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Original Research Article

Time-Series Analysis of Industrial Sector Performance and Economic Growth in Nigeria: A Disaggregated Approach

Dr. Clement Korgbeelo[1*], Dr. Leelee N. Deekor[1]
[1]Department of Economics, Ignatius Ajuru University of Education Rumuolumeni, Port Harcourt
***Corresponding author:** Dr. Clement Korgbeelo
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Abstract: This study investigated the impact of industrial section performance on economic growth in Nigeria. Specifically, the study examined the impact of manufacturing sector output, mining and quarrying sector output, utility sector output and construction sector output on economic growth proxied by per capital real gross domestic product in Nigeria. Phillips-Perron unit root test, Johansen cointegration test and error correction mechanism (ECM) were applied on annual time-series data for the period 1981 to 2019. The findings indicated a long-run relationship between industrial sector performance and economic growth. The estimated long-run regression result showed that manufacturing, and mining and quarrying subsectors make significant contribution to economic growth while utility and construction subsectors have insignificant positive impact on economic growth in Nigeria. The short-run (ECM) regression result showed that the outputs of the manufacturing, mining and quarrying, construction and utility sectors all have insignificant positive impact on economic growth. Among other things, it is recommended that there should be a general improvement in the productive capacity of the industrial sector to enhance its contribution to economic growth.
Keywords: Industrial output, economic growth, error correction mechanism (ECM).

1. INTRODUCTION

Industrialization basically involves the process of developing the capacity of a nation to convert raw materials and other factor inputs to finished goods and to manufacture goods for other production or for final consumption (Todaro, 1992; Anyanwu, Oyefusi, Oaikhenan, and Dimowo, 1997). Industrialization dates back to the industrial revolution in Europe during the 18th and 19th centuries (Wilson, 2002). Today, the world is polarized into two major groups – the developed and the less developed world. The developed world is industrialized while the less developed world is not yet industrialized but wishes to be industrialized like their developed counterpart. Industrialization, according to Todaro and Smith (2011), is associated with high productivity and income, and has being a symbol of modernization and national economic power. This explains why most developing countries make industrialization a desirable goal to be pursued. This is because it is often seen as a sine-qua-non for attaining the development status of the developed world. It is generally asserted that the benefits of industrialization will trickle down to other parameters of development, and thus, lead to the rise in employment, output and income (Wilson, 2002).

Over the years, the performance of the Nigerian industrial sector has not been satisfactory. The sector has been characterized by high import content of industrial inputs, poor capacity utilization, inadequate linkages with other sectors of the economy, etc (Obioma and Ozugahalu, 2005). Hence, the contribution of the sector to the development of the economy (especially, in terms of contribution to economic growth and job creation) has not been quite encouraging. Wilson (2002) identified several problems militating against the development of the Nigerian industrial sector. These problems, among other things, include low capital base, smallness of the market, inadequate infrastructural facilities, insufficient managerial and entrepreneurial capabilities and political instability. To overcome these problems, successive governments have put in place several programmes, policies and packages of incentives with the aim of improving the performance of the sector. However, as a result of certain impediments, the various measures put in place by the various governments failed to achieve their objectives (Wilson, 2002). Consequently, the fortunes of the sector keep deteriorating.

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This study, therefore, examines the relationship between industrial sector performance and economic growth in Nigeria. In specific terms, the study investigates the impact of the output of the various sub-sectors or components of the industrial sector on economic growth measured in terms of per capita real gross domestic product. The rest of the paper is organized as follows: section two deals with conceptual clarifications and review of relevant literature; section three focuses on methodology; section four is concerned with data analysis, presentation of results and discussion of findings while in section five, we conclude the study and make recommendations.

2. LITERATURE REVIEW AND CONCEPTUAL CLARIFICATIONS

2.1 Conceptual Clarifications

2.1.1 The Concept of Industrialization

The term "industrialization" has been defined by different authors. For instance, according to Todaro (1992), "industrialization is the process of building up a country's capacity to process raw materials and to manufacture goods for consumption or further production". Similarly, Jhingan (2016) defines industrialization as "… the process of manufacturing consumer goods and capital goods and creating social overhead capital in order to provide goods and services to both individuals and businesses".

2.1.2 The Concept of Economic Growth

Economic growth has been conceptualized in two different ways. First, it is defined as sustained annual increases in a country's real national income or output, i.e, increase in the gross domestic product (GDP) or real gross domestic product (Real GDP). Defined in this way, economic growth is conceived as sustained increase in total output of goods and services over time (Nwaimo, 2009).

A second, and indeed, a better way to define economic growth is to do so in terms of income per capita. In this sense, economic growth is defined as the annual increases in per capita real income or per capita real GDP of a country over a period of time. (Ahuja, 2013). It is in this second sense that economic growth is used in this study.

2.1.3 Overview of Nigeria's Industrial Sector Performance

During the early 1960s up to the mid-1970s, the Nigerian government undertook certain policy actions to boost industrial production in the country. Consequently, there was a rapid growth of industrial capacity and output. There was also an increase in the relative importance of the manufacturing sub-sector in the economy. Consequently, for the period 1960-1975, the share of the industrial sector in total GDP averaged 22.3 per cent. The manufacturing sub-sector contributed an average of 30.4 per cent of the total industrial output, and 6.8 percent of the total GDP during the same period. (Dagogo, 2014; CBN, 2019).

For the period 1976-1985, the industrial sectors average share of total GDP was 30.6 percent. This was an improvement over the 1960-1975 periods. Similarly, the manufacturing sub-sector contributed 9 per cent of the total GDP. This was an increase over the 6.8 percent recorded for the period 1960-1975. However, there was a slight decline in the share of manufacturing in the total industrial output as the manufacturing sub-sector recorded an average of 29.5 per cent of the total industrial output for the period. (CBN, 2010; CBN, 2019).

The industrial sector witnessed a significant improvement in its contribution to the country's GDP for the period 1986-1999, as the share of the industrial sector stood at an average of 40.6 per cent. This may be attributed to the positive response of the sector to the policies implemented during the structural adjustment progamme (SAP) era. The performance of the manufacturing sub-sector however, declined as its contribution to the total industrial output and total GDP averaged 13.0 per cent and 5.3 percent respectively (Ajayi, 2007; Ekpo, 2014).

During the period 2000-2009, the industrial sector's share of total GDP averaged 38.4 per cent. This was a slight decrease over the 1986-1999 value. In the same manner, the contribution of the manufacturing sub-sector to the total industrial output declined to 7.2 per cent while the contribution of the manufacturing sub-sector to the total GDP declined to 2.8 percent. For the period 2010 to 2019, the share of the industrial sector to total GDP averaged 23.67 percent while the shares of the manufacturing sub-sector in the total industrial output and total GDP averaged 33.77 percent and 8.00 percent respectively (CBN, 2019).

2.1.5 Trends in Nigeria's Economic Growth: An Overview

Nigeria has had a fluctuating economic growth experience. For the period 1960 to 1965, the gross domestic product (GDP) growth rate averaged 4.9 percent. During the oil boom era, roughly from 1970 to 1978, the country had a positive GDP growth rate of 6.2 per cent. However, as a result of the oil glut of the 1980s, the country had negative growth rates. In the period 1988 to 1997 which was the period of the structural adjustment programme (SAP) and economic liberalization, to economy responded to the pro-liberal policies of SAP and as a result, a positive growth rate of 4.00 per cent was recorded (Anyanwu, Oyefusi Oaikhenan and Dimowo, 1997).

For the period 1997 to 1999, the annual GDP grew at an average of 2.3 per cent. The period 2000 to 2003 witnessed an increase of the average annual GDP growth rate which stood at 6.0 percent in 2004 and increased slightly to 6.6 percent in 2019 and 7.9 percent in 2010 (Ajayi, 1999; CBN, 2010; Ekpo and Umoh, 2013).

Following the rebasing of the GDP in 2014 which was put at 2010 constant basic prices, the growth rate of the GDP was 7.9 percent, 5.3 percent, 4.2 percent,5.5 percent, and 6.2 percent for the 2010, 2011, 2012, 2013, and 2014 respectively. These high growth rates were achieved because of the rebasing of the GDP and the addition of new sectors do the country's GDP. The new sectors were e- commerce, telecommunications, music and nollywood. However, data from the Central Bank of Nigeria indicated that the country's growth rate dropped to 2.8 percent in 2015. It is also reported that during the economic recession in 2016, the GDP contracted by 0.36 percent, 2.1 percent and 2.2 percent in the first, second and third quarters of 2016 respectively (Ministry of Budget and National Planning, 2017).

After five consecutive quarters of negative growth rates which started in the first quarter of 2016, the economy recovered from recession in the second quarter of 2017. The recovery has been sustained till date. The GDP grew by 0.8 percent, 1.9 percent and 2.27 percent for the years 2017, 2018 and 2019 respectively (Emefiele, 2019; CBN, 2019).

Table-2.1: Average Output of the Various Sub-sectors of the Nigerian Industrial Sector (1981-2019)

Years	Manufacturing Sub-sector (₦Billions)	Mining & Quarrying Sub-sector (₦Billions)	Utility Sub-sector (₦Billions)	Construction Sub-sector (₦Billions)
1981-1990	1465.30	4992.98	17.31	492.46
1991-2000	1614.48	6651.39	23.28	548.48
2001-2010	2527.17	8439.79	156.64	959.50
2011-2019	5284.70	6907.87	365.32	2405.89

Source: Author's Computation from CBN 2019 Annual Statistical Bullentin

From table 2.1, the manufacturing sub-sector output increased from an average value of ₦1465.30 billion for the period 1981-1990 to an average value of ₦5284.70 billion for the 2011-2019. The output of the mining and quarrying sub-sector increased from an average value of ₦4992.98 billion for the period 1981-1990 to ₦8439.79 billion in 2001-2010 and then decreased to ₦6907.87 billion for the period 2011-2019. For the utility sub-sector, the output averaged ₦17.31 billion for the period 1981-1990 and rose to ₦365.32 billion in the 2011-2019. Similarly, the construction sub-sector increased from an average value of ₦492.46 billion in 1981-1990 to an average value of ₦2405.89 billion in 2011-2019.

Table-2.2: Average Contributions of the Sub-sectors of the Nigerian Industrial Sector to Average Total Industrial Sector Output (1981-2019).

Years	Manufacturing Sub-sector (%)	Mining & Quarrying Sub-sector (%)	Utility Sub-sector (%)	Construction Sub-sector (%)
1981-1990	16.58	71.62	0.25	7.06
1991-2000	18.27	75.26	0.26	6.12
2001-2010	20.77	69.35	1.29	7.72
2011-2019	33.77	44.18	2.34	15.39

Source: Author's Computation from CBN 2019 Annual Statistical Bulletin

Table 2.2 shows that the manufacturing sub-sector contributed an average of 16.58 percent to average total industrial output for the period 1981-1990. The manufacturing sub-sector increased from its value in 1981-1990 to an average value of 33.77 percent for the period 2011-2019. The contribution of the mining and quarrying sub-sector increased from an average value of 71.62 percent in 1981-1990 to 75.26 percent in the period 1991- 2000 and later dropped to 44.18 percent for the period 2011-2019. The utility sub-sector contribution averaged 0.25 percent for 1981-1990 and increased to 2.34 percent in the period 2011-2019. For the construction sub-sector, its average contribution to total industrial output decreased from 7.06 percent in 1981-1990 to 6.12 percent in 1991-2000 and thereafter increased to 15.39 percent in 2011-2019.

Table-2.3: Average Contributions of the Sub-sectors of the Industrial Sector to Total Real GDP in Nigeria (1981-2019).

Years	Manufacturing Sub-sector (%)	Mining & Quarrying Sub-sector (%)	Utility Sub-sector (%)	Construction Sub-sector (%)
1981-1990	9.38	31.98	0.11	3.15
1991-2000	7.68	31.60	0.11	2.61
2001-2010	6.45	21.54	0.40	2.45
2011-2019	8.00	10.45	0.55	3.64

Source: Author's Computation from CBN 2019 Annual Statistical Bulletin

From table 2.3, the manufacturing sub-sector decreased from an average of 9.38 percent in 1981-1990 periods to 6.45 percent for the 2001-2010 and later increased to 8.00 percent during the period 2011-2019.

The mining and quarrying sub-sector contributed an average of 31.98 per cent in 1981-1990. It decreased to 10.45 per cent in 2011-2019. The contribution of utility sub-sector to total real GDP averaged 0.11 percent for the periods 1981-1990 and 1991-2000. It thereafter increased to 0.55 percent in 2011-2019. The construction's sub-sector contribution averaged 3.15 percent in 1981-1990. It decreased to 2.45 per cent in 2001-2010, but later rose to 3.64 percent in 2011-2019. The analysis from table 2.3 shows that the mining and quarrying sub-sector made the highest contribution to real GDP followed by the manufacturing sub-sector and then the construction subsector. The utility sub-sector made the least contribution to real GDP during the period under investigation.

Table-2.4: Average total industrial output, Real GDP and per capital real GDP in Nigeria (1981-2019)

Years	Average Total Industrial Output (₦-Billion)	Average Total Industrial Output as % of total Real GDP (₦-Billion)	Average Total Real GDP (₦-Billion)	Average Per capita Real GDP (₦-Billion)
1981-1990	6971.65	44.65	15614.29	172.1
1991-2000	8837.64	41.98	21051.71	179.1
2001-2010	12169.18	31.06	39182.89	279.7
2011-2019	15632.28	23.67	66049.59	368.44

Source: Author's Computation from CBN 2019 Annual Statistical Bulletin

From table 2.4, the average total industrial output increased from ₦6971.65 billion during 1981-1990 to ₦15632.28 billion in the period 2011-2019. In contrast, the average total contribution of the industrial sector to real GDP declined from 44.65 per cent in 1981-1990 to 23.67 per cent in 2011-2019. The per cent real GDP averaged ₦172.1billion in 1981-1990 and increased to ₦368.44 billion in 2011-2019.

2.2 Theoretical Framework

Several theoretical propositions have been developed to explain the process of economic growth in developing countries. However, for the purpose of this study, a variant of the structural change theories is considered. The structural change theories emphasize the process through which less developed countries transform their domestic economic structure from heavy dependence on traditional subsistence agranian society to a more modern industrialized economy (Todaro and Smith, 2011). The structural change models are based on the existence of dualism in the less developed countries. Both social and technological dualism assumed that underdevelopment in the less developed countries (LDCs) is caused by the inability of the system to fully utilize its potentials. The system is unable to do so because it is divided, and this division makes the economies unable to produce sufficient surplus for investment and growth. The structural change models therefore offer explanations as to how a dualistic economy can grow (Wilson, 2002).

In this study, we examine the Arthur Lewis' model of the structural change approach referred to as Lewis theory of unlimited supplies of labour. Arthur Lewis in the mid-1950s developed his theory which focused on the structural transformation of a traditional subsistent economy to a more modern industrial economy. In the Lewis (1954) model, the LDC consists of two sectors: a traditional, over populated rural subsistence sector characterized by zero marginal labour productivity (i.e, surplus labour) and a high productivity modern urban industrial sector where reproducible capital is used (Jhingan, 2016).

According to Lewis (1954), the fundamental connection between the two sectors is that, when the modern industrial sector expands, it draws labour from the unlimited supply of labour in the traditional sector. Thus, the main emphasis of the model is on both the process of labour transfer and output growth and employment in the modern industrial sector. Labour transfer and modern-sector employment growth are made possible by output expansion in the modern industrial sector. The rate of expansion is determined by the rate of industrial investment and capital formation in the modern sector which is brought about by the excess of modern-sector profits over wages. The above analysis is based on the assumption that the capitalists reinvest their profits and that there is constant wages in the modern industrial sector (Wilson, 2002; Jhingan, 2016).

The process of modern sector growth and employment expansion is assumed to go on until all surplus labour is absorbed in the modern industrial sector. Thereafter, extra labour can be transferred from the traditional sector only at a higher opportunity cost of lost of food production since, at this point, the marginal product of traditional sector labour is no longer zero. This is known as the "Lewis turning point" (Todaro and Smith, 2011). However, the structural transformation of the economy will have taken place as modern sector wages and employment continue to grow, with economic activity moving from traditional rural agriculture to modern urban industry.

2.3 Empirical Literature Review

Some of the studies conducted on the relationship between industrial sector performance and economic growth are reviewed in this section.

Yao (2016) investigated the impact of the manufacturing sector on economic growth in a sample of 187 middle income countries, and concluded that manufacturing is key to the growth of the middle income countries. Similarly, Keho (2018) used annual data from 1970 to 2014 to study the relationship between manufacturing sector output and economic growth in the ECOWAS member countries. The findings showed that manufacturing output positively influences economic growth in the ECOWAS region.

Ajmair (2014) analyzed the nexus between economic growth and the various components of the industrial sector of Pakistan using annual data from 1950 to 2010. The results showed that manufacturing, construction and utility sectors have strong positive impact on growth while mining and quarrying sector has weak negative impact on growth. Ndiaya and Lv (2018) examined the impact of industrial sector output on economic growth in Senegal for the period 1960 to 2012. The findings showed a significant positive impact of industrial output on economic growth.

Oladinrin, Ogunsemi and Ajie (2012) used annual time-series data for the period 1990 to 2009 to examine the causal nexus between construction sector output and economic growth in Nigeria. The findings showed bidirectional causality between construction sector output and GDP growth in Nigeria. Adofu, Taiga and Tijani (2015) examined the relationship between manufacturing sector output and economic growth in Nigeria for the period 1990 to 2013. The outcome indicated insignificant negative relationship between manufacturing sector output and economic growth. Isiksal and Chimezie (2016) used quarterly data for the period 1997:Q_1 to 2012:Q_4 to study the impact of industrial sector output on economic growth in Nigeria and observed a strong positive impact of industrial sector output on economic growth. Using annual data from 1960 to 2012, David, Noah and Agbalajobi (2016) analyzed the nexus between mining sector output and economic growth in Nigeria. The results showed that crude oil and natural gas has weak negative impact on growth while solid minerals have weak positive effects on growth. Oburata and Ifere (2017) in their study for the period1981 to 2015, found out that manufacturing sector output makes significant positive impact on economic growth. Similarly, Abdu and Anam (2018) used data from 1981 to 2016 to conduct a study on impact of industrial sector output on economic growth in Nigeria and found out that industrial output impacts positively on economic growth. Okeye, Mbakwe and Igbo (2018) using data from 1981 to 2016, observed that construction sector output and oil prices have significant positive impact on economic growth. Okunye (2019) and Ishola and Olusoji (2020) in their separate studies found significant positive relationship between industrial sector output and economic growth. On their part, Ajie, Okoh and Ojiya (2019) found positive impact of solid mineral resources on economic growth in Nigeria. Ududechinyere, Eze and Nweke (2018) found out that the manufacturing sector has significant positive impact on economic growth. Finally, Binta and Bassa (2018) established significant positive impact of industrial sector output on economic growth in Nigeria.

From the empirical literature reviewed, it is observed that most of the previous studies conducted in Nigeria used either a single component or sub-sector of the industrial sector or the aggregate value of the industrial sector output as the explanatory variable. This study disaggregated the total industrial output into the various components or sub-sectors and utilized them as the explanatory variables. Also, previous studies in Nigeria measured economic growth in terms of GDP or real GDP growth. The argument is that this measure of economic growth is misleading since it does not incorporate the influence of rapid population growth which may adversely affect the standard of living of the people. To fill this gap, this study measures economic growth in terms per capita real gross domestic. This is a better measure of economic growth since it considers the influence of population growth in computing economic growth.

3. METHODOLOGY

3.1 Description of the variables of the study

The variables used for this study are explained in this section.

3.1.1 Dependent Variable

The dependent variable used for this study is economic growth measured in terms of the real gross domestic product per capita. The real gross domestic product is the inflation adjusted monetary value of the final output of goods and services produced within the geographical confines of Nigeria.

The real GDP per capita is the ratio of the real GDP to the total population. The real GDP is obtained by dividing the real GDP by the total population. That is,

$$\text{Real GDP Per capita} = \frac{\text{Real GDP}}{\text{Total Population}}$$

In this study, real GDP per capita is measured in billions of naira.

3.1.2 Explanatory Variables

The explanatory variables used for this study are the outputs of the various sub-sectors of the industrial sector. They are briefly explained as follows:

i) Manufacturing Sector Output: This refers to the total money value of the total quantity of goods produced by the manufacturing sub-sector.
ii) Mining and Quarrying Sector Output: This refers to the total money value of crude petroleum natural gas, coal mining, metal ores, and quarrying and other mineral resources.
iii) Utility Sector Output: This is the money value of electricity, gas, steam, air conditioner, and water supply, and sewage and waste management.
iv) Construction Sector Output: This refers to money value of the worth of the construction industry in Nigeria.

All the explanatory variables are measured in billions of naira.

3.2 Model Specification

Our model is specified based on the Lewis (1954) theory of unlimited supply of labour, and the analytical model used by Ajmair (2014) in Pakistan. However, the model was slightly modified to accommodate the variables of this study.

The functional form of our model is specified as:

RGDPPC = f(MSO, MQSO, USO, CSO)--3.1

Where RGDPPC = Real Gross Domestic Product Per Capita
MSO = Manufacturing Sector Output
MQSO = Mining and Quarrying Sector Output
USO = Utility Sector Output
CSO = Construction Sector Output
f = Symbol of Functionality

RGDPPC is the dependent variable while MSO, MQSO, USO and CSO are the explanatory variables.

The ordinary least squares (OLS) multivariate regression equation based on the above functional model is expressed as:

$RGDPPC = \beta_0 + \beta_1 MSO + \beta_2 MQSO + \beta_3 USO + \beta_4 CSO + U$-------------------------------------3.2

Where β_0 is the regression intercept, β_1, β2, β_3 and β_4 are the coefficients of the individual parameter estimates. U is the error term. All other variables are as earlier interpreted.

A logarithmic transformation of equation 3.2 above gives us:

$RGDPPC = \beta_0 + \beta_1 LogMSO + \beta_2 LogMQSO + \beta_3 LogUSO + \beta_4 LogCSO + U$------------------3.3

Where Log = the natural logarithm of the variables. All other variables are as earlier defined. Our model is specified based on the Lewis (1954) theory of unlimited supply of labour, and the analytical model used by Ajmair (2014) in Pakistan. However, the model was slightly modified to accommodate the variables of this study.

The functional form of our model is specified as:

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Where β_0 is the regression intercept, β_1, β2, β_3 and β_4 are the coefficients of the individual parameter estimates. U is the error term. All other variables are as earlier interpreted.

A logarithmic transformation of equation 3.2 above gives us:
$RGDPPC = \beta_0 + \beta_1 LogMSO + \beta_2 LogMQSO + \beta_3 LogUSO + \beta_4 LogCSO + U$---------------3.3

Where Log = the natural logarithm of the variables. All other variables are as earlier defined

Based on economic theory, we expect the following signs of the coefficients of the individual explanatory variables, (i.e, the β's).

$RGDPPC = \beta_0 + \beta_1 LogMSO + \beta_2 LogMQSO + \beta_3 LogUSO + \beta_4 LogCSO + U = (\beta_1>0, \beta_2>0, \beta_3>0, \beta_4>0)$

The positive signs (greater than zero) of the coefficients of the explanatory variables imply that all the explanatory variables have positive relationship with the dependent variable.

3.3 Nature and Sources of Data

Annual time-series data covering the period 1981 to 2019 were used for this study. The data were obtained from secondary sources such as the CBN annual statistical bulletin for 2019, the CBN annual reports and statement of account (various years) and the World Bank Development Indicators (various years).

3.4 Techniques of Data Estimated

Based on certain desirable characteristics that the ordinary least squares (OLS) technique possesses (Koutsoyiannis, 2001), the model was estimated using the OLS regression technique. However, due to the peculiar nature of time-series data, the OLS technique was preceded by stationarity test to check whether the time-series data are stationary or not and to determine their order of integration. To this end, the stationarity test was conducted using the Phillips-Perron (PP) unit root test. The Phillips-Perron unit root test relies on rejecting the null hypothesis (H_0) of presence of unit root (i.e, series is non-stationary) in favour of the alternative hypothesis (H_1) of no unit root (i.e, series is stationary).

The general form of the Phillips-Perron unit root test takes the form of the regression.

$$\Delta y_t = a_0 + a_1 y_{t-1} + \sum_{n=1}^{n} ay_i + \varepsilon_t \qquad \text{---3.4}$$

$$\Delta y_t = a_0 + a_1 y_{t-1} + \sum_{i=1}^{n} a_1 \Delta y_t + \delta_t + \varepsilon_t \qquad \text{---3.5}$$

Where y_t is a time series, t is a linear time trend, Δ is the first difference operator, a_0 is a constant, n = the optimum number of lags in the dependent variable and ε_t is the white noise error term.

Based on the result of the unit root test, the Johansen cointegration was used to test whether there exist long-run (equilibrium) relationship among the variables in the model. Johansen (1988) and Johansen and Juselius (1990) suggested the test which is based on the vector autoregressive (VAR) model. The test starts with p-lag VAR model specified as follows:

$$y_t = \mu + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + \varepsilon_t \qquad \text{---3.6}$$

Where y_t is K-vector of non-stationary variables that are generally integrated of order one [i.e., I(1)]. A_1, A_2 and A_p are matrices of coefficients to be estimated and ε_t is a K-vector of innovations.

Given that most time-series have unit root, the VAR model above can be expressed in its first difference form as follows:

$$\Delta y_t = y_{t-1} + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Upsilon_i \Delta y_{t-1} + \varepsilon_t \text{ ----------3.7}$$

Where $\Pi = \sum_{i=1}^{p} A_{i-1}$ and $\Upsilon_i = -\sum_{j=i+1}^{p} A_j$

To determine the number of cointegrating vectors, two test statistics are used. These are the

Trace test and the Maximum Eigen test. These test statistics are estimated as;

$$\lambda trace(r) = -T \sum_{i=r+1}^{n} In(1-\lambda_i) \text{ -------------------------3.8}$$

$$\lambda max(r + r + 1) = -TIn(1 - \lambda_{r+1}) \text{-------------------3.9}$$

Where T is the sample size and λ_i is the eigen value. The trace statistic tests the null hypothesis that r = 0 against the alternative hypothesis that r>0. The max-eigen statistic test the null hypothesis that there are r cointegrating vectors against the alternative hypothesis of r+1 cointegrating vectors.

Equation 3.3 can be transformed into ECM formulation as shown below:

$$\Delta RGDPPC_t = \beta_0 + \sum_{i=1}^{n-1} \beta_{1t}\, \Delta RGDPPC_{t-1} + \sum_{i=1}^{n} \beta_{2t}\, \Delta InMSO_{t-1} + \sum_{t=1}^{n-1} \beta_{3t}\, \Delta InMQSO_{t-1} + \sum_{i=1}^{n-1} \beta_{4t}\, \Delta InUSO_{t-1} + \sum_{i=1}^{n-1} \beta_{5t}\, \Delta InCSO_{t-1} + \lambda ECM_{t-1} + \varepsilon_t \text{-------3.10}$$

Where Δ is the first difference operator, n is the lag length of the ECM, λ is the ECM coefficient and ε_t is the error term. All other terms are as earlier defined.

4. PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

4.1 Unit Root Test Result

The result of the Phillips-Perron unit root test is presented in table 4.1

Table-4.1: Phillips-Perron (PP) Unit Root Test Result

Variable	Phillips-Perron Test Statistic (At Levels)	Critical Values (1%)	Critical Values (5%)	Phillips-Perron Test Statistic (At 1st Diff.)	Critical Values (1%)	Critical Values (5%)	Order of Integration
RGDPPC	-2.771489	-3.572910	-2.893514	-8.613693*	-3.621023	-2.943427	I(1)
LOG(MSO)	-2.166585	-3.572910	-2.893514	-5.775091*	-3.621023	-2.943427	I(1)
LOG(MQSO)	-2.153079	-3.572910	-2.893514	-5.702730*	-3.621023	-2.943427	I(1)
LOG(USO)	-2.604268	-3.572910	-2.893514	-7.314048*	-3.621023	-2.943427	I(1)
LOG(CSO)	-1.937362	-3.572910	-2.893514	-3.400755**	-3.621023	-2.943427	I(1)

Source: Computed from E-view 10.0

Note: *and** denote rejection of the null hypothesis of unit root at 1% and 5% significant levels respectively.

From the Phillips-Perron unit root test in table 4.1, none of the series were stationary at levels. However, they all become stationary after taking first differences (i.e, I(1)) at 1% and 5% levels of significance.

4.2 Cointegration Test Result

The result of the Johansen cointegration test is presented in table 4.2. The Trace statistic and the maximum Eigen statistic are used in interpreting the result.

Table-4.2: Johansen Cointegration Test Result

Hypothesized No. of $CE_{(s)}$	Eigen Value	Trace Statistic	0.05 Critical Value	Prob.**
None*	0.630885	94.30786	69.81889	0.0002
At most 1*	0.510175	57.43193	47.85613	0.0049
At most 2*	0.385863	31.02476	29.79707	0.0359
At most 3	0.181481	12.98590	15.49471	0.1153
At most 4	0.139904	5.576318	3.841466	0.0182
Hypothesized No. of $CE_{(s)}$	**Eigen Value**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None*	0.630885	36.87593	33.87687	0.0213
At most 1	0.510175	26.40717	27.58434	0.0701
At most 2	0.385863	18.03885	21.13162	0.1284
At most 3	0.181481	7.409586	14.26460	0.4419
At most 4	0.139904	5.57318	3.841466	0.0182

Source: Computed from E-view 10.0

Trace test indicates 3 cointegrating equations at the 0.05 level

Max-eigen test indicates 1 cointegrating equation at the 0.05 level.

*denotes rejection of the null hypothesis at the 0.05 level.

**Mackinnon-Haug-Michelis (1999) P-values

From the Johansen cointegration test results in table 4.2, the trace statistic indicates 3 cointegrating equations while the Max-Eigen statistic indicates 1 cointegrating equation. The result therefore shows that there exists long-run (equilibrium) relationship among the variables of the model.

4.3 Long-Run Result

The normalized cointegrating coefficients, standard errors and t-statistics are presented in table 4.3.

Table-4.3: Long-run Coefficients

LGDPPC	LOG(MSo)	LOG(MQSo)	LOG(USO)	LOG(CSO)
1.000000	92.42912	5.941539	0.388521	14.13686
	(13.7759)	(1.62649)	(12.6182)	(9.32254)
	(6.709479)	(3.652982)	(0.030791)	(1.516417)

Source: Computed from E-view 10.0

Note: The figures in the first and second parentheses are the standard errors (S.E) and the t-values respectively.

4.4 Error Correction Model (ECM) Result

The error correction model (EMC) was first estimated with an over-parameterized model and thereafter, with a parsimonious model. The result of the parsimonious ECM is therefore presented in table 4.4.

Table-4.4: Parsimonious ECM Result

Dependent Variable: RGDPPC Method: Least Squares Date 04/17/21 Time: 07:35 Sample (adjusted): 1984 2019 Included observations: 36 after adjustments				
Variable	Coefficient	Std. Error	t-statistic	Prob.
C	-411.5485	688.3515	-0.597875	0.5560
DLOG(MSO)	77.66241	51.80440	1.499147	0.1480
DLOG(MSO(-1))	-0.940691	64.96688	-0.014480	0.9886
DLOG(MSO(-2))	-2.208487	49.29942	-0.044797	0.9647
DLOG(MQSO)	10.50988	59.42057	0.176873	0.8612
DLOG(MQSO(-1))	7.878786	58.11506	0.135572	0.8934
DLOG(MQSO(-2))	-27.55671	52.57951	-0.524096	0.6055
DLOG(CSO)	4.610543	70.25973	0.065621	0.9483
DLOG(CSO(-1))	2.427078	78.41505	0.030952	0.9756
DLOG(CSO(-2))	5.049213	41.71088	0.121053	0.9047
DLOG(USO)	3.348804	12.17030	0.275162	0.7858
DLOG(USO(-1))	14.22501	12.48979	1.138931	0.2670

DLOG(USO(-2))	3.736683	15.35636	0.243331	0.8100
ECM(-1)	-0.136935	0.041160	-3.326895	0.0006
R-Squared	**0.948810**	**Mean dependent var**	**259.8056**	
Adjusted R-squared	**0.918561**	**S.D Dependent var**	**74.53046**	
S.E. of regression	**21.26917**	**Akaike info criterion**	**9.237695**	
Sum squared resid	**9952.305**	**Schwarz criterion**	**9.853508**	
Log likelihood	**-152.2785**	**Hannan-Quinn Criter.**	**9.452631**	
F-statistic	**31.36682**	**Durbin-Watson stat.**	**2.022385**	
Prob. (F-statistic)	**0.000000**			

Source: Computed from E-view 10.0

The result of the error correction model in table 4.4 shows that the error correction term (ECM (-1)) is rightly signed. Hence, its coefficient has the expected negative sign. It is equally statistically significant at the 0.05 level. The ECM (-1) variable has a coefficient of -0.136935. This indicates a speed of adjustment of about 13 percent from any short-run disequilibrium to long-run (equilibrium) values within a period of one year.

4.5 Post-Estimation Tests Results

The results of the various post-estimation tests are shown in table 4.5

Table-4.5: Results of Post-Estimation Tests

Test	Value	Prob.	Decision
Linearity (Reset) Test t-statistic F-statistic	 0.839154 0.696766	 0.4280 0.4280	Accept Null Hypothesis (Model correctly specified)
Breusch-Godfrey LM Test F-statistic	 0.596772	 0.5284	Accept Null Hypothesis (No Autocorrelation)
Heteroscedasticity (Glejseer) Test F-statistic	 0.573623	 0.7184	Accept Null Hypothesis (Residuals have constant variance)
Normality (Jaque-Bera) Test F-statistic	 1.635871	 0.5267	Accept Null Hypothesis (Data Normally distributed).

Source: Computed from E-view 10.0

The post estimation tests showed that the basic assumptions of the classical linear regression model (CLRM) are statisfied.

4.6 Discussion of Findings

The Johansen cointegration test showed that there exists long-run (equilibrium) relationship among the variables in the model.

4.6.1 Estimated Long-Run Result

The long-run result indicated that all the components or subsectors of the industrial sector turned up with the expected positive sign. This shows that there is a positive relationship between each of the components of the industrial sector and economic growth in Nigeria. However, based on t-values, manufacturing and mining and quarrying subsectors are statistically significant while utility and construction subsectors are not statistically significant. Hence manufacturing, and mining and quarrying sub-sectors have significant positive relationship with economic growth while utility and construction sub sectors have positive but insignificant relationship with economic growth in the long-run.

4.6.2 Estimated Short-Run Result

i) The short-run result showed that manufacturing sector output in the current period has insignificant positive impact on economic growth while its lagged values in the first and second periods have insignificant negative impact on economic growth.

ii) Mining and quarrying sector output in the current period and its value lagged by one period have insignificant positive impact on economic growth. However, mining and quarrying lagged by two periods has insignificant negative impact on economic growth.

iii) Construction sector output in the current period, and its lagged values in periods one and two all have insignificant positive impact on economic growth.

iv) Similarly, utility sector output in the current period, and its periods one and two lags have insignificant positive relationship with economic growth.

The short-run result also showed that the coefficient of multiple determination (R-squared) is 0.948810 indicating that the explanatory variables accounted for about 94 percent of the total variations in the dependent variable. The adjusted R-squared is 0.918561. The F-statistic is 31.36682 with Prob(F-statistic) of 0.000000. This implies that the overall regression is statistically significant at the 0.05 level of significance. The Durbin-Watson statistic is 2.022385 indicating that the estimated model is not affected by the problem of autocorrelation.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Conclusions

Based on the estimated long-run result, the following conclusion was drawn from the study.

i) Manufacturing sector output makes strong contribution to economic growth in Nigeria.
ii) Output of the mining and quarrying sector makes significant contribution to the growth of the Nigerian economy.
iii) The contribution of the construction sector output to economic growth in Nigeria is weak.
iv) Utility sector output insignificantly impacts on the growth of the Nigerian economy.

5.2 Policy Recommendations

Based on the conclusions from the study, the following recommendations are given.

i) To improve the contribution of the industrial sector to the growth of the Nigerian, economy, there should be a general improvement in the country's productive capacity.
ii) To improve the performance of the utility sub-sector, there should be improvement in the supply of power and energy. To this end, there should be improvement in the supply of electricity, gas, water, etc for industrial use.
iii) There should improvement in the provision of infrastructure like roads, rail way, etc.
iv) The Bank of Industry should make its credit facilities available and accessible to industrialists in the country.
v) The Nigerian Export-Import Bank (NEXIM) and the Nigerian Export Promotion Council (NEPC) should collaborate to assist industrialists in Nigeria to secure the needed industrial raw materials and to improve the quality of our industrial products to compete favourably in the international markets.

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