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The Dynamics of Population and Economic Growth in Nigeria

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Abstract

There is no consensus on the actual relationship between population growth and economic growth in economies around the world. The dynamic relationship between these two phenomena in the Nigerian economy was examined using yearly data obtained from Central Bank of Nigeria Statistical Bulletin from 1970 to 2014. The ADF testfound that the two series were only differenced stationary and Johansen Co-integration test revealed that both variables had long-run relationship. The VECM revealed that economic growth adjusts to its long-run equilibrium at the rate of 6 percent annually. Impulse Response Functions and Forecast Error Variance Decomposition revealed that population growth played significant role in the growth of Nigerian economy. Contingent on the results of ADF, Toda-Yamamoto VAR model was estimated in order to carryout Granger non-causality test. Unidirectional causality flowing from population growth to economic growth was found thereby buttressing the earlier results. It was recommended that government capitalizes on the population growth by encouraging skill acquisition which could enhance productivity of the growing labour force. This is imperative because if the growth rate of GDP is less than the growth rate of population, there would be a decline in GDP per-capita and possibly fall in standard of living.

Key words: Economic growth, Population growth, Dynamics, Nigeria

1.0 Introduction

The debate over the intrinsic relationship between population growth and economic growth has been on for long timeamong economists. The starting point of this debate could be specifically traced back to Malthus (1803)who posited that "*population growth would lower the standard of living of the people*" in the long-run. The direction of the argument then was that given that land is fixed in supply, population growth will eventually reduce the amount of resources available to individuals leading to starvation. The assertion did not make reference to the influence of technology which may raise production and possibly standard of living beyond the perceived negative effect of population. According to Marsiglio (2012) population growth affect technical progress by providing a higher number of researchers. Earlier, economists believed that high birth rates and rapid growth in populationin poor countries would divert scarce capital away from saving and investment thereby placing a drag on development. This view was contingent on the fact that parents would have to spend more on education and healthcare expenses of the newly born and the children rather than saving and investment.On the contrary, some later assertions such as Kuznets (1967) and Simon (1981) could not establish any significant relationship between population growth and per capital income growth. Other studies reported positive relationship in the long-run. In the 1990s however there was emergence of findings of negative correlation between economic and population growth. Till today, there has been no consensus on the matter of relationship between population growth and economic growth.

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Much of contemporary economics on population problems has centered on what could be the optimum size and its impact on economic growth and development.According to Ali *et al.,* (2013), there are three major views on the issue of the type of relationship between population growth and economic growth. There is the*Pessimistic view* which expected a ***"population bomb***" as a result of population growth. This implies that as the food supplies growing arithmetically and population is growing geometrically a point would be reached when there would be no more food to feed the growing population and humans will start to feed on their deads.The second view is the *Optimistic theory* which was of the opinion that population is important for economic growth because it enhances the productive capacity of the economy as population growth leads to increase in labour supply thereby reducing labour cost. This is believed to be able to give firms and employers of labour a better opportunity of hiring more labour into the production process and thereby leading to a reduction in the unemployment rate and increase in the general output of the concerned economy.The third view is that of the *Neutralists*who believe that population does not have anything to do with economic development.However, there is no universal consensus as to whether population expansion is beneficial, detrimental or neutral to economic growth.

In Nigeria, most economic policies are directed towards economic growth and development. However, since the 1970s, growth in GDP has been fluctuating more compared with what was observed in the 1960s. It ranged from about 10 percent in the 1970s to a negative growth rate of an average value of -2 percent experienced in the 1980s and a slow growth rate of about 2 percent in the 1990s. Nigeria's economy is presently ranked 27th and 23rd in the world interms of nominal GDP and in terms of Purchasing Power Parity (PPP) respectively. The country's nominal GDP as at 2016 was US$492.986billion while the GDP adjusted for PPP was US$1,105.343 billion during same period (IMF, 2017) with a -2.1 percent economic growth rate (NBS, 2016). According to Worldometers (2017), the country's projected population for year 2017 is about 191.5million people.The main issue before any government is the effective utilization of the population towards improved economic growth.However, little is known about the dynamics of the relationship between population growth and economic growth in Nigeria and where it exists findings have been as diverse as the number of research. Hence, there is an urgent need to evolve a research with the sole aim of determining the relationship between population and economic growth in Nigeria. Findings from such study are expected to be useful to policy makers and governments at various levels in the country while it will also contribute to the body of literature on the issue in question.

2.0 Literature Review

As stated earlier, there has been lack of concordance in the findings of studies on relationship between population growth and economic growth and development.While some found positive relationship between the two variables, some others reported negative relationships and there are cases where no significant relationship was found.Ali*et al..,* (2013), Fumitaka (2010), Musa (2015) and Adediran (2012) all reported positive relationship between population growth and economic growth rate. Fumitaka (2010) specifically reported a long-run co-integrating relationship between population expansion and economic growth in the Philippines. The study further reported a unidirectional long-run causality from GDP to population implying that there was an "economic growth- induced population growth" in Philippine. Adediran (2012) found that population growth was positively affected by growth in per capita income and population growth also positively influence per capita income indicating a positive bi-causal relationship between the two in Nigeria. Ali*et al.,* (2013) reported that population growth had positive impact on economic growth in Pakistan.Musa (2015) reported a unidirectional causality running from population growth to economic development in India. Simon(1981) suggested that population growth may have had a positive impact on per capita GDP growth in the long-run as a result of improvement of productivity through the contribution of new ideas and learning thereby improving production.

However, some studies have reported that large population size is an impediment to developments. For instance Sinding (2009), Sach (2008) and Headey and Horge (2009) emphasized that as more data become available, rapid population growth exerted a significant negative effect on economic growth in developing countries. Minh (2012) concluded that the effect of population growth on economic growth was linear and negative in all developing countries examined. Kelly (1998) and Kelly &McGreevey (1994) examined the effect of high population growth on economic development and found that it had little or insignificant effect on per capita GDP growth. Thornton(2001) conducted a research on the long-run relationship between population growth and economic development in sevenSouth American countries namely Brazil, Peru, Argentina, Chile, Venezuela, Mexico and Columbia.The findings of the study supported the conclusion reached by Dawson and Taffin (1998) in Columbia that a long run relationship between population and real per capita GDP existed.

The divergence nature of the findings of the various researches on the population growth and economic growth underscores the need to further examine the nature of the relationship existing between the two variables.

3.0 Data and Methodology

The study usedtime-series datacollected from the Central Bank of Nigeria and World Bank Development Indicator from 1970 to 2014. The series upon which data were collected wereGross Domestic Product (used to measure economic growth by percentage)and population (growth rate). Both variables were treated endogenously given the evidence of interdependence between the two variables as established in theory and practice.

3.1 Theoretical Framework

This study adopted the Solow-Swan growth model. Solow's model takes the rate of saving, population growth and technical progress as exogenous. There are two inputs capital and labor which are paid their marginal products. Assuming a Cobb -Douglas production function at time t is given by:

$Y_{(t)} = K_{(t)}^{\alpha}A(t)L_{(t)}^{1-\alpha}$ $0<\alpha<1$……. (i)

Where Y is output, K is capital, L is labor and A is the level of technology.

The initial levels of capital, labor and level of technology are taken as given. Labor and level of technology grow at constant rates:

$L^{*}_{(t)} = nL_{(t)}$……..……..……..……(ii)

$A^{*}_{(t)} = gA_{(t)}$ ……..……..……..……..… (iii)

Where n and g are exogenous parameters and where L* and A* denotes derivatives of labour and technology with respect to time.

Applying the concept that a variable's growth rate equals the rate of change of its log to equations (ii) and (iii) reveals that the rates of change of the logs of *L* and *A*are constant and that they are equal to *n* and *g* respectively. Thus,

$\ln L_{(t)} = \{\ln L(0)\}$……..……..……(iv)

$\text{LnA}_{(t)} = \{\ln A(0)\} + gt$…… …… (v)

Where *L*(0)and *A*(0) are the values of L and A at time 0.Exponentiating both sides of these equations gives:

$L_{(t)} = L(0)e^{nt}$……(vi)

$A_{(t)} = A(0)e^{gt}$……..(vii)

The number of effective units of labor, A(t) L (t), grows at rate *n*+*g*.

The model assumes that a constant fraction of output *s* is invested. Defining *k* as the stock of capital per effective unit of labor, $k = K/AL$, and *y* as the level of output per effective unit of labor, $y=Y/AL$, the evolution of k is governed by;

$\dot{k}_{(t)} = sy_{(t)} - (n+g+\delta)k_{(t)} = sk_{(t)}^{\alpha} - (n+g+\delta)k_{(t)}$……(viii)

Where δ is the rate of depreciation. Equation (8) implies that *k* converges to a steady state value $\dot{k}$ defined by $sk^{\alpha} = (n+g+\delta)\dot{k}$, or

$\dot{k} = [s/(n+g+\delta)]^{1/(1-\alpha)}$…….(ix)

The steady state capital labor ratio is related positively to the rate of saving and negatively to the rate of population growth. The central prediction of the Solow model concerns the impact of saving and population growth on real income. Substituting equation(ix) into the production function as in equation (i) and taking logs we find the steady state income per capita as:

$\ln\left[\frac{Y(t)}{L(t)}\right] = \ln A(0) + gt + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta)$ …… (x)

3.2 Model Specification

Relating the theoretical framework highlighted above to the study i.e to investigate the relationship existing between economic growth and population growth, the model to be adopted can be extracted from equation (x), thus;

$GDPR_t = f(POPR_t)$……..(xi)

Where: $GDPR_t$ is the economic growth rate $POPR_t$ is population growth rate.

Relying on the result of exogeneity test and following Gideon *et al.,* (2013) on the study of the impact of population change on economic growth in Kenya, a bivariate model was adopted;

$$GDPR_t = \alpha_0 + \sum_{i=1}^{k}\alpha_{1i}GDP_{t-i} + \sum_{i=0}^{k}\alpha_{2i}POPR_{t-i} + \varepsilon_{1t} \text{……} \quad \text{(xii)}$$

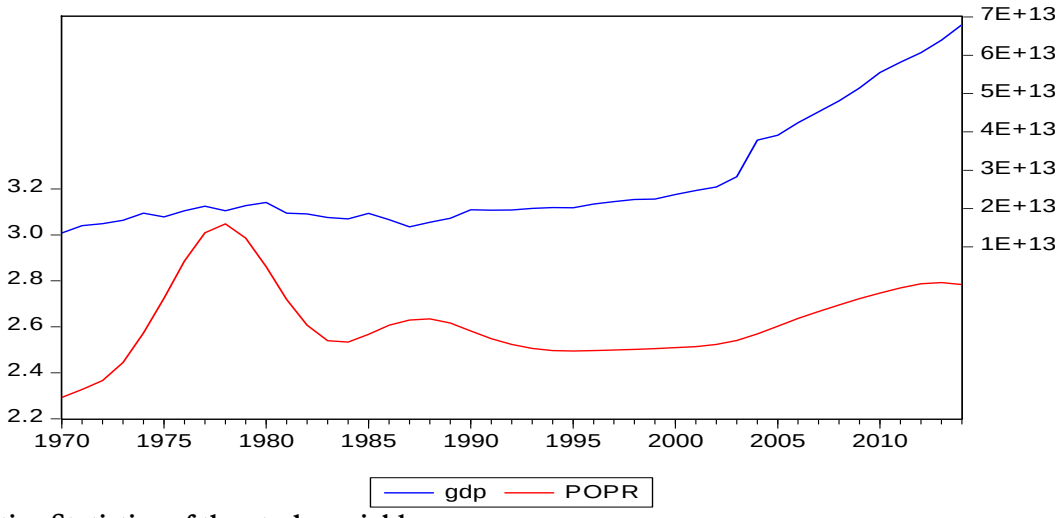
$$POPR_t = \beta_0 + \sum_{i=0}^{k} \beta_{1i} GDP_{t-i} + \sum_{i=1}^{k} \beta_{2i} POPR_{t-i} + \varepsilon_{2t} \ldots\ldots\ldots \text{(xiii)}$$

4.0 Empirical Results

4.1 Trends of GDP and Population Growth in Nigeria from 1970 To 2014

Figure 1 shows the trends in GDP and population growth over time. From the graph, GDP has increased over time while population growth rate increased between 1970 and 1980 but fell sharply afterwards and has been rising slowly afterwards. It might be that the economic boom in the 1970s occasioned by increasing oil revenue propelled the rapid increase in population growth rate in accordance with authors such as Ali *et al.*, (2013), Fumitaka (2010) and Musa (2015) that economic growth may induce population growth. In line with this view, population growth rate decreased noticeably in the 1980s possibly due to the bad shape of the economy at that time. It would be recalled that the period in question was the period when the military ceased power; inflation skyrocketed with massive unemployment and rising exchange rate in Nigeria. In fact, the common slogan at the period was that people should give birth to few children they could cater for.

Fig 1 Trends in GDP and Population Growth 1970-2014



4.2 Descriptive Statistics of the study variables

Table 2 presents the descriptive statistics of the observations of the variables employed for this study. The statistics involve the measure of central tendency and measure of dispersions of the observations. The variables were GDP and population growth

Table 1: Descriptive Statistics

	GDP	POPGR
Mean	2.75E+13	2.622
Mode	2.02E+13	2.582
Maximum	6.80E+13	3.048
Minimum	1.36E+13	2.293
Standard deviation	1.51E+13	0.167
Skewness	1.428	0.666
Kurtosis	3.643	3.330
Jarque-Bera	0.000325	0.171
Probability	0.1945	0.8775
Sum	1.24E+15	117.9913
Sum square deviation	9.99E+27	1.225
No. of observation	45	45

4.3 Tests for Stationarity

It is important to determine the stationarity of the series employed for the study in order to avoid estimating spurious regressions and obtaining invalid results. This further guided in the choice of the type of Vector Autoregressive model (VAR) adopted in studying the dynamics of the relationship that exists between economic growth and population growth. Table 2 shows the results of the unit root test for stationarity of the series. The results in the table revealed that none of the two variables was stationary at level but were only differenced stationary i.e became stationary after first difference. Thus, the VAR model could not be adopted, instead, the Vector Error Correction Model to account for both the short run dynamics and the long run relationships of both variables.

Table 2: Unit Root Test Results

	LevelI(0)			First Difference I(1)			
Variable	**None**	**Constant**	**Constant &trend**	**None**	**Constant**	**Constant& trend**	I(D)
GDP	6.072	4.167	1.410	-0.8653	-4.113***	-5.691***	I(1)
POPGR	0.092	-1.362	-2.634	-4.06***	-3.992***	-5.672***	I(1)

Source: Author's Computation 2016.
,**, imply significant at 10%, 5% and 1% level of significance respectively**

4.4 Co-integration Test

Cointegrating relationship between the two variables was assessed using the Johansen Co-integration technique.As presented in table 3, both the maximum Eigen values and the trace statistic indicated that there was at most one co-integrating relationship between the variables. Given the critical value of 3.841 in both Maximum Eigen and Trace Statistic which is below the critical value indicated that the null hypothesis (that there is at most one co-integrating equation) cannot be rejected at 5% level of significance. This implies that there is long-run relationship between the population and economic growth growth.

Table 3: Results of Cointegration Tests

Trace Test					**Maximum Eigen Value**			
Hypothesis	**Eigenvalue**	**Trace statistic**	**0.05 Critical Value**	**Prob**	**Hypothesis**	**Max-Eigen Staitstic**	**0.05 critical value**	**Prob**
r=0*	0.394	19.2622	15.4947	0.0129*	r=0*	17.0475	14.2646	0.0177
r=1	0.063	2.2147	3.8414	0.1367	r=1	2.2147	3.84146	0.1367

Source: Author's Computation 2016.
*** 5% and 1% level of significance respectively.**

4.5 Vector Error Correction Model

Based on the unit root test and the co-integration test results presented above, it becameimperative to estimate the Vector Error Correction Model, to determine the speed at which the short run relationship existing between the two variables adjuststo the long-run. Results showed that both population growth and GDP growthmodels had error correction coefficient values of -0.06 and -0.357 respectively. Thus, the speed of adjustments of population growth and GDP growthrespectively from their short run joint dynamics to their long run relationship are 6 percent and 35.7 percent, though, the latter was not significant. This implied that in the GDP growth equation, 6 percent of the disequilibrium into the system in the previous year as a result of an external shockis corrected in the current year. By extension, any disequilibrium in economic growth as a result of a major shock in population growth rate is likely to take about 17 years before being corrected or restored back to equilibrium. Furthermore, the result obtained here is consistent with the Granger non causality test whose result is presented in Table 4(using the Toda-YamamotoVAR model).

4.6 Granger Non-Causality Test

Although the Johansen co-integration test revealed that there was long-run relationship between population growth and economic growth, it failed to reveal the direction of causality between the two variables; this necessitated the use of Granger Non-Causality test to determine which of the two variables Granger was causing the other.

The Granger causality test was conducted on the Toda-Yamamoto VAR model estimated whose optimal lag length of four (4) was determined using the Akaike Information Criterion (AIC). Table 4 showed that there was a unidirectional causality between the two variables with causality flowing from population growth to economic growth. The null hypothesis of the test was that a variable does not granger-cause the other.As shown in Table 4, only the null hypothesis that population growth does not granger-cause economic growth at 5% level of significance was rejected. The result obtained here is consistent with findings of several studies such as Ali*et al.*, (2013) in a study covering the period from 1975 to 2008 in Pakistan. Adediran (2012) also examines the relationship between economic growth and population growth in Nigeria between the period of 1980 and 2010 but found a bi-directional relationship. The difference between this study and that of Adediran (2012) may be due to the differences in the period covered by the study i.e 1970 to 2014 in this study compared with 1980 to 2010 in that of Adediran (2012). The larger the sample size the better *ceteris paribus*.

Table 4: Granger Non-Causality Test Result

Null Hypothesis	Chi-Square	P-Value	Decison
Population growth does not granger cause Economic Growth	18.41576*	0.0483	Reject Null
Economic Growth does not granger cause population growth	6.467148	0.7746	Accept Null

Source: Author's Computation 2016.
***Significant at 5 percent (Reject Null Hypothesis)**

4.7 Impulse Response Function

Figure 2 and Table 5 present the responses of each of the endogenous variables to exogenous shocks to it and to the other variable. Both the table and the graph revealed that GDP responded to shocks to it significantly only for a maximum period of two years. Although, a one standard deviation shock causes a positive externality on the subsequent values of GDP for seven out of the ten year lead period considered, the effects were only significant in the second and third year. Population growth was found to be responding significantly only to shock to itself for a maximum period of six years rather than to shocks to GDP. This implies that shock to GDP does not have significant effect on the subsequent values of population growth.

Figure 2: Impulse Responses of Population growth and Economic Growth

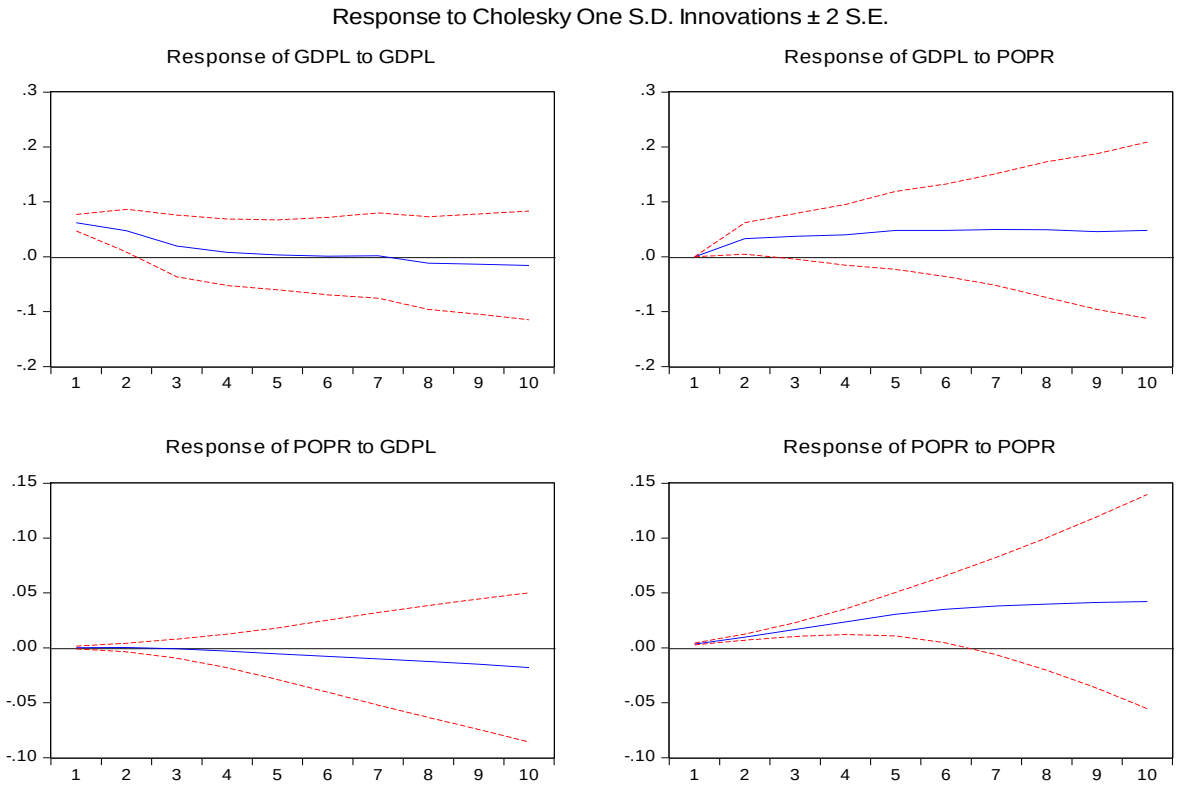


Table 5: Impulse Response Table

	Response of GDP		Response of POPR	
Period	**GDPL**	**POPR**	**GDPL**	**POPR**
1	0.061917***	0.000000	0.000203	0.003495***
2	0.047292**	0.033209**	0.000245	0.009735***
3	0.019579	0.037242*	-0.000809	0.016685***
4	0.007876	0.039855	-0.002896	0.023712***
5	0.003356	0.047925	-0.005447	0.030639***
6	0.001100	0.048031	-0.007696	0.035130*
7	0.001859	0.049430	-0.010075	0.038020
8	-0.011717	0.049181	-0.012488	0.039898
9	-0.013620	0.045892	-0.014982	0.041335
10	-0.015958	0.048058	-0.017915	0.042115

Source: Authors' Computation 2016.
, **, imply significant at 10%, 5% and 1% level of significance respectively.**

4.8Variance Decomposition

Variance Decomposition using Cholesky variable ordering shows that though initial variance of GDP growth rate was mostly explained by GDP, the proportion of future variance of GDP accounted for by population growth continued to increase. This implied that the proportion of variance of GDP explained/attributed to variances in population growth became larger and larger. Furthermore, population growth has more significant effect on the future value of GDP. Table 6 revealed that for about 6 years over 40% of variations in the Values of GDP were explained by its current variance while a significant proportion of its variation from the fifth year were explained by the variance of population growth rate. It was also revealed that variance in population growth in the ten subsequent years were significantly explained by population growth itself as over 90% could be link to it within the ten year lead period considered.

Table 6: Forecast Error Variance Decomposition Table

	Error Variance Decomposition of GDPL		Error Variance Decomposition of POPR	
Periods	GDPL	POPR	GDPL	POPR
1	100.0000***	0.000000	0.337603	99.66240***
2	84.62492***	15.37508	0.094629	99.90537***
3	72.15995***	27.84005	0.195696	99.80430***
4	61.50347***	38.49653	0.955751	99.04425***
5	50.58830**	49.41170**	2.016176	97.98382***
6	42.91916*	57.08084**	3.046267	96.95373***
7	36.99134	63.00866***	4.187546	95.81245***
8	32.99278	67.00722***	5.458032	94.54197***
9	30.45757	69.54243***	6.866257	93.13374***
10	28.35796	71.64204***	8.546531	91.45347***

Source: Authors' Computation, 2016
,**, imply significant at 10%, 5% and 1% levels of respectively**

5.0 Conclusion and Recommendations

From the major findings in this study, it can be concluded that there is a dynamic relationship between population growth and economic growth in Nigeria. The effects of population on GDP may result from a labor induced population growth (i.e. a population growth which leads to increase in labor supply) as well as continuous increase in capital stock.

Hence, as population grows, it is assumed that labour supply increased considerably (given the nature of the Nigeria economy) and/or investment grows more than proportionately and this translates into meaningful growth. This is as a result of the fact that the Nigeria's economy and indeed most production processes are labour intensive.Governments at various levels are advised to focus on adequate labour supply, skill and productivity to generate meaningful economic growth in Nigeria and this can be achieved through improvement in education, initiation of efficient training programmes as well as appropriate skill acquisition programmes. Furthermore, population growth should be controlled in a way that high dependency ratio is avoided. In other words, the pattern of population growth should be one which allows for expansion in labour supply only (i.e. labor induced population growth).

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