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Population age structure and the development of the Nigerian economy: An empirical analysis

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Abstract
The growth rate and other demographic properties of the population have the tendency to affect the development of a country. This study examined the impact of population age structure on the development of the Nigerian economy. In specific terms, the study investigated the impact of children population, labour force or active population, aged population and life expectancy on two indicators of economic development namely; standard of living and capital formation. Annual time series data for the period 1981 to 2020 were used for the study. The analytical techniques used for the study include the Phillips-Perron unit root test, the autoregressive distributed lag (ARDL) model, and the Granger causality test. The findings indicated that children population strongly reduces the standard of living and insignificantly reduces the rate of capital formation. Labour force significantly contributes to the improvement in the standard of living but makes insignificant positive contribution to the rate of capital formation. Also, Aged population insignificantly deteriorates the standard of living while it makes insignificant positive contribution to capital formation in Nigeria. Life expectancy makes strong contribution to the improvement in the standard of living while it makes insignificant positive contribution to capital formation. The Granger causality tests indicated the following unidirectional causalities: from standard of living to life expectancy; from labour force to capital formation; and from life expectancy to capital formation. It is recommended, among things, that, to reduce the growth rate of the population, government should embark on public enlightenment campaign to educate the people on the need to have fewer number of children.

Keywords: population, age, structure, development

Introduction

The role of population in the development process has been a subject of controversy among scholars. There are two opposing perspectives in this regard. These are the population pessimists and the population optimists. The population pessimists are of the view that population growth is a real problem to development. They argue that high rate of population growth is responsible for the high level of poverty, malnutrition, low standard of living and other social problems in the less developed countries. The population pessimists also assert that rapid population growth exerts a heavy dependency burden on the active population. This reduces their ability to save and accumulate the necessary capital needed for economic growth and development. High population growth rate also results in high level of unemployment (Wilson, 2002) [22].

On the other hand, the population optimists argue that a large population implies enormous human resources which is key to economic growth and development. This argument stems from the fact that every other resources required for economic growth and development are passive and are therefore only driven by the availability of human resources (Yesufu, 2000) [23]. The population optimists further argue that rapid population growth is not real cause of under development among the less developed countries. They argue that the distorted or lopsided geographical distribution of population and resources across the world is the real problem. For instance, they contend that the developed countries that constitute only about one-quarter of the world population consume about 80 percent of the world resources while the developing countries that constitute about three-quarter of the world population only consume the remaining 20 percent of the world resources (Wilson, 2002) [22]. The implication therefore, is that, if the world resources were to be equitably distributed based on spatial population distribution, rapid population growth would not constitute any problem to economic development of any region.

Nigeria is known tohave a rapidly growing population. With an estimated population of about 200 million persons and an annual growth rate of about 2.9 per cent, it is the most populous country in Africa and among the top ten most populous countries in the world. The composition of the population shows that it is mainly youthful with 41 percent being children of age 0-14 years and a dependency ratio estimated at 76 percent (Alimi *et al*, 2021) [5]. Given the above demographic characteristics, one may be tempted to assert that demographic factors are largely responsible for the dismal performance of the Nigerian economy in recent times. However, it is only through empirical analysis that such a claim can be substantiated.

Nevertheless, there is no consensus in the empirical findings on the relationship between population growth and economic development in Nigeria. Thus, while some studies established positive relationship between population growth and economic growth and development, others found negative impact of population growth on economic growth and development. For instance, Esu & Udonwa (2016) [10], Akinbode *et al* (2017) [4], Peter & Bakari (2018) [20], Efuntade & Efuntade (2020) [8], Alimi *et al* (2021) [5], etc. found positive impact of population growth on indicators of economic development. On the other hand, Onwuka (2006) [18], Olanipekun & Akeju (2017) [16], Adenola & Saibu (2017) [1], Egbolonu & Dim (2018) [9], Young (2018) [24], Ebingba *et al* (2019) [7], Maijama *et al* (2019) [12], etc. established negative impact of population growth on indicators of economic development in Nigeria.

From the fore-going discussion, there is no clear conclusion on the impact of population growth on the development of the Nigerian economy. It is against this backdrop that this study investigates the impact of population age structure on economic development in Nigeria.

Conceptual Clarifications and Literature Review

Conceptual clarifications

Population age structure

In economic parlance, population simply refers to the number of persons living in a particular geographical area at a given point in time. Population age structure refers to the percentage change in the age distribution of the population over a period of one year. For the purpose of this study, the population age structure in Nigeria include children population within the age corhort 0-14 years, active or working population within the age 15-60 years, and aged population within the ages of above sixty years.

Economic development

Todaro and Smith (2011) [21] define economic development as "a process involving major changes in the social structures, popular attitudes, and national institutions, as well as the acceleration of economic growth, the reduction of inequality and the eradication of poverty".

Though there are several indicators that can be used to measure economic development, for the purpose of this study, economic development is measured in terms of two important indicators of development namely; standard of living and capital formation.

The standard of living refers to the level of income, necessities, luxury and other goods and services that are readily available to an average person in a given society. Per capita income is the most common parameter used in measuring standard of living. For the purpose of this study, per capita income is measured in terms of real gross domestic product per capita which is defined as the inflation adjusted final output of goods and services produced within Nigeria divided by the total population.

Capital formation or capital accumulation refers to the process by which a society saves part of its currently produced resources for the production of capital goods and services in the future (Wilson, 2002) [22]. For the purpose of this study, capital formation is proxied by gross fixed capital formation which is defined as the amount of produced assets including the production of such assets by resident producers for their own use, less disposals in fixed assets in a given year.

Theoretical literature review

Several theories have been put forward to explain the effect of population growth on the economy. One of the earliest thesis of population was written by the Reverend Thomas Robert Malthus (1766-1834) in 1798 and later modified in 1803 (Olufin, 1996) [17]. According to Malthus, if the growth rate of the population is not adequately checked, it would eventually outrun its means of sustenance (i.e., food production). This would adversely affect the standard of living of the people (Anyanwoucha, 2006). Another theory of population is the theory of demographic transition, also called the theory of population stages or the theory of population cycle. The theory has three versions. For instance, W.S. Thomson and F.W. Notestein presented the theory in three stages, Karl Sax's version has four stages while C.P. Blacker's version has five stages (Jhingan, 2016) [11]. The theory which is based on the actual demographic trends of the developed nations of world states that, every country passes through different stages of demographic development. The theory therefore explains the effects of changes in the birth and death rates on the growth rate of the population. According to the Blacker's version, the five stages of demographic transition include: the high stationary stage, the early expanding stage, the late expanding stage, the lower stationary stage, and the declining stage (Jhingan, 2016) [11]. The theoretical basis for this study is the optimum theory of population. The optimum theory of population which was propounded by Edwin Cannan in 1924, has been popularized by Robbins, Dalton and Carr-Saunders (Overbeek, 1977) [19]. The optimum theory of population also called the modern theory of population states that, given the natural resources, stock of capital and the existing state of technology, there is a definite size of the population that gives the highest per capita income. This unique population is known as optimum population (Zimmermann, 1989) [25].

Empirical literature review

Onwuka (2006) [18] established that population adversely affects the development of the Nigerian economy. Olabiyi (2014) [15] found out that aged population has negative effect on economic growth while children population and labour force have positive effects on economic growth in Nigeria. Akeju (2016) studied the

effects of population age structure on household savings in Nigeria and found out that high dependency ration retards savings. Esu and Udonwa (1026) showed that population growth has positive impact on economic growth in Nigeria. Akinbode *et al* (2017) [4] established unidirectional causality from population growth rate to GDP growth rate in Nigeria. Olanipekun and Akeju (2017) [16] found that young age dependency rate and working population have negative effects on savings in six ECOWAS countries. Adenola and Saibu (2017) [1] established that population growth has insignificant negative effect on real GDP in Nigeria. Peter and Bakari (2018) [20] found that population growth has positive impact on economic growth while fertility rate has negative impact on economic growth in Nigeria.

Egbolonu and Dim (2018) [9] observed that population growth has significant and insignificant negative impact on industrial output in the long-run and short-run respectively. Also, life expectancy has insignificant positive impact on industrial output both in the long-run and short-run while labour force has insignificant negative effect on industrial output both in the long-run and short-run in Nigeria. Young (2018) [24] established negative relationship between population ageing and per capita real GDP growth rate in Nigeria. Similarly, Ogbuabor *et al* (2018) [13] found that population growth has long-run negative impact on the growth rate of per capita GDP in Nigeria.

Ogunjimi and Oladipupo (2019) [14] observed that aged population has significant negative impact on real GDP; children population has significant positive impact on real GDP while labour force has insignificant positive impact on real GDP in Nigeria for the period 1981 to 2016. Ebingba *et al* (2019) [7] established significant positive impact of population growth on education and health services in Cross Rivers State Nigeria. Maijama *et al* (2019) [12] showed that population significantly aggravates unemployment in Nigeria. Efuntade and Efuntade (2020) [8] observed that fertility rate and international migration have significant effect on GDP while mortality rate has significant negative impact on GDP in Nigeria. Alimi *et al* (2021) [5] found that population growth has significant positive effect on growth rate of real GDP and GDP per capita in Nigeria. Adeosun and Popogbe (2021) [2] established that population growth has significant positive impact on employment rate in the long-run and significant negative impact on employment rate in the short-run in Nigeria.

From the empirical literature reviewed, it is observed that there is no consensus in the empirical findings of previous studies on the impact of population growth on the Nigerian economy. For instance, Esu and Udonw (2016) [10], Akinbode *et al* (2017) [4], Peter and Bakari (2018) [20], Efuntade and Efuntade (2020) [8], Adeosun and Popogbe (2021) [2], Alimi *et al* (2021) [5], etc. Found positive impact of population growth on the Nigerian economy. On the other hand, Onwuka (2006) [18], Olanipekun and Akeju (2017) [16], Adenola and Saibu (2017) [1], Egbolonu and Dim (2018) [9], Young (2018) [24], Ogbuabor *et al* (2018) [13], Ebingba *et al* (2019) [7], etc, showed that population growth negatively affects the economy.

It is also observed from the empirical literature that only Olabiyi (2014) [15], Akeju (2016) [3] and Ogunnjimi and Oladipupo (2019) [14] that disaggregated the total population into children, working and aged population corhorts. However, in the case of Olabiyi (2014) [15], the data period covered 1981 to 2013. From 2013 to 2020, several changes must have taken place in the size of the variables used for the study. Besides, the study measured economic growth in terms of GDP. Similarly, for Akeju (2016) [3], the data period is from 1980 to 2013 while the impact of population is examined on savings. For Ogunjimi and Oladipupo (2019) [14], economic growth is measured in terms of real GDP.

Furthermore, apart from Ogbuabor *et al* (2018) [13] and Alimi *et al* (2021) [5], none of the studies reviewed measured economic growth in terms of per capita real gross domestic product. However, in the case Ogbuabor *et al* (2018) [13], the study used the growth rate of per capital Real GDP instead of the nominal values of the variable. Besides, Ogbuabor *et al* (2018) [13] and Alimi *et al* (2021) [5] did not disaggregate the total population based on the age structure.

Finally, none of the studies conducted in Nigeria examined the impact of population age structure on capita formation in Nigeria. To fill the gaps identified above, the present study examined the impact of children population, working population, aged population and life expectancy on two indicators of economic development namely; standard of living (proxied by per capita real GDP) and capital formation in Nigeria

Methodology

Variables of the study

1. **Dependent variables:** The dependent variables used for this study are standard of living and capital formation. Standard of living is proxied by per capita income measured in terms of per capita real gross domestic product. Capital formation is proxied by gross fixed capita formation. Per capita real GDP is measured in millions of naira while gross fixed capital formation is measured in billions of naira.
2. **Explanatory variables:** The explanatory variables for this study are as follows:

a. **Children population:** This refers to the percentage of the total population that falls within the age bracket 0-14 years.

b. **Labour force:** This is the active or working population. It refers to the percentage of the total population that falls within the age corhort 15-60 years.

c. **Aged population:** This is the percentage of the total population that are above 60 years

d. **Life expectancy at birth:** This is the number of years a new born infant would live if prevailing pattern of mortality rate at birth remains the same throughout its life. Life expectancy was used as a control variable.

Models specification

The models used for this study are specified based on the theory of optimum population and the analytical model used by Ogunjimi and Oladipupo (2017) which is expressed as follows:

RGDP = f (GFCF, CPOP, LABF, APOP, SSE)……. (1)

Where RGDP = Real Gross Domestic Product (a proxy for economic growth),
GFCF = Gross Fixed Capital formation (a proxy for physical capital)
CPOP = Children Population,
LABF = Labor Force;
APOP = Aged Population, and
SSE = Secondary School Enrolment

The adopted model was however slightly adjusted so as to allow the inclusion of the variables of the present study. The models used for this study are therefore specified as follows:

Model 1: Standard of living model

The functional form of the model is specified as follows:

PCRGDP = F (CP, LBF, AP, LEX---------- (2)

Where PCRGDP =Per Capita real Gross Domestic Product (a proxy for standard of living);
CP = Children Population;
LBF = Labour Force;
AP = Aged Population;
LEX = Life Expectancy at Birth; and
F = functionality Notation

PCRGDP is the dependent variable while CP, LBF, AP, and LEX are the explanatory variables. LEX was introduced as a control variable.

The ordinary least squares (OLS) multiple regression equation based on the above functional model is specified as follows:

$PCRGDP = a_o + a_1 CP + a_2 LBF + a_3 AP + a_4 LEX + U$---------- (3)

Where $a_o$is the intercept term, $a_{1,}$ a_2, a_3, and a_4 are the coefficients of the explanatory variables, and U is random variable. All other variables are as earlier defined. Transforming equation (3) into logarithmic form, we have:

$PCRGDP = a_o + a_1 LCP + a_2 LLBF + a_3 LAP + a_4 LLEX + U$---------- (4)

Where L is the natural logarithm of the variables where applicable.

Model 2: Capital formation model

The mathematical form of the model is expressed as follows:

GFCF = f (CP, LBF, AP, LEX)---------- (5)

Where GFCF = Gross Fixed Capital Formation (a proxy for capital formation). GFCF is the dependent variable while CP, LBF, AP and LEX are the explanatory variables. All other variables are as earlier defined.

The OLS multiple regression equation based on the above mathematical model is specified as follows:

$GCFC = \beta_o + :\beta_1 LCP + \beta_2 LLBF + \beta_3 LAP + \beta_4 LLEX + €$---------- (6)

Where β_o is the regression constant, $\beta_{1,}$ $\beta_{2,}\beta_3$, and β_4 are the coefficient of the explanatory variables while E is the error term. All other variables are as earlier defined.

A logarithmic transformation of equation (6) gives the following equation:

$LGFCF = \beta_o + :\beta_1 LCP + \beta_2 LLBF + \beta_3 LAP + \beta_4 LLEX + €$---------- (7)

Where L is the natural logarithm of the variables. All other variables are as earlier defined

Apriori theoretical expectations

Based on a priori reasoning, we expect the following signs of the coefficients of the explanatory variables.

Model 1: $PCRGDP = a_o + a_1 LCP + a_2 LLBF + a_3 LAP + a_4 LLEX + U$ ($a, < o, a_2 > o, a_3 < o, a_4 > o$)

Model 2: $LGFCF + \beta_o + :\beta_1 LCP + \beta_2 LLBF + \beta_3 LAP + \beta_4 LLEX + \epsilon$ $\beta_1 < 0$, $\beta_2 > 0$, $\beta_3 < 0$ $\beta_4 > 0$)

The implication of the above signs of the parameter estimates is that we expect children and aged population tohave negative relationship with each of the dependent variables while we expect labour force and life expectancy to have positive relationship with the dependent variables.

Nature and sources of data

This study made use of annual time-series data from 1981 to 2020. The data were obtained from secondary sources such as the Central Bank of Nigeria annual statistical bulletin for 2020, the Central Ban of Nigeria annual reports and statements of account (various years), and the World Bank Development indicators (various years).

Techniques of data estimation

Since the study made use of time-series data, the analytical procedure was preceded with stationarity test to determine the unit root properties of the time-series data. The Phillips-Perron unit root test was used in conducting the stationarity test. Based on the result of the unit root test, the autoregressive distributed lag (ARDL) bounds test for cointegration was used in examining the long-run behavior of the variables. The error correction mechanism (ECM) was used in modeling the short-run dynamic behavior of the variables while the Granger causality test was used to determine the nature of causality that exist between the variables.

Presentation of Results and Discussion of Findings

Presentation of results

Descriptive statistics

The result of the descriptive statistics is presented in table 1.

Table 1: Descriptive statistics result

Variable	PCRGDP	LGFCF	LCP	LLBF	LAP	LLEX
Mean	0.269018	8459.079	44.19875	53.03525	2.843000	48.62500
Median	0.239700	8206.830	44.04500	53.21500	2.805000	47.00000
Maximum	0.385400	15789.70	45.15000	53.70000	5.830000	55.00000
Minimum	0.199000	712.1800	43.54000	51.98000	2.100000	46.00000
Std. Dev.	0.067649	2352.810	0.513401	0.566211	0.508034	3.183994
Skewness	0.508879	0.023261	0.491597	-0.586663	5.153561	0.757746
Kurtosis	1.608219	6.236034	1.912643	1.902077	31.588828	2.027482
Jarque-Bera	4.954809	17.45680	3.581689	4.303545	1539.211	5.404182
Probability	0.083961	0.000162	0.166819	0.116278	0.000000	0.67065
Sum	10.76070	338363.1	1767.950	2121.410	113.7200	1945.000
Sum Sq.Dev.	0.178477	2.16E+08	10.27964	12.50320	10.06584	395.3750
Observations	40	40	40	40	40	40

Source: Computed from E-view.

From the descriptive statistics result in table 1, the mean valuesof the variables are 0.269018, 8459.079, 44.19875, 53.03525, 2.843000 and 48.62500 for PCRGDP, LGFCF, LCP, LLBF, LAP and LLEX respectively. The standard deviation statistic shows that LGFCF with a standard deviation value of 2352.810 is the most unstable variable while PCRGDP with a standard deviation value of 0.067649 is the least unstable (most stable) variable. The skewness statistic shows that PCRGDP, LGFCF, LCP, LAP and LLEX are positively skewed while LLBF is negatively skewed. The kurtosis statistic indicated that PCRGDP, LCP, LLBF and LLEX are platykurtic (i.e., their values less than 3). This means that their distribution have lighter tails relative to normal distribution. On the other hand, LGFCF and LAP are Leptokurtic (i.e, their values greater than 3). This suggests that their distributions have heavier tails relative to normal distribution.

Unit root test result

The result of the Phillips-Perron unit root test is presented in table 2.

Table 2: Phillips-Perron unit root test result

Variable	Phillips-Perron Test Statistic (At Levels)	1% Critical Value	5% Critical Value	Phillips-Perron Test Statistic (At 1st Diff)	1% Critical Value	5% Critical value	Order of integration
PCRGDP	-0.502538	-3.610453	-2.938987	-3.469143**	-3.615588	-2.941145	I(1)
LGFCF	-1.197663	-3.610453	-2.938987	-7.806523*	-3.615588	-2.941145	I(1)
LCP	-1.254115	-3.610453	-2.938987	-3.820300*	-3.615588	-2.941145	I(1)
LLBF	-1.147591	-3.610453	-2.938987	-2.989324**	-3.615588	-2.941145	I(1)
LAP	-5.568867*	-3.610453	-2.938987				I(0)
LLEX	0.903486	-3.610453	-2.9389887	-6.517962*	-3.615588	-2.941145	I(1)

Source: Computed from E- View

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

From the unit root test result in table 2, Aged population (LAP) is stationary at levels at the 1% level of significance while [i.e. I (o)] per capita real GDP (PCRGDP), Gross fixed capital formation (LGFCF), children population (LCP), labour force (LLBF) and life expectancy (LLEX) are stationary at first difference [i.e. I (I)] at the 5%, 1%, 1%, 5% and 1% levels of significance respectively.

The results of the ARDL bounds test for cointegration for the two models are presented in tables 3 and 4.

Table 3: ARDL bounds test result for the standard of living model

F- Bounds Test Null Hypothesis: No Long-Run Relationship				
Test Statistic	**Value**	**Significance**	**I(0)**	**I(1)**
F- statistics	3.861209	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Source: Computed from E-View

Table 4: ARDL bounds test result for the capital formation model

F- Bounds Test	**Null Hypothesis: No long-run relationship**			
Test statistic	**Value**	**Significance**	**I(0)**	**I(1)**
F- statistics	3.861209	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Source: Computed from E-View

From the ARDL bounds tests results in table 3 and 4, the computed F-Statistics of 3,861209 and 3.967112 for the standard of living and capital formation models respectively are greater than the upper bound critical value of 3.49, at the 5% level of significance. The null hypotheses of no long-run relationships are therefore rejected and we conclude that there exist long-run (equilibrium) relationships in the two models.

Estimated long-Run regression results

The ARDL estimated long-run regression results for the two models are presented in tables5 and 6.

Table 5: Estimated long-Run regression result for the standard of living model.

Levels equation				
Case 2: Restricted constant and no trend				
Variable	**Coefficient**	**Std. Error**	**t-statistic**	**Prob.**
LCP	-0.151688	0.037015	-4.098064	0.0003
LLBF	0.136083	0.033152	4.104822	0.0003
LAP	-0.00630	0.006858	-0.879340	0.3867
LLEX	0.024478	0.001576	15.53017	0.0000
C	13.01982	3.332553	3.906859	0.0005
EC = PCRGDP –(-0.1517*LCP + 0.1361* LLBF-0.0060* LAP + 0.0245* LLEX + 13.0198)				

Source: Computed from E-View

Table 6: Estimated Long-Run Regression Result for the Capital Formation Model

Levels Equation				
Case 2: Restricted constant and no trend				
Variable	**Coefficient**	**Std. Error**	**t-statistic**	**Prob.**
LCP	-898.0697	20309.99	-0.044218	0.9652
LLBF	238.1956	19585.44	0.012162	0.9904
LAP	1172.914	1314.886	0.892027	0.3848
LLEX	468.4369	335.0860	1.397960	0.1801
C	34656.14	1922406.	0.018027	0.9859
EC = GFCF –(-898.0697* LCP + 238.1956* LLBF +1172.9140* LAP + 468.4369* LLEX + 34656.1397)				

Source: Computed from E–View

Estimated short-run regression results

The estimated short-run (ECM) regression results for the standard of living and capital formation models are presented in tables 7 and 8 respectively.

Table 7: Estimated short-run regression result for the standard of living model

ECM Regression Case 2: Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-statistic**	**Prob.**
D(PCRGDP (-I)	0.614721	0.110627	5.556716	0.0000
D(LLBF)	0.035112	0.016088	2.182478	0.0376
D(LLBF (-I)	-0.049164	0.016359	-3005282	0.0055
d(llex)	0.002776	0.002669	1.039925	0.3073
CointEq (-1)	-0.448403	0.085813	-5.225348	0.0000
R-squared	0.614721	Mean dependent var		0.002782
Adjusted R-squared	0.571971	S.D dependent var		0.011415
S.E. of regression	0.007468	Akaike info criterion		-6.834222
Sum squared resid.	0.001841	Schwarz		-6.618750
Log likelihood	134.8502	Hannan-Quinn criter		-6.757558
Durbin- Watson stat	2.323204			.

Source: Computed from E-View

From the short-run result in table 7, the coefficient of the error correction variable turned up with the correct negative sign and it is also statistically significant at the 0.05 level of significance. With a coefficient of-0.448403, the implication is that about 44 per cent of any disequilibrium in the short-run is reconciled to long-run equilibrium trend of standard of living within one year.

Table 8: Estimated short-run regression result for the capital formation model

ECM Regression Case 2: Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-statistic**	**Prob.**
D(LGFCF(-I)	0,244089	0.188415	1.295488	0.2125
D(Lgfcf (-2)	0.052837	0.134328	0.393345	0.6990
D(LCP)	6384.841	6326.630	1.009201	0.3270
D(LCP(-1)	846.6006	8426.156	0.100473	0.9211
D(LCP(-2)	-10301.80	9617.516	-1.071150	0.2991
D(LLBF)	-17.15523	6800.968	-0.01463	0.9918
D(LLBF (-2)	-1.0624.21	8149.116	-1.303717	0.2097
D(LAP)	495.3254	455.3446	1.087803	0.2919
D(LAP(-1)	-399.6568	683.9836	-0.584308	0.5667
D(LAP(-2)	-582.4375	616.9563	-0.944050	0.3584
D(LLEX)	59.86427	638.7680	0.093718	0.9264
D(LLEX(-1)	-705.8795	593.7217	-1.188906	0.2508
D(LLEX(-2)	-919.6163	841.0323	-1.093438	0.2895
CointEq(-1)	-0.202984	0.250628	-4.799870	0.0002
R-squared	0.655095	Mean dependent var		10.35162
Adjusted R-squared	0.435610	S.D dependent var		1972.140
S.E. of regression	1481.588	Akaike info criterion		17.73055
Sum squared resid	48292277	Schwarz Criterion		18.38363
Log likelihood	-313.0152	Hannan-Quinn criter		17.96079
Durbin- Watsonstat	2.121685			.

Source: Computed from E-View

From the short-run result in table 8, the coefficient of the error correction variable turned up with the correct negative sign and it is also significant at the 0.05 significance level. The coefficient of the error correction term is-0.202984. This implies a speed of adjustment of about 20 percent of any disequilibrium in the short-run to long-run (stable) equilibrium of capital formation model within one year in the current period.

Granger causality test results

The results of the pairwise Granger Causality tests for the standard of living and capital formation models are presented in tables 9 and 10 respectively.

Table 9: Pairwise granger causality test result for the standard of living model lags: 2

Null Hypothesis	**Obs**	**F-Statistic**	**Prob.**
LCP does not Granger cause PCRGDP PCRGDP does not Granger Cause LCP	38	1.63138 0.84314	0.2110 0.4394
LAPdoes not Granger cause PCRGDP PCRGDP does not Granger cause LAP	38	0.09813 2.04890	0.9068 0.1450
LLBF does not Granger cause PCRGDP PCRGDP does not Granger cause LLBF	38	1.16163 0.00394	0.3254 0.9961

LLEX does not Granger cause PCRGDP PCRGDPdoes not Granger cause LLEX	38	2.25864 5.52059	0.1204 0.0085

Source: Computed from E-view

Table 10: Pairwise granger causality result for the capital formation model

Null Hypothesis	Obs	F-Statistic	Prob.
LCP does not Granger cause LGFCF LGFCF does not Granger Cause LCP	38	1.2.67779 1.51714	0.0836 0.2342
LAP does not Granger cause LGFCF LGFCF does not Granger cause LAP	38	0.90012 0.38092	0,4163 0.6862
LLBF does not Granger cause LGFCF LGFCF does not Granger cause LLBF	38	3.54357 0.50670	0.0404 0.6071
LLEX does not Granger cause LGFCF LGFCF does not Granger cause LLEX	38	6.80072 0.08019	0.0034 0.9231

Source: Computed from E-view

Post-estimation tests results

The results and decisions of the post-estimation tests for the two models are presented in tables 11

Table 11: Post estimation tests results

Test for standard of living model	Value	Prob.	Decision
Linearity (Ramsey-Reset) Test t-statistic F-statistic	0.123021 0.015134	0.9030 0.9030	Accept (Model Correctly specified)
Breusch-Godfrey Serial correlation LM Test F-Statistic	1.67337	0.2072	Accept (No autocorrelation)
Heteroscedasticity (Breusch-Pagan-Godfrey) Test F-Statistic	0.521901	0.8461	Accept (Residuals have constant variance)
Normality (Jarque-Bera)Test F-statistic	1.503739	0.486772	Accept (Data normally distributed)
Tests for capital Formation Model	Value	Prob.	Decision
Linearity (Ramsey-Reset) Test t-statistic F-statistic	1.323326 1.732875	0.2463 0.2463	Accept (Model Correctly specified)
Breusch-Godfrey Serial correlation LM Test F-Statistic	1.896663	0.1754	Accept (No autocorrelation)
Heteroscedasticity (Breusch-Pagan-Godfrey) Test F-Statistic	1.773864	0.1533	Accept (Residuals have constant variance)
Normality (Jarque-Bera)Test F-statistic	1.71558	0.447432	Accept (Data normally distributed)

Source: Computed from E-view

Discussion of Findings

The results of the data analysis are discussed in detail in this section

Model 1

1. Standard of living model

The ARDL bounds test result for cointegration indicated the presence of long-run (equilibrium) relationship among the variables in the model

2. Estimated long-run regression result

The estimated long-run model of standard of living shows that children population has significant negative impact on per capita real GDP (i.e., standard of living). Labour force and life expectancy have significant positive effects on the standard of living while aged population has insignificant negative impact on standard of living in Nigeria.

3. Estimated short-run regression result

The ECM regression result for the standard of living model shows that per capita real GDP lagged by one period has significant positive impact on per capita real GDP (i.e., standard of living) in the current period. Labour force in the current period has significant positive impact on standard of living while it's lagged value in period one has significant negative impact on standard of living. Life expectancy in the current period has insignificant positive impact on the standard of living. The coefficient of multiple determination (R-squared) is 0.614721.

This implies that the explanatory variables jointly accounted for about 61 percent of the total variations in the dependent variable. The adjusted R-squared is O.571971. This implies that additional explainable variables are introduced into the model, the R-squared will reduce to about 57 percent. The Durbin-Watrson statistics is 2.323204. This means that the model is not affected by the problem of autocorrelation.

4. Granger causality test result

The pairwise Granger causality test result for the standard of living model indicated a unidirectional causality from standard of living to life expectancy while no causality was observed between the rest of the explanatory variables and standard of living.

Model 2

1. Capital formation model

The ARDL bounds test approach to cointegration indicated that there exists long-run relationship among the variables of the model

2. Estimated long-run regression result

The estimated long-run regression result for the capital formation model shows that children population has insignificant negative impact on capital formation. On the other hand, labour force, aged population and life expectancy have insignificant positive impact on capital formation.

3. Estimated short-run regression result

The estimated short-run regression result indicated that lagged values of gross fixed capital formation in periods one and two have insignificant positive impact on the gross fixed capital formation in the current period. Children population in the current period and its value lagged by one period have insignificant positive impact on capital formation while its value in period 2 has insignificant negative impact on capital formation. Labour force in the current period and its lagged value in period two have significant negative impact on capital formation while its lagged value in period one has insignificant positive impact on capital formation. Aged population in the current period has insignificant positive impact on capital formation while its lagged values in periods 1 and 2 have insignificant negative impact on capital formation. Similarly, life expectancy in the current period has insignificant positive impact on capital formation while it's lagged values in periods one and two have insignificant negative impact on capital formation.

The coefficient of multiple determination (R-square) is 0.655095. This means that about 65 percent of the total variations in the dependent variable can be attributed to the joint influence of the explanatory variables. The adjusted R-squared is 0.435610. The implication is that if additional explanatory variables are introduced into the model, the R-squared will decrease to about 43 percent. The Durbin-Watson statistics is 2.121685 indicating that the model is not affected by the problem of autocorrelation.

4. Granger causality test result

The result of the pairwise Granger causality test for the capital formation model indicated unidirectional causality from labour force to gross fixed capital formation and from life expectancy to gross fixed capital formation. The result showed no causality between children population and gross fixed capital formation and between aged population and gross fixed capital formation.

Conclusions and Recommendations

Conclusions

Based on the findings from the study, the following conclusions are drawn.

1. Children population strongly reduces the standard of living in Nigeria.
2. Labour force significantly contributes to the improvement of the standard of living in Nigeria.
3. Aged population insignificant reduces the standard of living in Nigeria.
4. Life expectancy strongly contributes to the improvement of standard of living in Nigeria.
5. Children population insignificantly reduces the rate of capital formation in Nigeria.
6. Labour force makes weak positive contribution to capital formation in Nigeria.
7. Aged population makes insignificant positive contribution to capital formation in Nigeria.
8. Life expectancy insignificantly increases the rate of capital formation in Nigeria.

Recommendations

Based on the conclusions drawn from the study, the following policy measures are recommended.

1. To reduce the birth rate and the growth rate of the population, governments at all levels should embark on public enlightenment campaigns to educate the people on the need to have fewer number of children. To this end, modern family planning techniques and facilities should be made available to the people especially, through the primary healthcare centres across the country.
2. To improve the contribution of the labour force or active population to standard of living and capital formation, policies and programmes that will create employment opportunities for the youth should be implemented.

3. To reduce the burden of the dependent population on the active population, health care provisions for children and the elderly should be subsidized by the government. Also, primary and secondary education should be made free while tertiary education should be subsidized
4. The country's population policy should be revised and updated to reflect current demographic realities in the country.

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