MIZORAM UNIVERSITY JOURNAL OF HUMANITIES & SOCIAL SCIENCES
A Refereed Bi-annual Journal
ISSN(P): 2395-7352
eISSN: 2581-6780
Vol. X, Issue 1 (June 2024) http://www.mzuhssjournal.in/

Lead Article

Population Growth and Economic Growth Nexus: Empirical Analysis from Six Populated Countries in Africa

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Abstract

The study investigates the nexus between population growth and economic growth using six countries (Nigeria, Ethiopia, Egypt, Tanzania, DRC and South Africa) with the largest population in Africa. The panel data span through the period 2001 to 2019. The selected variables include per capita gross domestic product (a proxy for economic growth), total population, life expectancy, fertility rate, crude death rate and gross fixed capital formation. The data was analyzed using ARDL long-run and short-run estimates, and Dumitrescu Hurlin causality technique. The finding from the ARDL predicts that total population has positive significant impact on economic growth in the long-run while negative significant impact was recorded in the short-run. Both life expectancy and gross fixed capital formation positively predicts per capita gross domestic product in the short and long-run periods. Similarly, fertility rate and crude death rate have positive significant impact on growth in the long-run not in the short-run. The causality test suggested that there is a unidirectional causality that run from economic growth to total population without a feedback effect. Following the findings, the study recommended that the government in Africa countries should invest more on infrastructural development, provide job opportunities for the rising population, and focus more on skill acquisition programs to boost economic growth.

Keywords*: Economic Growth, Population Growth, Panel Data, ADRL, Causality Analysis.*

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Introduction

The discussions over how population increase affects various countries' economies are still ongoing. For some scholars and authors, population growth will still be regarded as a problem because more people unavoidably utilized more of the limited available resources, as a result reduce long-term growth potential (Linden, 2017). While others believed that population growth will promote or stimulate economic growth likewise support economic prosperity. The notion here is that, the more the population, the more the tendency of more skills individuals who will contribute to economic expansion and growth through invention and technological advancement (See Kremer, 1993; Peter & Bakari, 2018). In the same vein, some authors are of the opinions that in later years many develop economies will be confronted with slower economic growth based on the notion that population growth is considerably slow (Abeer, 2020).

The debate regarding population growth and economic performance was first initiated by Robert Malthus in 1798 in his book title; "The Principle of Population". Malthus therefore believed that if population growth is unrestrained, it will outpace food production. Otherwise put, according to his predictions, the humanity will increase in a geometrically progression while food production and supply will increase in arithmetical progression. According to the aforementioned, population is the total number of individuals or persons who live in a specific area and are able to procreate. Whereas population growth is the rise in populace size of a given locality/region or country. When the fertility rate or total birth rate is higher than the crude death rate or mortality rate, population expansion happens on any continent, including Africa. This suggests that there are more births than deaths, which leads to an increase in population size. The population might increase in addition to the growing birth rate or fertility rate if there are more emigrants than immigrants in a nation. As a result, the population of that area is likely to rise since more people are moving to the country than are leaving it. Population growth has quite a number of merits and demerits. For instance, rising population growth bring about increases in the aggregate labour force. A country will ultimately experience high growth rates if its large labor force participates in productive activities. A typical example of a country with high growth rates is China, which uses its high labor force in productive processes and has experienced phenomenal growth that has helped the country's economy become so robust and developed (Kuhe, 2019). On the contrarily, if the growth in population is not channel into productive activities, there is the tendency that, population will have adverse effect on the economy.

In line with the above discussion, productive activities in a country can be term economic growth. This can be defined as the ability of a nation or country to generate gross national product of five to seven percent. Consequently, GDP is a measurement of the annual productivity of the property and labor of all citizens and foreign residents within the geographic borders of a country including its foreign territories such as embassies and purchased military bases abroad. Gross domestic product (GDP) and gross national product (GNP) are two measures of capturing economic growth. Therefore, economic expansion helps raise society's earnings, aids in lowering unemployment levels, aids in the provision of public services, raises living standards, and lengthens life expectancies (Akinwande, Atanda

& Olorunfemi, 2012; International Monetary Fund, 2022 & Marubeni Research Institute, 2022).

Globally, the most populous continent is Asia with approximately 4.67 billion people, and this is followed by Africa with 1.3 billion estimated populace (Kuhe, 2019). However, record has shown that the highest fertility rate and annual growth rate of population is associated with Africa. In 2021, record has it that Africa has the lowest GDP per capita ($5,362), and her gross domestic product contribution to global GDP was the lowest (4.9%). These appalling reports indicates that African population is not economically viable and resourceful. For instance, South Africa, Tanzania, the Democratic Republic of the Congo, Nigeria, Ethiopia, and Egypt have challenges with rising population, which is accompanied with high levels of corruption, institutional failure, escalating unemployment level, rising poverty rate, widening income inequality and political instability or unrest. These and many other factors might hinder population growth from boosting economic growth in these countries. So far, the debate regarding how the growth of national economies is determined by demographic factors such as population is still unresolved. Regardless of the suppositions that population growth brings about long-term economic growth (See Tartiyus, Dauda & Peter, 2015; Peter & Bakari, 2018), there are other opposing views in extant literatures/works. From the perspectives of Desrochers and Hoffbauer (2009) and Linden (2017), these authors however, opined that the adverse implications of rising population for economies is rising poverty, pollution, and unemployment alongside social ills especially in developing countries. From this viewpoint, population growth may be detrimental to economies of nations. In much same way, the empirical works of Dao (2012) and Okwori, Ajegi, Ochinyabo and Abu (2015), shows that there is no discernible connection between population expansion and economic growth.

Based on the revealed, there is no iota of doubt that the issues of population growth and economic growth still needs recent study especially in this post COVID era. Where human lives and economic activities were seriously hampered. It is against this backdrop that this study is key because its address the subject matter, from the point of view of six selected populated countries (Congo, Nigeria, Egypt, Ethiopia, Congo, Tanzania, and South Africa) in Africa, which studies of this nature are scare and scanty. This research is importance for African countries policy formulation on how to manage the ever-increasing population and how population can contribute to the growth of this region economy.

Stylized Facts regarding Rising Population (GRPOP) as well as Economic Development (GRGDP) Connection in the Researched Nations

The trends of the yearly growth rate of gross domestic product (GRGDP) and population (GRPOP) are shown in Figures 1 to 6 for the years 2000 to 2020. The pattern is examined for the following nations: South Africa, Nigeria, Tanzania, Ethiopia, Egypt, and the Democratic Republic of the Congo.

The annual rate of gross domestic product (GRGDP) in Nigeria as depicted in Figure 1 indicates that GRGDP has been fluctuating during the periods under reviewed. For instance,

the highest GRGDP was recorded in 2002 while the lowest in 2016. In 2019, the GRGDP was below the benchmark of 5% which indicates that the economy is not growing as expected. Regarding annual growth rate of population (GRPOP), the trend shows that the human population growth rate is rising gradually.

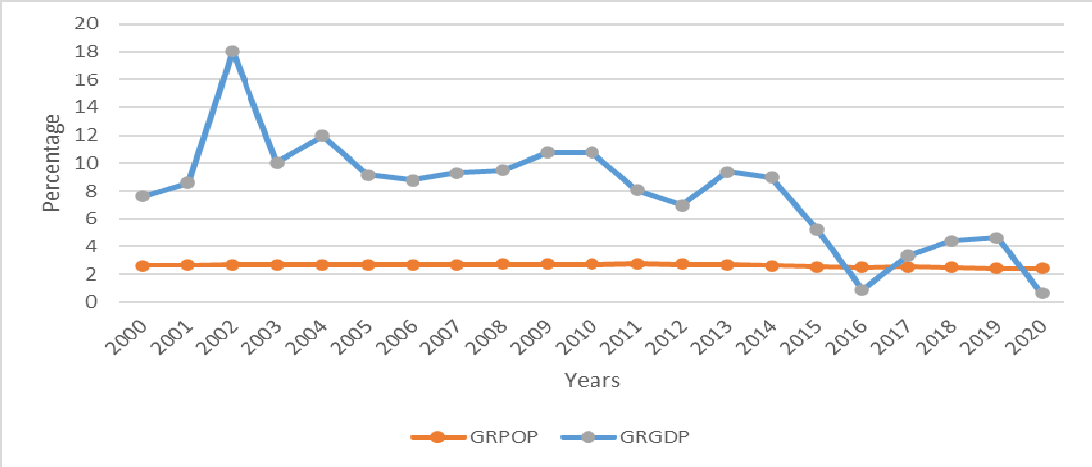

Fig. 1: Population and Economic Growth in Nigeria
Source: Author computation (2023)
(Data source: https://databank.worldbank.org/source/world-development-indicators)

The Figure 2 shows that the trends of GRGDP for Ethiopia economy has been unstable from 2001 to 2019. The economy lowest GRGDP was experienced in 2003 while the highest was in 2004. Regarding annual growth rate of population (GRPOP), the trend shows that the population annual growth is rising gradually.

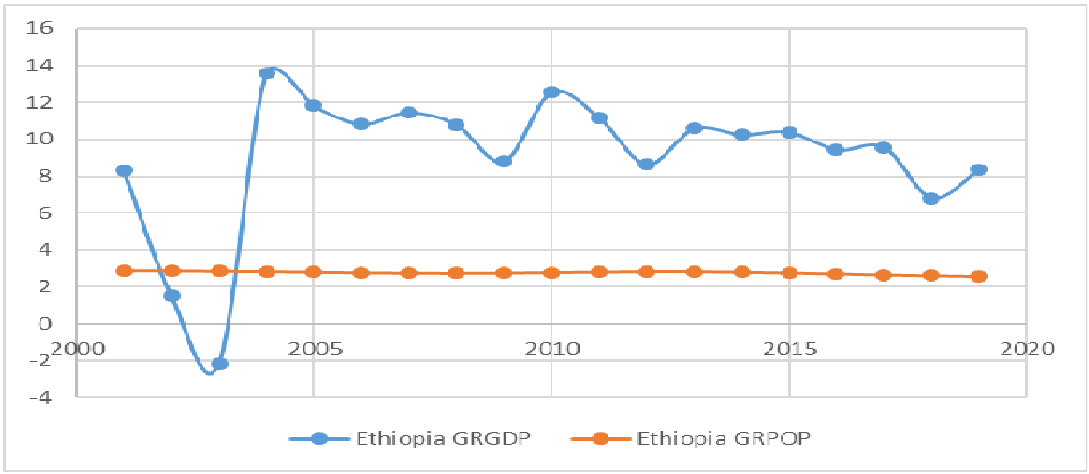

Fig. 2: Ethiopia GRPOP and GRGDP Relationship
Source: Author computation (2023)
Data source: https://databank.worldbank.org/source/world-development-indicators

Regarding the Chart 3, the trends analysis for the Egypt economy shows that GRGDP was at it peak in 2008 while GRPOP was at peak in 2013.

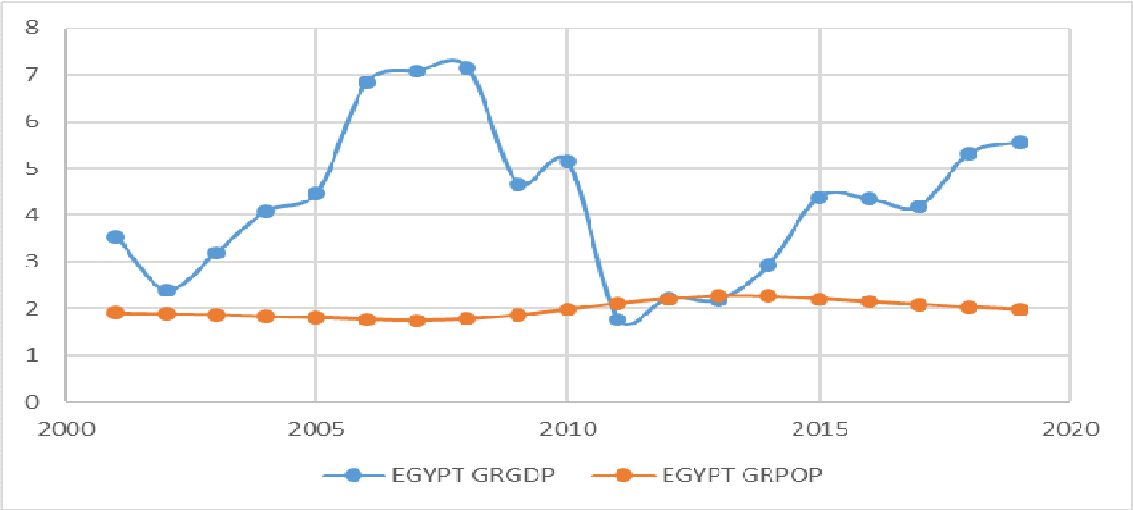

Figure 3: Egypt GRPOP and GRGDP Relationship
Source: Author computation (2023)
Data source: https://databank.worldbank.org/source/world-development-indicators

The lowest GRGDP was in 2011 while the lowest GRPOP was noticed in 2007 in Egypt. For Democratic Republic of Congo, the Figure 4 shows that GRGDP was maximum in 2014 and minimum in 2001 with a negative growth rate. The trends of GRPOP was steady rising.

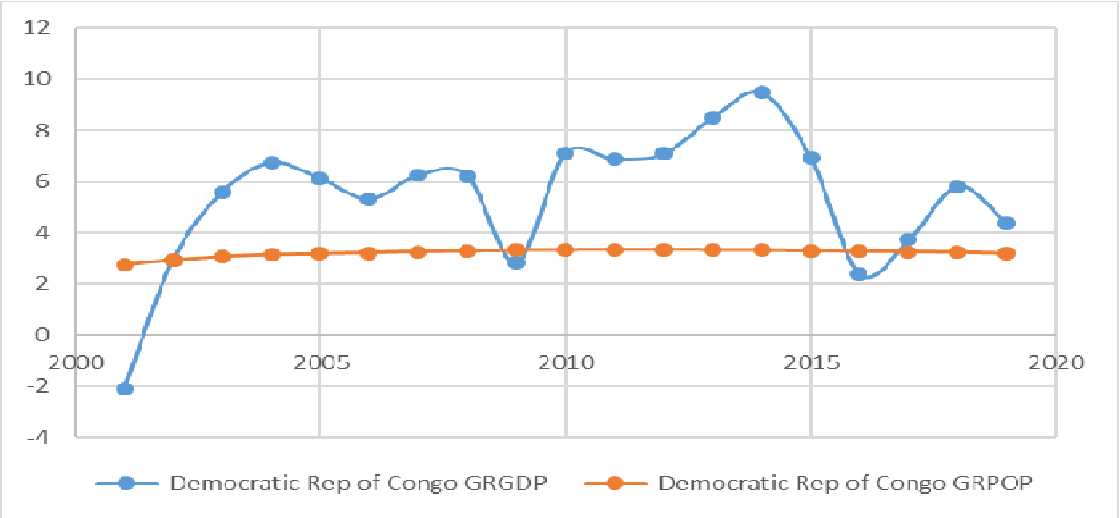

Fig. 4: Growing Population and Growth of the Economy Relationship (Congo Rep.)
Source: Author computation (2023)
Data source: https://databank.worldbank.org/source/world-development-indicators

From Figure 5, GRGDP was at its peak in 2011 and lowest in 2012 in Tanzania economy. While GRPOP maintained growth rate from 2% to 3%.

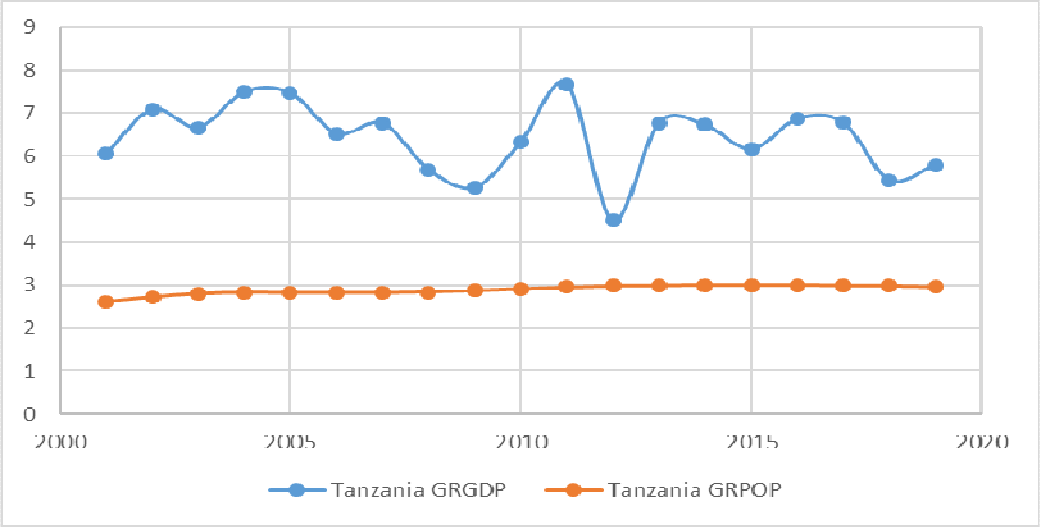

Fig. 5: Tanzania's growth and population relationship (Growth rate)
Source: Author computation (2023)
Data source: https://databank.worldbank.org/source/world-development-indicators

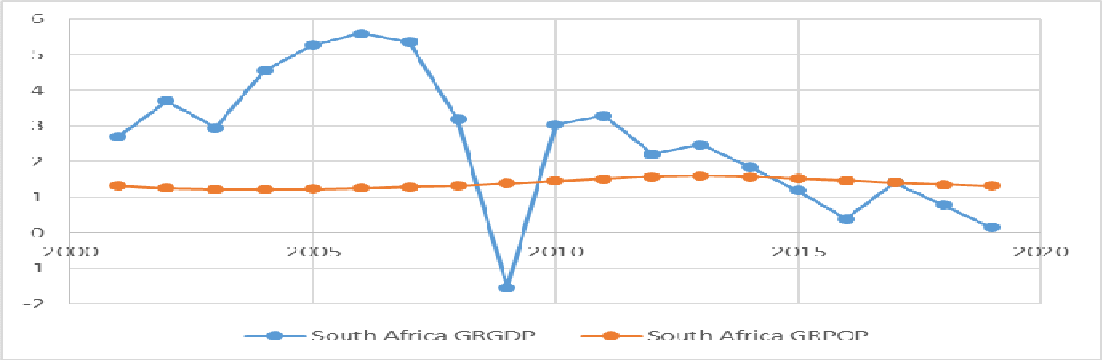

Fig. 6: Evidence of Population and Economic Performance Nexus in South Africa
Source: Author computation (2023)
Data source: https://databank.worldbank.org/source/world-development-indicators

A close examination of Figure 6 suggests that GRGDP was negative and lowest in 2009 for the South Africa economy. In 2006, the economy experienced the highest growth rate of GDP while GRPOP encircled around 1% to 1.6%.

Inferring from Figure 1-6, it is observed that population and growth are not rising or declining in the same proportion in the surveyed economies, this finding makes this study unique for further analysis.

Conceptual issues, Theoretical and Empirical Reviews

Concept of Population

According to Ryder (1964) population is characterised as a total of individuals which conforms to a given definitions. The pillar of population study is formal demography. According to Showkat (2015), a population may be defined as any assortment of a particular

group of people or of non-human elements, such as things, institutions of higher learning, periods of time, places, wheat prices, or individual workers' incomes. A population, according to Tarsi and Tuff (2012), is a group or category of people or members of the same species that live and interbreed in a certain region. In order to survive throughout time, individuals of a population frequently rely on the same resources, are susceptible to the same environmental restrictions, and depend on the availability of other members. When a population is being studied, scientists look at how its members interact with one another and with their surroundings. Additionally, Satishprakash (2020) pointed out that the term "population" refers to the collection or group of all the units to whom the research's conclusions should be applied. It comprises of every unit that may be used to apply research findings. In other words, a population is a grouping of all the units that have the variable attribute that is the subject of the study and for which general conclusions may be drawn.

Concept of Economic Expansion/Growth

The notion of economic growth may be considered to be a process wherein a nation's per capita income and real national income grows in a lengthy period of time. From the point of view of Mladen (2015) economic growth comprises changes in material output in a specific period, generally a year. As a result, the author highlighted that according to economic theory, economic growth is explained as increasingly rise in the worth of commodity and services utilized as well as produced each year, which is measured as the rate of growth in the gross domestic product or national income. According to Feldman, Hadjjmichael, Kemeny, and Lanahan (2014), macroeconomists, who rely on measurable indicators like gross national product or aggregate income, place a priority on economic growth. According to Schumpeter (2001), the fundamental characteristic of economic growth is an increase in both production and consumption of the same products and services. According to Aleksey and Yuner (2015), many interpretations of the idea of "economic growth" include measurements like gross national product or aggregate income that have both quantitative and qualitative qualities.

Theoretical Review

There are ample of theories that explains the controversial association between economic activities and human population. These debates have been on for almost two centuries now. For instance, Thomas Robert Malthus presented his theory and stated that population increases geometrically and food supplies increase arithmetically, subjecting population to poverty. Human reproductive power exceeds the ability of land to feed people, which means that population growth will negatively affect economic growth as a result of human activities and pressure on nature, which is considered to be limited. Indifferently, evidence has shown that Malthusian prediction does not apply to some countries and continents. For instance, in the East Asia nations, there is significant improvement in the living condition of the people as well as economic advancement, despite the rising rate of human population. One key factors for this achievement, is the high skill and educational levels of the young economic active population, who have built dynamic and innovative skills in the technology space (Peter & Bakari, 2018).

The demographic transition hypothesis is a further important concept to consider. The hypothesis describes how population growth and economic expansion are related. The theoretical article examines the variations in birth and death rates as well as the effects of an expanding population on growth and development. According to the hypothesis, when society develops from a rural, agricultural, and illiterate culture to an urban, industrial, and literate society, the population of any region shifts from having a high birth rate and a high death rate to having a low birth rate and a low death rate. Furthermore, the Solow (1956) growth model that opined that the expansion of any economy is affected by the growing population in two diverse ways. From one perspective, rise in population will cause the economic active labour force to increase, thereby causing increase in absolute and steady state growth rate of output. On the contrary, the capital stock of each worker tend to decline, bringing about fall in productivity level as well as decrease in per worker output in the steady state. By implication, a rising population will dampen or cause detrimental effect on growth of the economy (Peter & Bakari, 2018).

Empirical Reviews

There is a vast corpus of research that has been done on the connection between population expansion and economic growth. The two factors may or may not be positively or negatively correlated, although this is still being determined. For instance, using time series data between 1950 and 1993, Dawson and Tiffin (1998) evaluated the relationship between India's growth and population. For the investigation, the causality test and cointegration approach were used. The results explain that both the explanatory variable and regressand are not cointegrated while the causality outcome indicates no causal association between both variables. In like manner, Thornton (2001) empirical study on the subject matter employed seven Latin America countries. The countries are Brazil, Argentina, Colombia, Chile, Mexico, Venezuela and Peru while the data span from 1900 to 1994. Both panel cointegration and Granger test were used to analyse the macroeconomic data. The co-intergration test indicates that the population variable and the predicted variable have a cointegrating relationship. Nevertheless, to back up empirical research showing a lack of a connection between population growth and economic expansion, Dawson and Tiffin (1998) work explored population dynamics and economic development on selected countries and the finding and concluded support existing results of no cointegrated nexus between growth and human resource population.

Dushko and Risto (2012) investigated population growth and economic growth relationship using 10 Balkan nations with data from 1950-2009. The theoretical underpinning is built under the optimal intergenerational model of population growth while the econometric techniques are Hausman test and fixed effect model. The finding displays direct association between population parameter and GDP growth. Using time series data of fourteen years, Hamza (2015) investigated economic development and the consequences of population dynamics in 30 low developing economies. The results showed that population dynamics possess a direct likewise considerable effect on the areas of economies prospects. Additionally, Sibe et al. (2016) used data from 30 most populous nations between 1960 and 2013 to analyze the association between per capita income and population increase. The

results show a long-term connection between overall population and per capita income. Thus, bidirectional link concerning population growth and per capita income is noted, contrary to the ECM result, which implies that growing population depicts direct significant influence on the surveyed economies. The authors concluded that rising populace had a favorable effect on economic growth in the light of the findings.

Going by a related development, Peter and Bakari (2018) investigated the relationship that exist between the two variables with case study of 53 selected Africa nations taking data spanning through the periods of 1980 to 2015. The empirical outcome reveals that population as a variable, is positively significant in determining the growth of Africa economies. Whereas, fertility rate is not, due to it adverse effect on the economies. The populace health capital and aged population was used by Yingzhu, Rong, and Lexiang (2021) to determined economic progress using cross-country data spanning from 2000 to 2016. The empirical findings reveal a reversed U-shaped connection/association between population aging and economic increase, and health investment is a helpful indicator for promoting economic growth.

In addition, Osobase, Ohioze and Olowoyo (2021) studied economic growth influence by life expectancy and population in 100 countries from 2002 to 2017. The pooled mean group (PMG) result shows that both population growth and life expectancy have adverse significant influence on the economies of the surveyed nations. Using panel data from 1976 to 2017, Ahmad and Nayyab (2021) explored how demographic factors explains economic progression in Pakistan, India, Bangladesh, and Sri Lanka. Life expectancy and fertility rates are employed as demographic indicators, whereas GDP is used to show economic growth. The results indicate that in these four South Asian nations, the total fertility rate and life expectancy have a considerable influence on economic growth. Finally, the work of Osobase, Ohioze, Samuel, Ojo and Charles (2022) used data from 2001 to 2019, sampled on 66 nations that make up eighty-five percent of the world population. The empirical result indicates that population, fertility rate, crude death rate and gross fixed capital formation significantly and directly affect per capita GDP. A two-ways causal relationship was detected between the regressand and all the explanatory variables. Based on the reviewed literature above, it can be said with certainty that most studies have not sufficiently captured the influence of population increase on economic growth in Africa since the nations included in existing works are not the most populous in the area. This study uses recent data and six of the most populous countries in the continent of Africa to test the population increase and economies expansion nexus to close existing knowledge gap.

Research Methodology

This current research employs both descriptive research design as well as ex-post facto (EPF) exploring design. The EPF research design works with gathering selected data from respectable organizations such as World Bank and the Central Banks of various countries understudy. The descriptive research survey is to guarantee that the proper data is obtained for the study. The research period runs from 2001 to 2019. Six nations (Nigeria, nation of Ethiopia, Egypt economy, Congo republic, Tanzanian nation, and the South Africa

economy) make up the sample size out of the 54 African nations and account for 47.14 percent of the continent's population. The study arrived at this figure, via dividing Africa aggregate population (1,373,486,472) in 2021 by the total population (647,453,677) of the studied countries. These countries are the most populated in the continent. The macroeconomic data are per capita GDP (PCGDP), aggregate population (POP), life expectancy estimate (LEX), fertility ratio, death/ mortality rate (CDR) and gross fixed capital formation.

The underpinning framework is built under the classical and neoclassical models. The simple classical model views output (Y) of a nation as a function of two inputs. The labour force variable (L) as well as the capital variable (K). The time in the equation denote each period of time. Mathematically, given/stated as:

$$Yt=F(Lt, Kt)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

The neoclassical economists extended equation 1 to include technological progress (A) which includes skills, work experience and human capital development. This inform another equation stated as:

$$Y=F(L, K, A)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

According to the neoclassical hypothesis, rising savings and investment levels or a decline in population growth rate can both explain per capita income increase (Y). In line with equation 2, Cobb-Douglas proposed a production function that connotes the connectivity of selected demographic macroeconomic variables and economic variable. The analytical framework is;

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}, \quad 0 < \alpha < 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

According to equation 3, production or per capita income at time 't' is reliant on technical advancement (A), capital (K), and labor (L) at time 't'. Where α and 1- α are coefficients that represent contributions of labour and capital.

Based on equation 2 and 3, as well as the works of Akintunde *et al.* (2013) and Shen and Shen (2021), the model for the study is form.

The estimated parameters of the model are expressed as per capita income (PCGDP) as a function of total population (POPt), life expectancy (LEXt), fertility rate (FERt), crude death rate (CDRt), and gross fixed capital formation (GCFt) at time 't'. The model is depicted as:

$$PCGDP_t = f(POP_t, LEX_t, FER_t, CDR_t, GCF_t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

Stating the equation 4 in an econometric form gives equation 5 below.

$$PCGDP_t = \varpi_0 + \varpi_1 POP_t + \varpi_2 LEX_t + \varpi_3 FER_t + \varpi_4 CDR_t + \varpi_5 GCF_t + \mu t \ldots\ldots\ldots 5$$

Where;
$PCGDP_t$ = Per capita Real gross domestic product at time 't' for each country
POP_t = Aggregate population of each country at time 't'
LEX_t = Life expectancy of individual in the given country
$FERT_t$ = Fertility rate for the countries at the stated periods of time 't'
CDR_t = Crude death rate in each country for the specified periods 't'
GCF_t = Gross fixed capital formation in each country
ϖ_0= Intercept, ϖ_1 - ϖ_5= Regression parameters of explanatory variables.

A priori expectation
$0 < \varpi_1 \varpi_3 > 0$, $\varpi_4 < 0$, ϖ_2 and $\varpi_5 > 0$.
This study employs the pooled ordinary least square and Autoregressive Distributed Lag (ARDL) technique to assess the equation. The OLS calculations, however, might be biased by a variable that was left out. Consequently, the ARDL model is also utilized to prevent this issue. Because ARDL models can take into account unobserved country-specific effects and use all available information (data), i.e., by not reducing the time series to a single (average) observation, they are able to address the issue of omitted variables and bias problems encountered in single cross section analysis. The Augmented Dickey Fuller (ADF), Phillip Perron (PP) unit root techniques, Lag selection criteria, and Bound tests are completed before carrying out the ARDL estimation. Granger causality technique is applied to the panel data. This is to determine whether only one variable, or both the dependent and independent variables, have an impact on one another. The World/Global Development Indicators, 2021, are used to generate the data. The program used to estimate the data is called E-view 10.0.

Presentation of Data and Interpretation of Results
Descriptive Statistics
The Table 1 shows the descriptive statistics for the whole nations. A cursory look at the estimated per capita GDP (PCGDP) of $2175.969 when compared with the total Africa average of $2028.2 (Statista, 2023), it is agreed that the six economies have fairly higher PCGDP. This shows that the economies are averagely doing fine with respect to per capita spending. The estimated mean population of 83289392 is greater than the average Africa population of 25434935. This is an indicator that the surveyed countries are the most populated in the continent. The average life expectancy for this study is 59.4 years which is below the African estimate which is given as 62.5 years (Lars, 2023). In spite, of higher PCGDP, life expectancy indicator is low when compared to the continent mean, this might be attributed to low per capita health spending. The mean fertility rate (4.66) and crude death rate (10.42) are higher than the African mean of 4.268 and 8.64 (Macrotrends, 2023 & Statista, 2023). This suggests that rising rate of births by each woman is accompanied by rising death rate.

Table 1: Descriptive Statistics for the Six Countries

WHOLE	PCGDP	POPL	LEX	FER	CDR	GCF
Mean	2175.969	83289392	59.39612	4.663596	10.42737	3.21E+10
Median	1094.177	71421924	58.70600	5.112500	10.42700	2.61E+10
Maximum	8810.931	2.01E+08	71.99000	6.740000	17.67500	1.10E+11
Minimum	153.5910	34385849	46.51000	2.381000	5.778000	4.96E+08
Std. Dev.	2240.086	42969595	7.120221	1.466586	3.334447	2.55E+10
Skewness	1.385764	1.228669	0.204977	-0.259601	0.181524	0.615555
Kurtosis	3.817077	3.597885	1.933118	1.539503	1.914764	2.391841
Jarque-Bera (J-B)	36.17891	27.71590	5.660636	10.41136	5.674679	8.170460
Probability	0.000000	0.000001	0.058994	0.005485	0.058581	0.016819
Observations	114	114	114	114	114	114

Source: Author computation (2023)

The skewness test suggests that all the variables are positively skewed except FER. For the kurtosis estimate, only PCGDP and POPL are leptokurtic while other variables are platykurtic. Taking the probability values of the J-B estimate, it can be stated that two of the variables (LEX & CDR) are normally distributed, while others are not.

Unit Root Test

The panel data was subjected to difference unit root tests and the outcomes are depicted in Table 2. The result depicts unit root tests at difference levels.

Table 2: Unit root tests

Variables	Levin, Lin & Chu t*	INT ORDER (IO)	ADF - Fisher Chi-square	INT ORDER	PP - Fisher Chi-square	INT ORDER	Im, Pesaran and Shin W-stat	INT ORDER
LPCGDP	-3.22	I(1)	27.85	I(1)	46.93	I(1)	-2.82	I(1)
LPOP	-2.49	I(0)	33.36	I(0)	64.89	I(0)	-3.31	I(0)
LEX	-13.64	I(0)	137.10	I(0)	73.92	I(0)	-13.79	I(0)
FER	-6.56	I(0)	291.61	I(0)	264.25	I(0)	-7.43	I(2)
CDR	-8.90	I(0)	276.67	I(0)	293.74	I(0)	-7.52	I(0)
LGCF	-5.57	I(1)	50.41	I(1)	52.29	I(1)	-5.36	I(1)

Source: Author computation (2023)

From the outcomes in Table 2, it can be said that there is mixed stationarity among all the variables. Having established that the variables are stationary at different level, the next stage is to estimate the cointegration test to evaluate if there exist a long-run relationship among the set of data.

Cointegration Result

The data was subjected to the Johansen Fisher panel cointegration test as revealed in Table 3. From the estimate, it is stated that there are five cointegrating equations, which implies that

the study rejects the null hypothesis. Therefore, it can be stated that there is a measure of long-run empirical relationship between the outcome variable and all the predictors.

Table 3: Cointegration Test

Johansen Fisher Panel Cointegration Test		Trend assumption: Linear deterministic trend		
Series: LPCGDP LPOP LEX FER CDR LGCF		Included observations: 114		Sample: 2001 2019
Lags interval (in first differences): 1 1		Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)		
Hypothesized	Fisher Stat.*		Fisher Stat.*	
No. of CE(s)	(from trace test)	Prob.	(from max-eigen test)	Prob.
None	6.931	0.8621	25.35	0.0132
At most 1	76.46	0.0000	76.46	0.0000
At most 2	220.2	0.0000	146.6	0.0000
At most 3	109.6	0.0000	66.78	0.0000
At most 4	59.39	0.0000	52.42	0.0000
At most 5	26.43	0.0093	26.43	0.0093
* Probabilities are computed using asymptotic Chi-square distribution.				

Source: Author computation (2023)

The LR nexus between LPCGDP and the regressors is conflicting with the work of Dawson and Tiffin (1998) and supported by the findings of Sibe et al. (2016), Peter and Bakari (2018) and Osobase et al. (2021), that asserted that for the growth of the economies, there is the need for moderate rate of population expansion.

ARDL Long-run and Short-run Results

The panel estimate is illustrated in Table 4. In the result, population growth which is the key explanatory variable appeared to have negative significant effect on LPCGDP in the short-run, however, positive significant effect on the outcome variable (LPCGDP) was within the long-run period. The implication of the result is that population growth in the SR dampen growth of these economies, and this might be due to rising fertility rate and dependency ratio not backed with productivities. All things be equal, in the LR, rising dependency ratio and fertility rate can translate to rising labour force and supply, which tends to support productive activities and growth in these nations. The direct effect of LPOPL on the economies is buttressed by the studies of Thornton (2001), Dushko and Risto (2012), Hamza (2015) and Sibe *et al.* (2016) and Peter and Bakari (2018), but contrary to the result of Osobase *et al.* (2021).

The life expectancy variable has demonstrated positive effect on LPCGDP, though not significant in predicting the outcome variable (PCGDP) in the SR but significant in the LR. The result of insignificant effect of LEX on the economies, reflects the mean life expectancy of 59.4 years obtained from the descriptive statistics. It must be noted that in nations such as Japan, USA, Canada, Norway etc., there is interaction between high per capita income and

life expectancy. As people spend more, it increases their health status and longevity. However, the findings of this study shows that LEX can exert positive effect on LPCGDP in the long-run, implying when the right policies and programmes of growth are duly put in place. This result is in line with the work of Ahmad and Nayyab (2021) and Osobase et al. (2022) but contrary to the results of Hakeem et al. (2016) and Osobase et al. (2021).

Table 4: ARDL Result for the Whole Countries

Dependent Variable: D(LPCGDP)			Sample: 2002 2019	
Dynamic regressors (1 lag, fixed): LPOPL LEX FER CDR LGCF				Dependent lags: 1 (Fixed)
Varia	Coeffici	SE	t-Estimated	Prob. Valve*
	LR Equation			
LPOPL	89.58242	31.76331	2.820311	0.0065
LEX	0.842846	0.242699	3.472805	0.0010
FER	2.843175	0.477774	5.950875	0.0000
CDR	2.523385	0.401721	6.281442	0.0000
LGCF	0.030557	0.034148	0.894824	0.3744
	SR Equation			
COINTEQ01	-0.491625	0.275401	-1.785122	0.0792
D(LPOPL)	-83.04068	34.38161	-2.415265	0.0187
D(LEX)	4.653432	3.423028	1.359449	0.1790
D(FER)	-5.731618	7.322924	-0.782695	0.4368
D(CDR)	7.638286	4.935163	1.547727	0.1269
D(LGCF)	0.391526	0.170175	2.300733	0.0248
C	-386.1222	217.0093	-1.779289	0.0802
@TREND	-0.307304	0.184655	-1.664201	0.1012

Source: Author computation (2023)

A short look at the panel ARDL result indicates that fertility rate has direct significant impact on per capita income in the long-run but adverse insignificant impact on per capita income in the short-run. One explanation for this is that rising FER will not support growth in the SR, but lead to increasing population and expanded labour force that will support economic activities and boost PCLGDP in the long run. Contrary, Ogunleye et al. (2018), Peter and Bakari (2018) and Ahmad and Nayyab (2021) in their findings noted that fertility rate has adverse impact on per capita income. This signifies that as fertility rate is declining, following the rule of thumb of demographic theory, economies will experience growth. Following the long-run result, CDR depicts positive and significant influence on LPCGDP and insignificant effect in the SR. In sum, it can be inferring that LGCF exert significant effect on LPCGDP in the SR not in the LR. The role of LGCF in supporting the domestic economies is observed in both SR and LR, as the predictor (LGCF) positively predicts LPCGDP, though only in the LR, this effect is felt significantly. Arguably, a stable rise in domestic investment will cause the economies to growth and bring about a rise in LPCGDP. This finding corroborates the result of Mahmoudinia et al. (2020). The ECM coefficient has the expected negative sign (-0.491625) and statistically significant in predicting LPCGDP. The estimated coefficient given as -0.49 indicates that it will takes about 49 percent

adjustment for equilibrium to be established from SR to LR. Based on the statistically significant of the ECM t-test at 10 percent, the Granger causal procedure is estimated.

Granger Causality Outcome

The Table 5 depicts the pairwise Dumitrescu Hurlin panel causality tests (DHPCT). These tests were undertaken to see if there is a causal relationship that exist between the predicted variable (LPCGDP) and all the predictors. For a variable to Granger cause another, the estimated probability value must be lesser than 5% significance level.

The pairwise (DHPCT) demonstrated that there is a one-way directional relationship that runs from per capita income (LPCGDP) to total population and fertility rate (FER) without feedback effect from LPOPL and FER to economic growth/per capita income. A unidirectional causal nexus was observed to run from life expectancy (LEX) to LPCGDP without a feedback effect.

Table 5: Pairwise Dumitrescu Hurlin tests

Periods: 2001 2019			Lagged: 2
Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
LPOPL will not homogeneously cause LPCGDP	3.90884	1.25737	0.2086
LPCGDP cannot homogeneously cause LPOPL	17.9223	12.9352	0.0000
LEX does not homogeneously cause LPCGDP	10.0596	6.38298	00000000.2
LPCGDP does not homogeneously cause LEX	4.06126	1.38438	0.1662
FER does not homogeneously cause LPCGDP	4.26102	1.55085	0.1209
LPCGDP does not homogeneously cause FER	21.6929	16.0774	0.0000
CDR does not homogeneously cause LPCGDP	7.64826	4.37355	0.0001
LPCGDP does not homogeneously cause CDR	7.48790	4.23991	0.0002

Source: Author computation (2023)

Similarly, both crude death rate and per capita income (LPCGDP) Granger cause each other's. In sum, it can be deduced that the influencing power between LPCGDP and LPOPL is unidirectional in the studied countries. Thus, while Sibe et al. (2016), Mahmoudinia, Kondelajib and Jafaric (2020) and Osobase et al. (2022) found a bidirectional causality between the two main variables, this current study observed a one-way causal nexus flowing from LPCGDP to LPOPL. That is, as people are economically empowered, there is the likelihood that population will increase in the selected nations.

Conclusion and Recommendations

This study employed time series data spanning from 2001 to 2019 to ascertain the growth and population relationship/link with six countries with the largest population in the continents. The countries are Nigeria, Ethiopia, Egypt, Democratic Republic of Congo, Tanzania, and South Africa. The variables understudy includes PCGDP taking to measure the surveyed economies growth), total population (POP), life expectancy (LEX), fertility rate (FER), crude death rate (CRDR) and gross fixed capital formation (GFCF). The variables

were analysed using descriptive statistics and other dynamic econometric tools. The findings from the descriptive statistics indicate that mean of per capita income, population, crude death rate and fertility rate were higher than the African average. Except life expectancy which is below the mean of Africa estimate. The results for the unit root tests show that there is mixed integrated orders while the findings from cointegrated results indicates that the null hypothesis of no cointegration was rejected. This implies that there is cointegration between the dependent and explanatory variables. The result from the ARDL test reveals that total population has positive significant impact on LPCGDP in the LR and adverse effect on economic growth in the SR. This result was backed by previous findings. In addition, life expectancy variable significantly predicts economic growth both at LR and SR. This result suggests that living longer is a necessary condition for these economies to experience growth. Similarly, the fertility rate has a positive effect on economic growth. This result does not support some extant studies reviewed. The positive relationship between GCF and economic growth was direct, which implies that more investment in these economies will create more employment for the population and increase purchasing power of the people. Further analysis, using the pairwise Dumitrescu Hurlin panel causality tests, the study found that there is one directional causality that runs from LPCGDP to total population without a feedback effect. The results of bi-causal relationship are found between crude death rate and per capita income (LPCGDP) only. This implies that both crude death rate and per capita income influences each other. Based on the findings, this study recommended that the government in Africa countries should invest in infrastructural development, provide job opportunities for the rising population and focus more on skill acquisition programs. These methods will not only help increase financial protection for the citizens but make population growth to have positive impact on economic growth. Also, the issues of corruption, insurgents, political and ethnicity unrests should be adequately addressed for a stable economy to be achieved. Lastly, policies that will assist to address Africa declining life expectancy and rising fertility rate should be implemented.

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