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Abstract:
This research work focuses on the relationship between population growth and industrial output in Nigeria for the period 1980 to 2017. It is particularly interesting to study the relationship between population growth and industrialization in Nigeria because at present, Nigeria is making rapid effort to advance her economy while undergoing a demographic transition that has been projected to be geometric in nature. This research developed an Auto-regressive Distributive Lag (ARDL) model using Index of Industrial Output as the dependent variable and Population growth rate, Birth rate, Total Labour Force (as a percentage of total population that are employed), Capacity Utilization and Manpower Development Index as the independent variables. The data was obtained from the World Bank, the National Population Commission and the Central Bank of Nigeria Statistical Bulletins (various issues). The findings reveal that Population Growth Rate has an inverse relationship with Industrial Output both in the short run and in the long run while Total Labour Force and Capacity Utilization also decrease Industrial Output both in the short and long-run periods. Since the Bounds test reveals a long-run relationship between population and Industrial Output, we recommend a renewed determination and political will to implement the National Policy on Population for sustainable development that outlines a sectoral strategy to manage our rising population.

Keywords: Auto-regressive Distributive Lag, Capacity Utilization, Industrialization, Population growth.

Introduction/Background to the Study:
For many years, it has become established that the economic growth of a nation is significantly dependent on the growth of its population. Human capital is the key to economic growth and development in any nation. This stems from the fact that every other facility and resource required for economic growth is driven by the availability of human capital (Nwosu, Dike and Okwara, 2014). However, in the absence of effective human capital development, an increasing population can have an adverse effect on the economic growth of a nation. This is because a lot more resources are taken out to manage and cater for the teeming population than the same can generate (Brand, 2009).

At independence in 1960, Nigeria’s population was estimated to be 45.2 million people (NPC, 1991;2006). Nigeria’s population has been increasing for at least the last 5 decades due to very high birth rates, quadrupling its population during this time (wikipedia, 2018). Nigeria’s population growth was fastest in the 1980s after child mortality dropped rapidly and has slowed slightly since then as the birth rate has also declined slightly. Nigeria is one of the fastest
growing countries in the world in terms of population. With an estimated population of 140 million and an annual population growth rate of 2.9% (NPC 2006), Nigeria is the most populous nation in sub-Saharan Africa and the tenth most populous in the world (UNDP, 2016). However, the United Nations Development Programme asserts that the composition of this population is mainly skewed in favour of the youthful category with 49% being youths below the age of 21 and therefore a dependency ratio estimated at 89%. A large proportion of this population favours and is living in the rapidly expanding urban areas, presently estimated at over 45.2% and will likely hit 55.4% mark by the year 2020 (UNDP, 2016).

With these statistics however, Nwosu, Dike and Okwara (2014) posit that the population growth shows profound inequities and disproportions when analyzed with development indicators such as: a doctor – patient ratio of 21 doctors per 100,000 people, infant mortality rate of 112 per 1000 live births, maternal mortality of over 980 per 100,000 live births, life expectancy at birth projected at 50 years, industrial capacity utilization less than 50% and most of all, less than expected industrial sector production index.

For example, in the 1980s, when the population of Nigeria was growing exponentially at 2.4% - 3%, Nigeria’s industrial production base was still around N40 billion to N50 billion annually as compared to other developing countries of the World at the time like Thailand and Indonesia which had industrial output of more than N200 billion annually (Budget, 2017). Government expenditure on education was N170 million in 1981 and reached N9.75 billion by the end of 2000 (CBN, 2017). With a population figure of more than 100 million people and adult population constituting more than half of the total population figure, Nigeria’s total labour force was a mere 29% of total adult population in 1981 and currently revolves around 40-50% from the 1990s till date (NPC, 2016).

The major problem identified in this research work is the general belief that growth of population could be to the advantage of a country in terms of the sheer size of its domestic market, better division of labour and increased productivity through improvements in the ratio of labour force to population as well as enhancement of its political and military power. The decreasing output of the industrial sector coupled with Nigeria’s overdependence on the oil sector has made many stakeholders point to the fact that Nigeria is not utilizing her vast population to enhance growth of the industrial sector. It is still unclear whether the recent economic down-turn in Nigeria is a direct consequence of a neglected rapid population growth. Also, the recent rapid population growth in Nigeria as projected by the UNDP is not known to have been equally associated with unemployment with figures ranging from 17 percent per annum for the entire population to 60 percent for the youths. Problems like job opportunities being fewer than the numbers seeking for them and a non-proportionate government investment in human capital development have been identified by many researchers to be among the problems working against the optimal growth of the industrial sector in Nigeria.

In the light of the problems identified above, this research work sought to achieve the major objective of ascertaining the relationship between population growth and industrial output in Nigeria by focusing on the core population growth indices which include population growth rate, birth rate, total labour force, capacity utilization, human capital development and unemployment rate. Pertinent questions raised in order to help guide the study were: What is the relationship between population growth rate and industrial output in Nigeria? To what extent have birth rate, total labour force, capacity utilization, unemployment rate and human capital development affected the output of the industrial sector in Nigeria? The scope of this
study was from 1980 to 2017 and it concentrated on the identified indices within the Nigerian economy.

**Literature Review:**

Nwosu, Dike and Okwara (2014) define population growth as the increase in the number of human inhabitants of a given place. Thomas (1973), quoted in Adewole (2016), views the population of an area as the total number of all individuals alive at a particular point in time. He further asserts that the growth rate of population is the percentage increase in the number of individuals alive at a particular point in time at a given place. Ben (2015) delineates the total population of any area of the earth’s surface as a representation of a balance between two forces:

1. One is natural change caused by the difference between the number of births and deaths. If births are more numerous than deaths in any period, the total population will increase. However, if they are less numerous, it will decrease. This simple relationship is modified by a second force: Migration.

2. Migration: When immigrants are more numerous than emigrants, there will be a population increase. (We assume, of course, that we are ignoring natural change for the moment). When emigrants are more numerous, there will be a population decline (Ben, 2015).

Net changes in the total population are caused by the interaction of four elements: Births and immigrants tend to push the total up: Deaths and emigrants tend to bring the total down (Taylor and Francis, 2008). Although migration may be the most important factor in small areas (for example, in a small village or a city block), it is less significant at the national level. Taylor and Francis opine that, for the world as a whole, migration is irrelevant because all movements take place within the limits of the recording area. However, overpopulation is described as a condition where people's numbers exceed the carrying capacity of its habitat. In common parlance, the term usually refers to the relationship between the human population and its environment, the earth. Overpopulation does not depend only on the size or density of the population, but on the ratio of population to available sustainable resources. It also depends on the way resources are used and distributed throughout the population (Aguirre, 2017).

Matching population growth with development is the real object of global and country action towards improved welfare, human development and economic growth. The changing patterns in the size, structure and distribution of population provide useful leads into the persistent shifts in the choice of approaches for managing development (Rostow, 1998 in Nwosu et al, 2014). Countries like China, India, Russia etc have utilized their rapid population growth to their advantage by way of human capital development and utilization of skilled man-power for technological advancements (Caldwell, 2002).

Nigeria tends to be least able to cope with the development and environmental consequences of rapid growth due to her low per capita income, indebtedness, and limited capacity for investments (UNFPA, 1991). The situation in Nigeria is not different from what is obtainable from other African countries; her population is large which makes it a “giant” relative to the other African countries.

**Nigeria’s Industrial Sector:**

The structure of the Nigerian economy is typical of an under-developed country (Louis, Chete John, & Adeoti Foluso, Adeyinka Femi, 2016). Between the early 1990s and 2011 to 2012, the
primary sector, in particular, the oil and gas sector, dominated GDP, accounting for over 95% of export earnings and about 85% of government revenue. The industrial sector accounted for 6% and less of economic activities in the years leading up to the 2000s, while in 2011, the manufacturing sector contributed only 4% to the Gross Domestic Product (Louis, et al, 2016).

The industrial sector, in the late 60s and early 70s, was characterized by agriculture which was the mainstay of the Nigerian economy at the time. The agric sector provided food and employment for the populace providing more than 90% employment rate for the teeming population and providing raw materials for the nascent industrial sector and also generating the bulk of government revenue and foreign exchange earnings (CBN, 2017). Following the discovery of oil and its exploration in commercial quantities in the late 70s and 80s, the fortunes of agriculture gradually diminished. Nigeria, with over 50million unemployed population, grappled with the few available jobs in the oil sector thereby neglecting the agric sector (Louis, et al, 2016).

The economic transformation strategy agenda, otherwise known as Nigeria Vision 20:2020 launched in 2009, sets out the direction for current industrial policy in Nigeria. The industrialization strategy aims at achieving greater global competitiveness in the production of processed and manufactured goods by linking industrial activity with primary sector activity, domestic and foreign trade and service activity (NEEDS, 2010). The recent trade policies of the federal government (from NEEDS, 2010 to date) have sought to reduce the unpredictability of the trade policy regime, establish a schedule to adopt the ECOWAS common tariffs (CET) and respect obligations under multilateral trading systems (Adenikinju, 2005).

The strengthening of the institutional and regulatory frameworks has helped to drive the industrial sector in Nigeria towards a sustainable growth. These institutional and regulatory frameworks include

1. Banking sector reforms by the CBN
2. Increase in the pace of privatization and publicly-owned companies
3. Liberalization of the telecommunications sector
4. Improvements in Standards Organization of Nigeria’s (SON) standardization of industrial products
5. Implementation of export incentives by the Nigerian Export Promotion Council
6. Improvements in the activities of the Bank of Industry (BOI), Nigerian Agricultural Cooperatives and Rural Development Bank (NACRDB), SMEDAN, NITDA, EFCC, ICPC, etc.

Population Growth and Industrial Output in Nigeria:
Adewole (2012) asserts that population growth affects the growth of the industrial sector in particular and economic development generally in two ways;

1. By promoting industrial production and economic development: This occurs in the developed economies
2. By retarding industrial production and economic development: This occurs in the developing countries like Nigeria.

According to a study by the committee of the office of the foreign secretary National Academy of Science (SCOFSNAS) 1972, rates of population growth in many less developed Countries are at least half the rates of economic growth and in some cases, almost equal to the latter.
Rapid population growth slows down the growth of per capita incomes in developing countries and tends to perpetuate inequalities in income distribution.

Jhingan (2005), in his view, states that the growth of population tends to retard the per capita income in 3 ways: It increases the pressure of population on land; It tends to raise the cost of consumption goods because of the inability of the cooperating factors to increase proportionately. It tends to a decline in the accumulation of capital because with increase in family members, expenses increase. These adverse effects of population growth on per capita income operate more severely if the percentage of children in the total population is high, as is actually the case in Nigeria. Children involve economic cost in the form of time spent and money expended in bringing them up. In addition, faster population growth makes the choice scarcer between higher consumption now and the investments needed to bring higher consumption in the future. Improving the industrial production base of any economy depends upon investments. In Nigeria, the resources available for investment are limited. Therefore, rapid population growth retards investment needed for higher future consumption (Adewole, 2012). The International Monetary Fund (IMF) reported in 2017 that it feared that issues such as population, poor foreign exchange management and policy implementation would dwarf the majority of industrial outputs in Nigeria; but the red flag is the population bomb. With the population currently growing at 2.7%, it is expected that industrial output should expand to higher rate in order to improve human development indices.

The industrial sector in Nigeria suffers from a dearth of skilled labour force. Majority of the labour force are skilled with increasing rate of imported labour to drive its production (Louis et al, 2016). Countries like China and India have proved that “a country’s greatest wealth is its people” by transiting from poor, agrarian economies to become world’s second and seventh largest economies respectively as Japan, the world’s third largest, had done before them (WDI, 2017).

**The Theoretical Framework:** The classical economic theory of population growth as postulated by Malthus states that a rise in incomes, particularly among the poorer classes in any country, tends to increase fertility rates but decrease mortality rates. The course of events since Malthus' time has not only negated that theory but has also led to the gradual evolution of the theory of demographic transition. This theory is based on the hypothesis that man's reproductive behavior is highly responsive to his environment, and it typically relates to a sequence of birth and death rates to a country's economic development.

The prospects of the Malthusian’s prediction enacting itself due to population out-stripping the available resources is timely for developing countries; low Per Capita incomes of the developing nations lead to poverty which is on the increase in the developing nations because of rapid population. The crux of the matter now is how to manage the population growth as we seem to be in a vicious cycle of poverty, unemployment and rapid population increase. This research work considers the complex interrelations between population and industrial growth.

According to Ominde and Ejiogu (1972) as quoted in Adewole (2012), two ideas are relevant to the discussion being initiated here. First is the question as to whether population growth will generate the type and intensity of tension and stress required to act as an effective catalyst to improving even the local industries towards a generalized expansion in industrial capacity of the country. This will depend on the social, economic and physical resources and political situations within which the people concerned are operating their economy. Secondly, the point
at which individuals react favorably to the tensions of population growth to bring about economic development will be related to the people's level of skills, motivations, expectations, as well as resourcefulness and the circumstances in which population growth at the individual household level creates stress or strain.

Jhingan (2005) considers the consequences of population growth on economic development. To him, these consequences have attracted the attention of economists ever since Adam Smith wrote his “Wealth of Nations”. “The annual Labour of a nation is the resource which, originally supplies it with all the necessaries and conveniences of life”. It was only Malthus and Ricardo who created an alarm about the effects of population growth on the economy. But their fears have been proved somewhat unfounded because the growth of population in Western Europe has led to its rapid industrialization. Population growth has helped the growth of such economies because they are wealthy, have abundant capital and a scarcity of labour (Adewole, 2012). Adewole goes further to assert that in such countries, the supply curve of labour rate of population has led to a rapid increase in productivity and every increase in population has led to a more than proportionate increase in the gross national product.

Empirical Review: Nwosu, Dike and Okwara (2014) investigated the time series role of population growth on economic growth in Nigeria and how economic growth is affected through population growth by using annual secondary observation of population growth rate and GDP from 1960 to 2008. Their empirical results support the fact that population growth has a significant impact on economic growth. Their study also found that there is a sustainable long run equilibrium relationship between economic growth and population growth. They also found evidence of unidirectional causality between population growth and economic growth.

Adewole (2012) examined the effect of population on economic development in Nigeria by using trend analysis with the scope spanning between 1981 and 2007. His study analyzed two models using Real GDP and Per capita income as dependent variables and Population growth rate as the independent variable in both models. His findings revealed that population growth has a positive and significant impact on economic sustainability proxied as real gross domestic product (RGDP) and Per Capita Income but with a negative slope in the Real GDP model. He recommended a sustained improvement of the social/human welfare of the people and population-related policies to promote growth in national output as population increases. Such policies include food subsidies, employment generation, public health provisions, etc.

Ogujiliba (2016) examined how changes in population dynamics affect household portfolio choices (expenditure on food, monetary transactions, goods and services and non-cash expenditure) in Nigeria, given the fact that Nigeria is going through a demographic transition. His study established a link between demographic variables and household expenditure components using the Vector Error Correlation Methodology. His results suggested that population growth in Nigeria can produce significant effects on the economy via the expenditure profiles of households. The results also suggested that other factors such as real per capita income and ratio of other expenditure categories to total expenditure, influence the growth of household expenditure components.

Onwuka (2013) studied the impact of Nigeria’s growing population on the country’s development. He empirically tested the association between population growth and economic development in Nigeria between 1980 and 2013. His model used growth rate of GDP as a function of population growth rate, capita output, oil production and agricultural output. He
found that the growth of the population outweighs that of output and this has hindered the capacity of successive governments to efficiently provide social services to the people, thereby negatively affecting development. His recommendation, based on the findings, is that curbs on population growth through appropriate policies that would integrate the country’s population programmers into the mainstream development efforts are necessary. That way, higher per capita consumption of social services by the citizens would be facilitated and which would ultimately boost their access to the benefits of development.

**Model Specification:**
The model specified for this study followed the empirical works of Adewole (2012), Onwuka (2013) and Nwosu et al (2014) who, in their separate works, specified Gross Domestic Product as dependent on population growth rate in a simple regression model. However, our model took a multiple econometric form by the introduction of several other determinants of population growth such as birth rate, total labour force, capacity utilization etc. In functional form, the model is specified thus:

\[ \text{INDO} = F(\text{PGR}, \text{BR}, \text{TLF}, \text{CAPU}, \text{MPDI}) \] …(1)

Where:
- \( \text{INDO} \) = Industrial Output
- \( \text{PGR} \) = Population Growth Rate
- \( \text{BR} \) = Birth Rate
- \( \text{TLF} \) = Total Labour Force
- \( \text{CAPU} \) = Capacity Utilization
- \( \text{MPDI} \) = Manpower Development Index (proxied by government expenditure on education, health and social services)

Expressing the model above in an econometric form, we have:

\[ \text{INDO} = \alpha_0 + \alpha_1 \times \text{PGR} + \alpha_2 \times \text{BR} + \alpha_3 \times \text{TLF} + \alpha_4 \times \text{CAPU} + \alpha_5 \times \text{MPDI} + \varepsilon \] …(2)

Where \( \alpha_0 \) is the intercept of the model, \( \alpha_1 \) - \( \alpha_5 \) are the parameters of the model to be estimated and \( \varepsilon \) is the stochastic error term

**Methodology:**
The ex-post-facto research design was employed for this study. The Secondary data was sourced from the Central Bank of Nigeria (CBN) Statistical bulletin, National Population Commission Annual bulletins and The National Planning Commission Annual abstracts (various issues). The period of study covered 1980 to 2017. The Autoregressive Distributive lag (ARDL) was used to model the relationship between population growth rate and industrial output in Nigeria by estimating the lagged values of population growth rates and its indices with a view to projecting future growth in industrial output.

**Test for Unit Root:** The analyses started with the test for Unit Root or stationarity; since most economic time series data are non-stationary. The test was conducted using the Augmented Dickey-Fuller (ADF) Unit Root test. The dynamic version of the long run relationship equation is specified as follows:

\[ \text{INDO}_{t-1} = \alpha_0 + \alpha_1 \times \text{PGR}_{t-1} + \alpha_2 \times \text{BR}_{t-1} + \alpha_3 \times \text{TLF}_{t-1} + \alpha_4 \times \text{CAPU}_{t-1} + \alpha_5 \times \text{MPDI}_{t-1} + \varepsilon_t \] …(3)

Where \( t-1 \) is the one period lag of the variable and \( \varepsilon_t \) is the disturbance term. The null hypothesis of \( \partial > 0 \) (non-stationary) was tested against the alternative hypothesis of \( \partial < 0 \) (stationary) at 5% level of significance. The ADF t-statistic was compared with the 5% critical value and if it is greater than the 5% critical value, the null hypothesis of no stationarity is rejected. The test enables us to avoid regression results that are spurious.
ARDL Bounds Test for Cointegration:

In order to empirically analyse the long-run relationships and short-run dynamic interactions among the variables of interest, we applied the autoregressive distributed lag (ARDL) cointegration technique. The ARDL bounds test is based on the assumption that the variables are I(0) or I(1) (Pesaran, et al, 2001).

Short Run and Long Run Estimation of the ARDL Model:

The short-run equation in our model is given as follows:

\[
D(INDO)_{t-1} = \alpha_0 + \alpha_1 D(PGR)_{t-1} + \alpha_2 D(BR)_{t-1} + \alpha_3 D(TLF)_{t-1} + \alpha_4 D(CAPU)_{t-1} + \alpha_5 D(MPDI)_{t-1} + ECM(-1)
\]

Where “D” represents the first difference operation of the variables, ECM(-1) is the one period lag of the model residual. The parameters \(\beta_1\) to \(\beta_5\) are the long-run coefficients of the model while the coefficient of ECM(-1) is the long-run speed of adjustment of the model. The sign of the coefficient of ECM(-1) should be negative and significant as well for holding the long-run equilibrium (Dhungel, 2014).

Data Analysis:

The Unit Root test carried out on the variables is summarized below:

**Table 1: Unit Root Test**

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF statistics at Level</th>
<th>ADF statistics at First Difference</th>
<th>Order of integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDO</td>
<td>-1.664266</td>
<td>-5.316667</td>
<td>I(1)</td>
</tr>
<tr>
<td>PGR</td>
<td>-3.062168</td>
<td>-6.461258</td>
<td>I(0)</td>
</tr>
<tr>
<td>BR</td>
<td>-3.027149</td>
<td>-9.366816</td>
<td>I(0)</td>
</tr>
<tr>
<td>TLF</td>
<td>-2.184378</td>
<td>-3.030234</td>
<td>I(1)</td>
</tr>
<tr>
<td>CAPU</td>
<td>-2.656964</td>
<td>-3.087650</td>
<td>I(1)</td>
</tr>
<tr>
<td>MPDI</td>
<td>-5.119611</td>
<td>-9.344002</td>
<td>I(0)</td>
</tr>
</tbody>
</table>

Source: Extracted from Eviews9 Output

The table above shows that the variables have a mixed order of integration. Industrial output (INDO), Total Labour Force (TLF) and Capacity Utilization (CAPU) are all stationary at first difference i.e. integrated of order I(1) while Population Growth Rate (PGR), Birth Rate (BR) and Man-power Development (MPDI) are stationary at level i.e. integrated of order I(0). The determination of the order of integration of the variables establishes the fact that the statistical properties of the variables are constant and do not change over time. Also, since there is no second order integrated I(2) variable, we go ahead to estimate the long run relationship amongst the variables using the ARDL Bounds test.
ARDL Bounds Test:
The bounds test carried out on the variables is summarized below:

Null Hypothesis: No long-run relationships exist

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th>Value</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
<td>4.755737</td>
<td>5</td>
</tr>
</tbody>
</table>

Critical Value Bounds

<table>
<thead>
<tr>
<th>Significance</th>
<th>I0 Bound</th>
<th>I1 Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>2.26</td>
<td>3.35</td>
</tr>
<tr>
<td>5%</td>
<td>2.62</td>
<td>3.79</td>
</tr>
<tr>
<td>2.5%</td>
<td>2.96</td>
<td>4.18</td>
</tr>
<tr>
<td>1%</td>
<td>3.41</td>
<td>4.68</td>
</tr>
</tbody>
</table>

Source: Extracted from E-views 9 Output
F-statistic = 4.7557

The ARDL Bounds test above shows that the F-statistic value of 4.7557 is greater than both the I(0) and I(1) bounds critical values at 5% hence we rejected the null hypothesis stated above. Therefore, we concluded that there exists a long-run relationship among the variables i.e. Population Growth Rate has a long-run effect on industrial sector’s output in Nigeria.

Auto-Regressive Distributive Lag Selection and Short-Run Estimates:
The lag distribution and short-run estimates of the ARDL population growth rate – industrial growth model is shown below:

<table>
<thead>
<tr>
<th>ARDL Cointegrating/Short-Run Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model selection method: Akaike info criterion (AIC)</td>
</tr>
<tr>
<td>Selected Model: ARDL(1, 0, 1, 4, 2, 4)</td>
</tr>
</tbody>
</table>

Included observations: 34

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDO(-1)</td>
<td>1.140130</td>
<td>0.162700</td>
<td>7.007555</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(PGR)</td>
<td>-0.424556</td>
<td>14.501128</td>
<td>-0.029277</td>
<td>0.9770</td>
</tr>
<tr>
<td>D(BR)</td>
<td>1.079386</td>
<td>0.861256</td>
<td>1.253270</td>
<td>0.2281</td>
</tr>
<tr>
<td>D(BR(-1))</td>
<td>1.139259</td>
<td>0.739887</td>
<td>1.539774</td>
<td>0.1432</td>
</tr>
<tr>
<td>D(TLF)</td>
<td>-2.912710</td>
<td>4.220603</td>
<td>-0.690117</td>
<td>0.5000</td>
</tr>
<tr>
<td>D(TLF(-1))</td>
<td>-6.185222</td>
<td>4.667206</td>
<td>-1.325252</td>
<td>0.2037</td>
</tr>
<tr>
<td>D(TLF(-2))</td>
<td>-1.695792</td>
<td>3.345916</td>
<td>-0.506824</td>
<td>0.6192</td>
</tr>
<tr>
<td>D(TLF(-3))</td>
<td>-5.562230</td>
<td>3.168133</td>
<td>-1.755681</td>
<td>0.0983</td>
</tr>
<tr>
<td>D(TLF(-4))</td>
<td>1.695792</td>
<td>3.345916</td>
<td>0.506824</td>
<td>0.6192</td>
</tr>
<tr>
<td>D(CAPU)</td>
<td>-0.594318</td>
<td>0.894797</td>
<td>-0.664193</td>
<td>0.5160</td>
</tr>
<tr>
<td>D(CAPU(-1))</td>
<td>1.347769</td>
<td>0.746242</td>
<td>1.806076</td>
<td>0.0898</td>
</tr>
<tr>
<td>D(CAPU(-2))</td>
<td>1.557663</td>
<td>1.281552</td>
<td>1.215451</td>
<td>0.2418</td>
</tr>
<tr>
<td>D(MPDI)</td>
<td>0.076116</td>
<td>0.093073</td>
<td>0.817813</td>
<td>0.4255</td>
</tr>
</tbody>
</table>
The lag selection followed the Akaike Info Criterion. The AIC selects the best fitted lag for the model with the lowest AIC. The ARDL model selected a lag structure of 1, 0, 1, 4, 2, 4 which means that one lag period was chosen for the dependent variable (Industrial Output), No lag for the first independent variable (Population Growth Rate), One lag for Birth Rate, Four lag periods for Total Labour Force, two lags for Capacity Utilization and four lags for Manpower development. The lag structure shows the maximum number of years it takes for the variable to bring about a change in the current value of industrial output.

It could be seen from the table that Population Growth rate (PGR) has no lag periods hence the current years’ rate of population growth decreases industrial output by 0.425 units. Also, Birth rate has one period lag and it shows that a unit increase in birth rate in the previous year and current year will lead to a corresponding increase in industrial output.

Total Labour Force, on the other hand, has 4 lag periods. The coefficients for the whole 4 years prior to the current year are negative which means that TLF has an inverse relationship with Industrial Output in the previous years and the current year. Capacity Utilization was positive in the first lag period (1.348) but changed to negative in the current year (-0.594). This suggests that capacity utilization of the manufacturing sector is gradually decreasing given the effects of population growth rate.

Furthermore, the Manpower development index (MPDI) proxied by expenditures on education, health and social services showed negative coefficients in the first and third period lags while it was positive in the second period lag and the current year. This represents a fluctuation in the effect of MPDI on industrial output which is attributed to the unsteady and inadequate government expenditures on the development of manpower.

**ARDL Long-Run Estimates:**
The Long-run estimates of the ARDL model is summarized below:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGR</td>
<td>-0.174249</td>
<td>0.051032</td>
<td>-3.414505</td>
<td>0.0170</td>
</tr>
<tr>
<td>BR</td>
<td>0.910593</td>
<td>0.549464</td>
<td>1.657239</td>
<td>0.1169</td>
</tr>
<tr>
<td>TLF</td>
<td>-0.836562</td>
<td>0.535914</td>
<td>-1.561002</td>
<td>0.1381</td>
</tr>
<tr>
<td>CAPU</td>
<td>-0.157778</td>
<td>0.042628</td>
<td>-3.701276</td>
<td>0.0043</td>
</tr>
<tr>
<td>MPDI</td>
<td>0.028298</td>
<td>0.091677</td>
<td>0.308668</td>
<td>0.7616</td>
</tr>
<tr>
<td>C</td>
<td>27.282490</td>
<td>20.097264</td>
<td>1.357523</td>
<td>0.1935</td>
</tr>
</tbody>
</table>

Source: Extracted from E-views 9 Output
INDO = 27.2825 – 0.1742*PGR + 0.9106*BR – 0.8366*TLF – 0.1578*CAPU + 0.0283*MPDI – 0.4365*CointEq(-1)

The long-run coefficients of the model showed that Population Growth Rate has a negative relationship with Industrial Output, decreasing it significantly by 0.174 units. Birth rate has a positive but insignificant relationship with industrial output. Conversely, total labour force (TLF) and Capacity Utilization (CAPU) both decreased industrial output by 0.8366 and 0.1578 units respectively. However, only capacity utilization decreased industrial output significantly given the p-value at 0.0043.

Manpower development has a positive coefficient of 0.0283 showing a positive relationship with industrial output, but the positive relationship did not significantly enhance the growth of the industrial sector’s output.

The speed of adjustment of the model was estimated at 0.436 which was approximately 43.6%. This means that the rate at which the model returns to long-run equilibrium is 43.6% estimated annually. The interception of the model showed that industrial output was about 27.282 units over the long run when the variables here were held constant at zero.

Finally, the adjusted R-square was 0.935 meaning that population growth rate and its indices account for up to 94% of the changes in the industrial sector’s output. It also has a significant joint impact on the industrial sector with F-statistic value of 28.93.

The Summary and Implications of the Findings:
The analyses of the relationship between population growth rate and industrial output gave some interesting findings which were summarized as follows:

1. Population growth rate decreases the rate of industrial output in Nigeria. The decrease is more significant in the long run than in the short run. This means that as the population increases, industrial output per capita decreases. This is not in line with economic a priori expectations and confirms the fact that the growing population in Nigeria has not been adequately utilized for the growth of the industrial sector. As stated by Onwuka (2013), “growth in population outweighs that of output and this has hindered the capacity of successive governments to efficiently provide social services to the people, thereby negatively affecting development”. This assertion gives credence to the fact that Nigeria’s population growth rate outweighs industrial production hence affecting the rate of economic growth.

2. The birth rate has a positive relationship with industrial output. As the birth rate increases, it tends to increase the growth of the industrial output. Total labour force, on the other hand, decreases industrial output both in the short run and the long run. This implies that the labour force absorbed by the industrial sector is not enough when compared to the population growth rate and this has resulted in decreasing output of the industrial sector.

3. The manufacturing capacity utilization has an inverse relationship with industrial output decreasing it by 0.594 units and 0.158 units in the short run and long run respectively. However, the manpower development index, proxied by government expenditure on education, health and social services, has a positive but insignificant impact on the growth of the industrial sector in Nigeria. This implies that the pattern of government expenditure has helped to equip a large percentage of the population towards impacting positively on the industrial sector but this has not been very
significant in terms of achieving the desired rapid growth of the industrial production as witnessed in the advanced nations of the world.

4. Population growth rate was found to have a long-run impact on the industrial sector jointly exerting up to 94% of the variations in industrial output.

Conclusion and Recommendations:
Nigeria’s population reached 182 million in 2016, according to the International Monetary Fund (IMF) estimates with a rate of growth of 2.5%. This research work modeled the relationship between the growth rate of population and the growth of the industrial sector with particular emphasis on the key variables that determine population growth like birth rate, total labour force, rate of capacity utilization and man-power development index. Our findings led to the conclusion that Nigeria’s growing population has not been effectively utilized to revolutionize the industrial sector. The sector still grapples with low labour force utilization, inadequate capacity utilization and absence of skilled manpower to grow its productions. Having determined the less expected impact of population growth rate on the growth of the industrial sector, it is, therefore, recommended that:

1. There should be a renewed determination and political will to implement the National Policy on Population for sustainable development that outlines a sectoral strategy to manage the rising population of Nigeria. This National Policy on Population was rolled out in the year 2004 but ignored thereafter. By going back and re-enacting and possibly modifying its provisions, Nigeria would have set out on the right track to utilize the abundant human resources for growth of the industrial sector.

2. There should be a rapid increase in government intervention in education, health and social services. By investing more in these areas, indigenous manpower will be built, total skilled and employable manpower will be enhanced and the industrial sector will be the better for it.

3. Continuous geometric population growth will only add more pressure on other indices like capacity utilization, total labour force, birth rate etc. and these can only contribute more to decreased industrial activities given the inadequate manpower development. In the light of this, the industrial sector in Nigeria should look inwards for the training and re-training of their manpower and not depend on government. Non-formal training centres should be established to enroll the teeming youth population and train them in areas that need specialisation so as to convert the growing population into a producing population thus driving the needed growth in the economy.

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