variables that affect economic growth positively but are not captured in the model. These stochastic variables are accounted for by the error term.

4.1. Diagnostic Tests

The diagnostic tests are additional tests that confirm the robustness of the model. These tests, along with their test statistics, are summarized as follows:

1. The adjusted R-squared: The model has an adjusted R value of 0.605. This indicates that industrialization and its associated variables explain up to 60.5 percent of the changes in Nigeria's economic growth rate. By implication, manufacturing output, mining output, electricity supply, construction output, water supply and sewage/waste management, and labor force participation rate account for 60.5 percent of the changes in Nigeria's economic development. This is a high explanatory coefficient.
2. 1. Test for Autocorrelation: The Durbin-Watson statistic is estimated at 1.909. Going by the rule of thumb, there is no autocorrelation in the model since the Durbin-Watson statistic tends toward two. Hence, the data used in formulating the model is free from the problem of autocorrelation. In other words, the error terms observed in one year did not affect subsequent years.

4.2. Test of Hypotheses

The hypotheses formulated earlier in this research are tested under this sub-section. The hypotheses are stated in their null forms (H_0). The decision rule is to reject the null hypothesis if the p-value of the t-statistic is less than the 0.05 significance level; otherwise, we accept the null hypothesis.

Table 6 presents a summary of the hypotheses test at 5% level of significance.

Table 6. Summary of the hypotheses test.

Null hypotheses	t-stat. (*p-value*)	Decision
H_{01}: There is no significant relationship between manufacturing sector output and economic growth in Nigeria.	t-statistic = -4.906 (*p-value*) = 0.0059	*p-value* < 0.05; null hypothesis is rejected.
H_{02}: There is no significant relationship between the mining sub-sector and economic growth in Nigeria.	t-statistic = -1.839 (*p-value*) = 0.0858	*p-value* > 0.05; null hypothesis is accepted.
H_{03}: There is no significant effect of electricity supply on economic growth in Nigeria.	t-statistic = -2.310 (*p-value*) = 0.0394	*p-value* < 0.05; null hypothesis is rejected.
H_{04}: Construction sub-sector output has no significant effect on Nigeria's economic growth.	t-statistic = -2.506 (*p-value*) = 0.0242	*p-value* < 0.05; null hypothesis is rejected.
H_{05}: Water supply, sewage, and waste management do not significantly affect Nigeria's economic growth.	t-statistic = -3.152 (*p-value*) = 0.0349	*p-value* < 0.05; null hypothesis is rejected.
H_{06}: There is no significant effect of labour force participation on Nigeria's economic growth.	t-statistic = 1.368 (*p-value*) = 0.1913	*p-value* > 0.05; null hypothesis is accepted.

Source: Researcher's computation from Eviews 9 software.

4.3. Discussion of Findings

The findings made in this research are in line with the research objectives. The specific objectives aimed to determine the effect of industrialization and its associated variables on the growth of the Nigerian economy. The model established a functional relationship between manufacturing, mining, construction, electricity supply, water/waste/sewage management, labour force participation, and economic growth in Nigeria. It is expected that the values of industrialization variables, with increased labour addition, should contribute to Nigeria's economic development. Having analyzed the data, the findings are discussed extensively below.

The long-run test confirmed the existence of a long-run relationship between industrialization and economic growth in Nigeria. The long run effect was also confirmed in the works of Okezie et al. (2017); Kida and Angahar (2020) and Isiksal and Odoh (2023). The implication is that industrialization exerts a long-term effect on the growth rate of Nigeria's real gross domestic product, and as such, Nigeria should pursue long-term targets with respect to growing the country's industrial sector.

In line with the established goals of the study, the outcome of the estimations suggested that the manufacturing sub-sector's production lowered the economic growth rate in the short term. Nonetheless, given its high likelihood value, the manufacturing sub-sector's production had a substantial detrimental impact on the economy. This suggests that the production of Nigeria's manufacturing sub-sector has not contributed to the necessary economic growth, which has considerably slowed down overall economic development. Okorontah and Uruakpa (2023) identified the poor operating environment of the manufacturing sub-sector as one of the factors that can slow down overall economic development. Furthermore, according to Banjoko, Iwuji, and Bagshaw (2012) the Nigerian manufacturing sector has significantly underperformed in comparison to its potential despite numerous policies and developmental initiatives implemented by successive civilian and military administrations since independence.

Further analysis revealed that the mining sub-sector output decreased Nigeria's economic growth rate in the short term, but the decrease was not significant. This implies that as the mining sub-sector output changes, Nigeria's economic growth tends to fall into negative territory, although the negative effect was not statistically significant owing to what Ekpo (2014) referred to as the miniature quantum of mining reserves in Nigeria. Ibeaja and Amadi (2024) found an insignificant effect of mining on the Nigerian economy. The mining sub-sector is not as large as the oil and gas sector, and this makes the effect of mining on the economy not significant. However, the negative effect portends great worry to the economy, as the mining sub-sector forms a substantial variable that drives the industrialization of any economy. From other economies, Ajmair (2014) found positive effects of mining and quarrying on the GDP of Pakistan. This is an indication that the Nigerian mining sub-sector has not shown the potential to drive the industrialization of the economy.

Again, electricity supply showed a negative effect on economic growth. This implies that the expectation was not met for electricity supply, as the industrial sector still grapples with the problem of erratic electricity, which has affected its impact on the economy. World Bank (2013) noted that electricity is unreliable from the public power supplier in Nigeria, and the reliability is known to be less than 50% nationwide. Iwayemi (2019) and Odell (2019) found that strong demand and increased supply of electricity would stimulate increased income and higher living standards in Nigeria, but the reverse is the case. Ekpo (2014) submitted that electricity supply in Nigeria has not helped Nigeria to attain the required level of industrialization that can produce dynamic change in the economic structure of the country. The findings made in this research corroborate the majority of previous research, and this points to the fact that the electricity supply situation to the industrial sector in Nigeria has remained low over the years.

The construction sub-sector showed a significantly negative effect on Nigeria's economic growth in the short run, but the interesting fact is the significant negative effect of the construction sub-sector on the economy. This study does not agree with the findings of Attiah (2019) and Ajmair (2014) because their research was not carried out on the Nigerian economy. The Nigerian construction sub-sector as pointed out by Afolabi and Laseinde (2019) has been largely undermined by foreign multinationals, which add little or nothing to the government's industrialization drive. Efforts to localize the industry through local content enactments have so far not yielded the desired results, as the construction sub-sector still persists in its inverse relationship with the economic growth rate.

While it is noteworthy and expected that water/sewage and waste management will affect the economy negatively, the significant effect this variable exerts on the economy was not expected. In contrast with the finding of Ajmair (2014) who posited that water supply distribution has a positive relationship with GDP of Pakistan, the Nigerian industrial sector has witnessed negative sewage conversion, thus leading to increased negative effects of waste on the economy. Isiksal and Odoh (2023) rightly pointed out that a mark of an industrialized economy is increased sewage and waste, but the expectation is that this will add value to the economy through conversion techniques. Thus, the negative effect shows that Nigeria is still far from being industrialized, as the economic growth rate drops with changes in water/sewage and waste management.

The intervening effect of the labour force participation rate was the last objective of the study, and the results revealed that labour force participation in Nigeria adds value to the economy but not significantly. This implies that labour utilization by the industrial sector is not sufficient to drive the needed growth in the economy. This corroborates the findings of Usman and Lazarus (2021). Who asserted that the human capital and income levels have not reached the threshold to make industries contribute reasonably to economic growth in Nigeria. Also, Okezie et al. (2017) and Abomaye-Nimenibo (2021) both the found labour force has a negative impact on the real GDP in Nigeria in the short run.

On the whole, the industrialization variables were found to have a jointly significant effect on the growth rate of the Nigerian economy, accounting for up to 60.5 percent of the changes in Nigeria's economic growth efforts. There was no serial correlation of the error term in the model, thus confirming the suitability of the variables used. Additionally, the speed of adjustment of the model to the long-run equilibrium was estimated at 14.8 percent. The implication is that, given a steady increase of 14.8 percent in industrialization indices in Nigeria, the economy will experience an equilibrium long-run growth.

5. Conclusion and Recommendations

Based on the above revelation in this study, the study concludes that industrialization has a negative effect on the development of the Nigerian economy. This conclusion stems from the fact that the various indices of industrialization which were examined (manufacturing, mining, electricity supply, construction, and water/sewage/waste management) have negative effects on the economic growth rate of Nigeria. However, labor force participation exerted a positive effect on the growth rate of the economy, but this was not significant, which gives the impression of an insufficient utilization of available labor by the industrial sector. To achieve the level of economic development that is desired in Nigeria, the government needs to strive to consider one or a combination of the recommendations made below.

5.1. Policy Implications and Recommendations

1. Given that the manufacturing sub-sector exerted a negative effect on the Nigerian economy, it implies that the Nigerian manufacturing sub-sector has deteriorated over the years, which culminated in the exit of major players in the industry. By implication, the Nigerian government will need to reform its industrial policies to promote manufacturing growth, such as providing incentives for investments, technology adoption, and innovations.

2. In a similar manner, the mining/quarrying sub-sector negatively affected economic growth. The implication is that the government may need to strengthen environmental and social regulations in the mining sector to mitigate the negative externalities, such as environmental degradation, health impacts, and community displacement.

3. Also, since electricity supply negatively affects economic growth, the government may need to reform the electricity sector to promote competition, efficiency, and investment in new generating capacity, transmission, and distribution infrastructure.

4. Despite the fact that the relationship between the construction subsector and economic growth is not statistically significant, the negative relationship still has implications. In this case, the government may need to strengthen the monitoring and evaluation framework to track the performance of construction projects, identify areas of improvement, and ensure that projects are delivering the expected economic benefits.

5. The government may need to invest in water supply infrastructure, upgrade the sewage system to reduce the risk of water pollution, and implement waste management reforms, including recycling programmes, waste-to-energy initiatives, and proper disposal of hazardous waste.

These key industrialization variables, when properly harnessed, can propel the needed growth in the economy. Since they exert a negative effect on the economy, there is bound to be retarded slowdown in the economy, which will extend to other sub-sectors. Achieving a highly industrialized economy is one where electricity supply is taken with utmost priority, the mining and quarrying sub-sector is made accountable for every output, and the construction sub-sector is largely localized. With increased industrialization comes increased waste and sewage generation. Thus, proper management of sewage and waste is paramount for electricity generation and increased access to factors that drive industrialization. Therefore, with the right policies and actions, Nigeria can achieve the desired level of industrialization.

Government policies are shaped by research on specific aspects of the economy. This study has shown the effects of industrialization on the Nigerian economy within the period under review. The combination of industrialization variables has revealed that the industrial sector has not had the desired effect on the economy, and this knowledge is very necessary to drive policies that will reverse this trend. Thus, this study has contributed to the updated knowledge of policymakers on the industrial sector–economic growth nexus in Nigeria for an extended period from 1990 to 2024.

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