Changes in Demography and Its Effect on Economic Growth in Developing Economies: Evidence from Selected African Countries

Vincent, M. O. (MSc)[1], Udeorah, S. F. (Ph.D.)[2]

[1,2]*Department of Economics, University of Port Harcourt, Nigeria*

Abstract:- **The paper investigated the role played by changes in demography in the growth of African economies during the period 1981-2017. Moreover, a comparative investigation of the effect of changes in demography on growth of selected economies based on the income level (namely high and upper-middle income, lower-middle income, and low income) was also done in this paper. Data for this study were sourced from the World Development Indicator (WDI) published by the World Bank. While, growth in GDP per capita was used to measure economic growth, demographic changes were examined from population dependency ratio, population gender distribution, and urban and rural population. The panel IPS unit root test conducted showed that all the time series for all categories of African countries examined were stationary at levels; hence the fixed/random effect panel regression models were estimated. Based on the result of the Hausman test, only one fixed effect was used to explain the effect of changes in demography on economic growth. First, it was found that age dependency ratio of entire population had a negative significant effect on economic growth among all African countries and lower-middle income countries in Africa. Secondly, age dependency ratio of the aged and young population had positive and significant on economic growth among all African countries and lower-middle income countries in Africa (with the magnitude of age dependency ratio of the young being greater). Thirdly, increase in female population impacted positively and significantly on economic growth among African countries. Fourthly, increase in male population had negative and significant impact on economic growth among all African countries and lower-middle income countries in Africa. Fifthly, increase in rural and urban population impacted positively and significantly on economic growth among African countries, high and upper-middle income countries, and low income countries in Africa. Lastly, while increase in urban population had more impact on economic growth among African countries, increase in rural population had more impact on economic growth among low income African countries. Among others, the study recommended that economic empowerment programmes should concentrate more on the women population as women in African tend to be more enterprising in managing small businesses that has been considered a catalyst for economic growth in the African continent.**

Keywords: **Age Dependency Ratio, Rural and Urban Population, Gender Distribution, Growth in GDP per capita**

I. INTRODUCTION

While population is defined as the total number of people living in a particular area at a particular point in time, demography is the study of the size, structure, and development of human populations (Scheidel, 1996). Demography could also be discussed in terms of population distribution by location (i.e. rural and urban), gender composition of population (i.e. male and female), and age distribution or dependency of population (i.e. young, working, or even ageing population). The linkage between demography and economic growth has been a subject of academic discussion in the past. Unlike the urban population known for its high literacy rate, majority gainfully employed in big firms and organizations, and engage mainly in mechanized farming; rural population are known for low literacy rate and majority engaging in subsistence or peasant farming (Hall, Scoones, & Tsikata, 2017). While many problems such as congestion, pollution, and slum settlements are caused by urban growth in contemporary developing countries, cities are often described as 'engines' of growth (Jacobs, 1972; Crook, 1997; Beall & Fox, 2009). Cities also provide large and concentrated markets, allowing for economies of scale in the production of manufactured goods as well as low transportation costs. It is in urban areas that firms can better match their labor demands with the supply of skills, while the returns to infrastructure such as roads, port facilities, and electricity grids are greater due to the concentration of industries and firms. In fact, Adebisi (2014) posited that a negative relationship exists between the rural settlement and economic growth. Gender distribution of a population also serve as predictive factor for output and productivity. Developing countries view men as generally stronger and more likely to contribute immensely to growth of the society. But women also play vital roles in the economic growth of African societies. As marketers of the farm product the contribution of women to the economic well being of a society and much greater than they are acknowledged for. H ence, the relationship between population by gender and economic growth depends on the precise size of the male population against the females' population. Baldwin (2006) a psychologist stated that men are story and women are weak. Therefore, if the population of the country has more females that males, it will have negative implications for the country's economic growth. A female-dominated population should therefore be succeeded by a male population with a view to attaining economic growth in the country (Sheltzer & Smith, 2014).One major consequence

of a large population in some developing African countries like Nigeria is that it leads to increase in dependency. Dependency is a situation whereby someone relies on others for the consumption of goods and services. Dependency works in line with the age distribution. Age distribution can be illustrated as 1- 17 years, 18 – 65 and above 65 years. Population by dependency also accounts for the economic growth of any economy (Nargund, 2009). A decrease in the labor force and increase in the elderly population could slow economic growth. A falling fertility rate leads to populations with many working age individual and fewer children to succeed them. Most economists argue that a country which a higher proportion of inhabitants of the old level, lower savings and increases government spending (Nargund, 2009). The demographic transition makes room for an increase in the old age dependency ratio, meaning that the smaller working age will be obligated to care for the older age group (Nargund, 2009).Dependency could be related to economic performance through its effect on savings which is the basic component of the neoclassical growth model. Typically, dependents (the elderly and children) will be supported either through government transfers which are financed through taxes and government assets, or they will be supported through in-house family care. In the former case, as the number of dependents increases, the required transfers increase which, in turn, require increasing taxes that suppress savings. Likewise, in the case of family-care, as dependents increase, the consumption rate per household will increase, which suppresses savings rate. Moreover, within a household, as dependency increases the time required to take care for the dependents will increase and the time available for paid labor force will be reduced. Most economists also argue that there is a negative relationship between the population ageing and economic growth (Nagarajan, Teixeira, & Silva, 2013; Nargund, 2009; Wesley & Peterson, 2017). Inequality in age structure is believed to affect a country's productivity level. Even so, some authors claim that a positive infraction exist between the infant/ageing and economic growth (Orlická, 2015). According to Prettner (2012), older individuals tend to save more. As a result, they provide more resources for investment which positively affects economic growth, and also in terms of lower health care costs in later years of life and other beneficial contributions to the economy.

Fundamentally, growth is an indispensable requisite for the development of developing African economy. More importantly, growth is associated with policies of controlled depletion of a natural and finance material resources. Rapid population growth has efficiently induced wide spread poverty among developing countries. Urbanization or especially rural-urban drift in developing countries is often associated with many problems such as congestion, pollution, poor housing conditions, pollution, unemployment, over stressed facilities and services, as well as crimes among other problems. African society believers that no matter how well a woman works she cannot be considered as being equal to a man. With no doubt men are stronger physically but does this fast create room for oppression of female gender, does this give room for women to be trampled upon by men? Most importantly should this deprive women the opportunity of contributing to the development of developing African economy? It is clear that with an increase in the proportion of people over the age of 65, there will be a decreased proportion of the people of working force age. This means that there will be more people depending on others and social welfare such as state pensions and less people working and paying income taxes, causing an increase in dependency ration. It also leads to increased fiscal gap and decreased participation rates. The impact of population dynamics on the larger economy has gained much traction during the 20th century. Despite the much earlier work by Malthus (1798) on the negative and cyclical relationship between population growth and income per capita, demographers and economists of the 20th century paid closer attention to understanding the particular characteristics, determinants, and consequences of demographic change, in an attempt to draw general trends of population change and effect. The discussed benefit of demography in the growth process of developing African countries and identified problems associated with demography has made an empirical investigation into the impact of demography on economic growth a necessity; as this will provide policy direction to developing countries. The aim of the study is to empirically investigate the impact of demography (rural/urban population growth, male/female population growth, and dependency population growth)on economic growth in Africa. Specially, the objectives of this study are to examine the impact of:

i. demography (rural/urban population growth, male/female population growth, and dependency population growth) on GDP per capita growth in selected African countries;
ii. demography (rural/urban population growth, male/female population growth, and dependency population growth) on GDP per capita growth in selected High and Upper Middle Income countries in Africa;
iii. demography (rural/urban population growth, male/female population growth, and dependency population growth) on GDP per capita growth in selected Lower-middle Income countries in Africa; and
iv. demography (rural/urban population growth, male/female population growth, and dependency population growth) on GDP per capita growth in selected Low Income countries in Africa.

The following hypotheses were also tested in this study:

i. H_0: Demography (rural/urban population growth, male/female population growth, and dependency population growth) has no significant impact on GDP per capita growth in selected African countries.
ii. H_0: Demography (rural/urban population growth, male/female population growth, and dependency population growth) has no significant impact on GDP

per capita growth in selected High and Upper Middle Income countries in Africa.

iii. H_0: Demography (rural/urban population growth, male/female population growth, and dependency population growth) has no significant impact on GDP per capita growth in selected Lower-middle Income countries in Africa.

iv. H_0: Demography (rural/urban population growth, male/female population growth, and dependency population growth) has no significant impact on GDP per capita growth in selected Low Income countries in Africa.

The remaining part of this study is organized into four (4) sections namely literature review, methodology, results and discussions, and summary, conclusion and recommendation.

II. LITERATURE REVIEW

This section is organized into the following sub-headings:

a. Theoretical Review;
b. Empirical literature; and
c. Gap in literature.

2.1 Theoretical Literature

2.1.1. Overlapping Generations(OLG) Model

Recognizing the influence of population growth and age structure, economic theoreticians began to incorporate demographic structure to what became classical macro economic models. Among the most notable of such works was that of Samuelson (1958) who pioneered the so-called "overlapping generations model" (OLG) where the economy was seen through the lens of several generations, and more importantly where the role of intergenerational transfers takes particular prominence. In Samuelson (1958), for instance, the fact that agents are driven by the desire to smooth their intertemporal consumption, knowing their retirement obligation, prompts a trade (or exchange) between generations at each point of time based on the social contrivance of money, which unequivocally influences equilibrium interest rates and savings. Inspired by this approach, Diamond (1965) incorporated capital into the OLG set-up and concluded that restoring consumption optimality, if not through fiat currency, can also be achieved through public debt and Pay-As-You-Go pension systems–both of which still forms of intergenerational transfers (see Weil (2008), and de la Croix and Michel (2002) for further details).

2.1.2. Life Cycle Theory

These macro models were, in fact, preceded years earlier by a micro-based model developed by Modigliani and Brumberg (1954), now widely known as "life cycle theory" who argued that individual choices of consumption and saving, based on known periods of work and retirement, influence national savings and spur the exchange between generations. This becomes particularly relevant for a growing population where the savings of the young, who are continuously larger in number, exceed the (dis)savings of the old, thus generating higher rates of economic growth. Gradually, demography became an integral part of many more economic models, deliberately incorporating age and death (or survival) rates as crucial elements. Yaari (1965) notably developed a life cycle model where the probability of survival is deliberately included as an uncertainty that influences a consumer's utility, asset accumulation and optimal consumption plan. Arthur & McNicoll (1977) incorporated for the first time detailed mathematical demography into an economic growth model in order to obtain optimal savings and fertility paths. Their work emphasized the importance of treating the population as a succession of life stages, each differing in characteristics and economic behavior. A year later, they expanded Samuelson's model to also include this mathematical demography and showed more explicitly the effect of intergenerational transfers in offsetting the decrease of capital per person as the population grows at a constant rate (Arthur& McNicoll, 1978). Given this context, Lee (1980) and Lee (1994) published a comprehensive life cycle model that looks at the aggregate consumption, savings, transfers, and government debt based on demographic tools, accounting for birth and survival rates and basing these on individuals and households as the unit of analysis. Lee's model drew a theoretical relationship between intergenerational transfers and population growth, and between the latter and overall economic growth. "If consumers are on average older than earners," he wrote, "then more rapid growth, by 'younging' the population, makes more consumption possible." From the individual's point of view, a more rapid population growth raises the interest rate; if people on average consume later than they earn, a higher interest rate enables them to consume more. With higher population growth rates, Lee's model dictates that society must save more to avoid further dilution of the capital-labor ratio. This theoretical framework has been expanded in a series of articles and is still developing. Willis (1988), some years later, for instance, concluded using many overlapping generations that equilibrium interest rates would always exceed population growth rates, therefore hindering the idea that money would be used as a store of value. d'Albis (2007) has also recently shown that capital dilution is not a definite consequence of population growth as it would depend on the difference between the average age of those holding capital and the average age of workers.

2.1.3. Unified Growth Theories

Unified growth theories aim to explain the transitions of an economy throughout its development. Particular attention has been paid to the transitions from per capita income stagnation to sustainable growth (Industrial Revolution) and from high to low fertility (Demographic Revolution). Pioneering works include Galor and Weil (2000) and Galor and Moav (2002). They emphasized the three-regime development process: the inherent interaction between population (size or composition) and technology level in the Malthusian regime accelerates technological progress and eventually triggers the Industrial

Revolution; the economy then enters the Post-Malthusian regime. Sooner or later the demand for human capital will rise to a level that, through child quality-quantity tradeoff, the Demographic Revolution will set in; the economy will then enter the Modern Growth regime. Ho (2016) also modified the unified growth model that encompasses living standard, fertility, female labor-force participation and women's power.

2.2 Empirical Review

Fox and Dyson (2008) analyze international data for the period since 1975 and find that urban growth has been positively associated with per capita GDP growth. Moreover, their study also asserts that urbanites are more likely to have better access to modern healthcare, education, water, sanitation and longer life expectancy. However, Brockerhoff and Brennan (1998) found that since the late 1970s the survival advantage of urban residents in Latin America and the Caribbean has decreased and stopped by the earlier 1990s. Massey (1996) also shows that urbanization has resulted in a geographic concentration of affluence and poverty throughout the world. This in turn will lead to a deeply polarized and increasingly violent world. Nevertheless, the net effect of urban growth and urbanization on economic growth is probably positive. We thus expect that the higher the rate of urban growth and the higher the level of urbanization, the higher the per capita GDP growth rate.

De Moorand Van Zanden (2010) argue that a scarcity of labour boosted women's position in the labour market, whilst Voigtländer and Voth (2006) argued that changing demand patterns (including greater consumption of meat) as a result of the consequential higher incomes increased opportunities for women in agriculture. DeMoor and Van Zanden (2010) also point to the way in which a higher age of marriage may have increased savings and human capital investment. Altogether, this suggests that the family system was affecting all three of the central determinants of economic growth: technological change (via real wages), investment (via savings) and human capital. Taken together, no longer it seems can we assume that Western success was built on the back of (largely male) entrepreneurs and inventors; the decisions of the everyday woman about family, work and fertility were likely just as important.Morrison, Raju, & Sinha (2007) proved that the impact of women's rights and decision-making power in families helped reduce poverty and improve productivity at per person and family levels. In addition, they showed the relationship between gender equality and poverty reduction and economic growth at the macro level. Özpolat and Yıldırım (2009) investigated the relationship between the education of women and economic growth by analyzing the economic dimension of women's education.

Bloom &Williamson (1998) have found out that the youth dependency has more negative effect on economic growth than the elderly dependency rate and its African dependency ratio is dominated by youth dependents. For instance, Zhang, Zhang, & Lee (2003) examined the impact of declines in adult mortality on growth in an overlapping generations model. With public education and imperfect annuity markets, a decline in mortality affects growth. Ono (2003) found the ageing lead to a deficit budget when government finances the social security and the tax revenue is deficient. The "pay-as-you-go" scheme would be preferred in this case. However, if the economy slows down, the fair pension scheme would be preferred. Athukorala and Tsai (2003), in Taiwan, found the significantly negative impact of Taiwanese household saving rate. The saving is necessary for increasing economic growth as the role of accumulation capital. Therefore, the impact of a larger ageing population also diminishes economic growth in the future. Lindh (2004), focusing on the dependency ratio, emphasized that the problem of ageing is not so much a question of the GDP level per se but of redistribution. No matter what the growth rate is, we either get a decrease in the relative standard of living of the elderly or we have to redistribute a sizable part of productivity growth from the active generation to the elderly. Davies and Robert (2006) studied the role of population ageing for foreign direct investment (FDI) and the strategic taxation of capital. the study argued that foreign firms will not invest in a country with an ageing population since the working age population is scarce, consequently negatively affecting the country's capability to produce wealth. Walder and Döring (2012) argued that the degree of inequality regarding the population age structure of a country impacts on the consumption pattern of its households. Due to the ageing problem, the overall demand for certain goods will be affected, since they will not provide any utility for the older household. Prettner (2012) posited that older individuals tend to save more. As a result, they provide more resources for investment, which positively affects economic growth. In fact, the rise in longevity will positively influence investment, particularly in R&D which is generally recognized as an engine for economic growth (Aghion and Howitt, 1992). Freitas and Martins (2014) analyzed the impact of health, pension systems and longevity on savings. The study used a simple life-cycle model embodying social transfers (health care and pension expenditures) and changes in longevity to determine the level of household savings. In another related study, Bloom, Canning & Finlay (2016) empirically examined the relationship between ageing population and economic growth in Asia between 1970 and 2014 relying on both descriptive statistics and fixed (dynamic) panel regression model. The finding of the study includes a negative relationship between ageing population and economic growth.

2.3 Gap in Literature

Most of the studies reviewed focused mainly on the impact of specific components of demography on economic growth. For example, Fox & Dyson (2008) examined the effect of urban population on economic growth; De Moor & Van Zanden (2010) and Özpolat & Yıldırım (2009) investigated the effect of population distribution by gender on economic growth; and Bloom & Williamson (1998) and Freitas & Martins (2014)

empirically showed the effect of population distribution by dependency on economic growth. These studies failed to establish the relative effect of different components of demography on economic growth. This study considers this to be a gap and as such is set out to fill the gap. Moreover, the studies reviewed did not also categorize countries into income groups to also show the effect of changes in different components of demography on economic growth of these economies. The authors of this study posit that a comparative analysis of the effect of changes in different components of demography on economic growth of different categories of economies is a worthwhile empirical investigation for drawing comparison-based conclusion.

III. METHODOLOGY

3.1 Research Design

The quantitative research design was adopted for this study. To achieve the objectives of the study, the parametric (panel regression) econometric tool were employed. The work is majorly quantitative.

3.2 Data and Scope of Study

Secondary data are used in the study. The balanced panel consists of annual data on 42 African countries (including MENA and SSA countries). The verifiable data are gathered from the World Development Indicator (WDI) published by the World Bank. Moreover, the study covered the period 1983-2017. The period covered was not based on any demographic or economic factor. Rather it was due to availability of data for all the countries selected. While demography was measured by ageing/young dependency, rural/urban population, and male/female; economic growth was proxied by GDP per capita growth rate.

3.3 Model Specification

Panel (cross-section and time series) data were pooled to investigate the relationship between different demographic components and economic growth. The specified model is used for the different categories of countries as set out in this study. The functional form of the model is thus:

$$\text{gdppcgr} = f(\text{adrwge, adrold, adryng, popfem, popmale, popruralgr, popurbangr}) \quad 3.1$$

Where

gdppcgr = GDP per capita growth rate

adrwge = Age dependency ratio (% of working-age population)

adrold = Age dependency ratio, old (% of working-age population)

adryng = Age dependency ratio, young (% of working-age population)

popfem = Population, female

popmale = Population, male

popruralgr = Rural population growth (annual %)

popurbangr = Urban population growth (annual %)

3.4. Estimation Procedure

3.4.1 Panel Unit Root Test

In order to investigate the possibility of panel cointegration, it is first necessary to determine the existence of unit roots in the data series. For this study we have chosen theIm, Pesaran and Shin (IPS, hereafter), which is based on the well-known Dickey-Fuller procedure. This decision is based on the fact that IPS test has been found to have superior test power by researchers in economics to analyze long-run relationships in panel data, we will also employ this procedure in this study. IPS begins by specifying a separate ADF regression for each cross-section with individual effects and no time trend:

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t\ 1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{i,t\ j} + \varepsilon_{it} \quad 3.2$$

where i = 1, . . ., *N* and *t* = 1, . . ., *T*

IPS use separate unit root tests for the *N* cross-section units. Their test is based on the Augmented Dickey-fuller (ADF) statistics averaged across groups. After estimating the separate ADF regressions, the average of the *t*-statistics for p_1 from the individual ADF regressions, $t_{iT_i}(p_i)$:

$$\bar{t}_{NT} = \frac{1}{N} \sum_{i=1}^{N} t_{iT}(p_i \beta_i) \quad 3.3$$

The *t*-bar is then standardized and it is shown that the standardized *t-bar* statistic converges to the standard normal distribution as N and $T \to \infty$. IPS (1997) showed that *t-bar* test has better performance when N and T are small. They proposed a cross-sectionally demeaned version of both test to be used in the case where the errors in different regressions contain a common time-specific component.

3.4.3 Regression Model

Both fixed and random effect panel data analyses are applied to deal with the sector heterogeneity, which may be caused by characteristics that differ among countries but are invariant over time. Problems such as heteroscedasticity and multicollinearity are also taken into consideration.

We follow the setup and let the growth of countries *i =1*,…, N, at time t = 1983,…, 2017, be denoted as y_{it} .Specifically, in this model GDP per capita growth rate should vary across country and over time. Since the demographic variables determining countries' GDP per capita growth rate may change over time, it is possible that GDP per capita growth rate itself may also move over time for the same country. We

denote country-specific variables as "F" and demographic variables as "M" in our model below (3.4). In this model, both sector specific and capital investment variables vary across time and sectors. The model is specified as follows:

$$y_{it} = \alpha + \sum_{k=1} \beta_k F_{k'it} + \sum_{j=1} \gamma_j M_{j't} + u_{it} \qquad 3.4$$

3.4.3.1 Fixed Effects Model

In the regression equation (3.4), the disturbance term u_{it} could be decomposed in an individual entity-specific effect u_i, and a remainder disturbance, v_{it}. The residual u_{it} contains the effects of all the unobserved variables that are not included in the regression and varies over time and across entities. Consequently, the disturbance term may be defined as:

$$u_{it} = \mu_i + v_{it} \qquad 3.5$$

So, we can rewrite equation (3.4). First we simplify our notation of country specific "F" and demographic variables "M" with x_{it} (1×k vector of explanatory variables) and then we substitute with the new definition of u_{it}.

$$y_{it} = \alpha + \beta x_{it} + \mu_i + v_{it} \qquad 3.6$$

3.4.3.2 Random Effects Model

Another way to account for heterogeneity is to run the random effects model. The Random Effects model, which is equivalent to the Generalized Least Square (GLS), needs to follow some severe restrictions in order to be applied in our regression. According to this method, the subtraction of the necessary mean value seems to be a better and more advanced solution than subtracting the whole mean value over all the cross-section units. Therefore, using the Random effect model we do not lose any degrees of freedom, since we do not use more variables, we just make transformations, so it is more efficient than the dummy fixed test. The problem of the Random effect model is that it follows a severe restriction since it is necessary for the independent variables to be exogenous $[Cov(\mu_i, x_{it}) = 0]$, so as not to have biased and inconsistent estimates. As it follows, we are going to run a Hausman Test to check the applicability of the Random model. Furthermore, if we reject the null hypothesis of Hausman Test, we will use the fixed effect model.

$$y_{it} = \alpha + \beta x_{it} + \varepsilon_i + v_{it} \qquad 3.7$$

Where $\omega_{it} = \varepsilon_i + v_{it}, \varepsilon_i \sim IDD(0, \sigma_\varepsilon^2)$ and $v_{it} \sim IDD(0, \sigma_v^2)$

The μ_t are independent of the v_{it} and both ε_i and v_{it} are independent of the x_{it}.

IV. EMPIRICAL RESULTS

4.1 Unit Root Test

Table 4.1, presents the results of the IPS panel unit root test for the data used in this paper. The result shows that all the variables were stationary levels. These results clearly show that the null hypothesis of a panel unit root in the level of the series can be rejected at various lag lengths for all the variables. Given the results IPS tests, it is not necessary to apply panel cointegration method in order to test for the existence of the stable long-run relation among the variables since they are all integrated of order zero. The panel regression results are therefore presented and discussed in the next sub-section.

Table 4.1: Panel Unit Root Test – Im, Pesaran and Shin (IPS)

Variables	All Selected African Countries	High and Upper Middle Income Countries in Africa	Lower-Middle Income Countries in Africa	Low Income Countries in Africa
	IPSTest Stat. [Order ofIntegration]	IPSTest Stat. [Order ofIntegration]	IPSTest Stat. [Order ofIntegration]	IPSTest Stat. [Order ofIntegration]
gdppcgr	14.25**[I (0)]	8.58**[I (0)]	8.89**[I (0)]	11.07**[I (0)]
lnadrwge	2.72**[I (0)]	9.39**[I (0)]	5.94**[I (0)]	14.84**[I (0)]
lnadrold	2.65**[I (0)]	4.34**[I (0)]	6.73**[I (0)]	11.84**[I (0)]
lnadryng	3.90**[I (0)]	9.22**[I (0)]	4.59**[I (0)]	14.89**[I (0)]
lnpopfem	19.11**[I (0)]	9.67**[I (0)]	2.31*[I (0)]	15.04*[I (0)]
lnpopmale	19.83**[I (0)]	8.42**[I (0)]	8.11**[I (0)]	14.82**[I (0)]
popruralgr	5.88**[I (0)]	8.36**[I (0)]	9.65**[I (0)]	11.15**[I (0)]
popurbangr	3.48**[I (0)]	7.24**[I (0)]	9.78**[I (0)]	12.10**[I (0)]

Source: Authors Computation, 2019

Note: All statistics are in absolute term;**, * indicates rejection of the null hypothesis of no-cointegration at 1% and 5%, levels of significance

4.2 Estimated Growth Models

4.2.1 Hausman Test

Both random and fixed effects results of the panel regression models for the categories of countries are presented in table 4.2. But to choose the effect that best explains the model, we employed the Hausman test which specifies its null hypothesis as accept random effect while the alternative hypothesis is reject random effect. From table 4.2, while the probability based on the Hausman test is greater than 0.05 for models estimated for the three sub-categories of countries, it is less than 0.05 for the model estimated for all the countries. Hence, the Hausman test statistics was not significant for models estimated for the three sub-categories of countries; but significant for the model estimated for all the countries. Therefore, while impact of changes in demography on economic growth will be examined based on the random effects for the three sub-categories of countries, the impact of changes in demography on economic growth for all the countries will be examined based on the fixed effect.

Table 4.2 Fixed and Random Effect Panel Regression

	All Selected African Countries		High and Upper-Middle Income Countries in Africa		Lower-Middle Income Countries in Africa		Low Income Countries in Africa	
Variables	FE	RE	FE	RE	FE	RE	FE	RE
lnadrwge	-54.57**	-41.13*	3.71	-12.33	-94.76*	-113.69**	175.11	147.23
lnadrold	12.20**	5.46*	-1.80	-0.55	11.02**	8.20*	-6.02	-8.55
lnadryng	48.72**	29.22*	-10.19	4.78	85.46*	99.48**	-167.42	-148.91
lnpopfem	47.37**	6.15	-8.08	-5.63	0.06	0.11	12.43	-0.63
lnpopmale	- 40.09**	-6.12	7.50	4.94	-0.89*	-1.34**	-12.20	1.36
popruralgr	0.57**	0.57**	-0.34	-0.51	-0.11	-0.60	0.92**	1.04**
popurbangr	0.97**	0.93**	1.21**	1.00**	0.27	-0.15	1.11**	0.99**
Constant	-106.24**	41.71**	36.37	42.62	72.44*	124.65**	-45.02	-3.83
R^2 Within	0.070	0.030	0.080	0.077	0.098	0.081	0.114	0.102
R^2 Between	0.050	0.420	0.077	0.026	0.321	0.408	0.003	0.241
R^2 Overall	0.000	0.060	0.056	0.059	0.069	0.107	0.091	0.109
HT [Prob>chi2]	**0.00**		**0.25**		**0.06**		**0.27**	

Source: Author's Computation, 2019.

Note: **, * indicates rejection of the null hypothesis at 1% and 5 levels of significance respectively.

Hausman test (HT):If H_0 is accepted, then RE best explains model; If $H_0$is Rejected, the FE best explains model

- *Impact of Changes in Demography on Economic Growth Among African Countries*

The fixed effect model is the basis for examining the impact of changes in demography on economic growth among selected African countries. First, the result shows that there is variation in the impact of changes in selected components of age dependency ratio of the population on growth in GDP per capita among selected African countries. While increase in age dependency ratio of aged (measured in % of working-age population) and age dependency ratio of the young (measured in % of working-age population) by 1% had positive and significant impact on growth in GDP per capita among selected African countries; increase in age dependency ratio of the entire population (measured in% of working-age population) by 1% had negative and significant impact on growth in GDP per capita among African countries. Secondly, the result also shows that there is variation in the impact of changes in composition of gender population on growth in GDP per capita among selected African countries. While 1% increase in female population had positive and significant impact on growth in GDP per capita among selected African countries; 1% increase in male population had negative and significant impact on growth in GDP per capita among selected African countries. Thirdly, impact of changes in population in both urban and rural areas had positive and significant impact on economic growth. 1% increase in urban and rural population had positive and significant impact on growth in GDP per capita among selected African countries. Lastly, there is a significant difference between the R^2 within (i.e. 0.070) and the R^2 overall (0.000) produced by the fixed effect method. Since Kunst (2013) posit that evidence for individual effects is not so important if the within and overall R^2 are close, we conclude that evidence for individual effects is so important since there is a significant gap between the R^2 within and overall (i.e. 0.070&0.000) respectively. Hence, the impact of the selected indicators of demography on economic growth is not the same for all the African countries selected.

- *Impact of Changes in Demography on Economic Growth among Selected High and Upper-Middle Income Countries in Africa.*

The random effect model is the basis for examining the impact of changes in demography on economic growth among selected high and upper-middle income African countries. First, the result shows that there is variation in the impact of changes in selected components of age dependency ratio of the population on growth in GDP per capita among selected high and upper-middle income African countries. While increase in age dependency ratio of the entire population (measured in % of working-age population)and age dependency ratio of aged (measured in % of working-age population) by 1% had negative and insignificant impact on growth in GDP per capita among selected high and upper-middle income African countries; increase in age dependency ratio of the young (measured in % of working-age population) by 1% had positive and insignificant impact on growth in GDP per capita among selected high and upper-middle income African countries. Secondly, the result also shows that there is variation in the impact of changes in composition of gender population on growth in GDP per capita among selected high and upper-middle income African countries. While 1% increase in female population had negative and insignificant impact on growth in GDP per capita among selected high and upper-middle income African countries; 1% increase in male population had positive and significant impact on growth in GDP per capita among selected high and upper-middle income African countries. Thirdly, the result also shows that there is variation in the impact of changes in population in urban and rural areas of the selected high and upper-middle income African countries. While changes in rural population had a negative and insignificant impact on economic growth; 1% increase in urban population had positive and significant impact on growth in GDP per capita among selected high and upper-middle income African countries. Lastly, there is a significant difference between the R^2 within (i.e. 0.077) and the R^2 overall (0.059) produced by the random effect method. Since Kunst (2013) posit that evidence for individual effects is not so important if the within and overall R^2 are close, we conclude that evidence for individual effects is so important since there is a significant gap between the R^2 within and overall (i.e. 0.077& 0.059) respectively. Hence, the impact of the selected indicators of demography on economic growth is not the same for all high and upper-middle income African countries selected for this study.

- *Impact of Changes in Demography on Economic Growth among Selected Lower-Middle Income Countries in Africa.*

The random effect model is the basis for examining the impact of changes in demography on economic growth among selected lower-middle income African countries. First, a variation in the impact of changes in selected dimensions of age dependency ratio of the population on growth in GDP per capita among selected lower-middle income African countries was observed. While increase in age dependency ratio of aged (measured in % of working-age population) and age dependency ratio of the young (measured in % of working-age population) by 1% had positive and significant impact on growth in GDP per capita among selected lower-middle income African countries; increase in age dependency ratio of the entire population (measured in % of working-age population) by 1% had negative and significant impact on growth in GDP per capita among lower-middle income African countries. Secondly, the result also shows that there is a variation in the impact of changes in composition of gender population on growth in GDP per capita among selected lower-middle income African countries. While 1% increase in female population had positive but insignificant impact on growth in GDP per capita among selected lower-middle income African countries; 1% increase in male population also had negative and significant impact on growth in GDP per capita among selected lower-middle income African countries. Thirdly, the result also shows that there is no variation in the impact of changes in population in urban and rural areas of the selected lower-middle income African countries. While changes in rural population had a negative and insignificant impact on economic growth; 1% increase in urban population also had a negative and insignificant impact on growth in GDP per capita among selected lower-middle income African countries. Lastly, there is a significant difference between the R^2 within (i.e. 0.081) and the R^2 overall (0.107) produced by the random effect method. Since Kunst (2013) posit that evidence for individual effects is not so important if the within and overall R^2 are close, we conclude that evidence for individual effects is so important since there is a significant gap between the R^2 within and overall (i.e. 0.081& 0.107) respectively. Hence, the impact of the selected indicators of demography on economic growth is not the same for all lower-middle income African countries selected for this study.

- *Impact of Changes in Demography on Economic Growth among Selected Low Income Countries in Africa.*

The random effect model is the basis for examining the impact of changes in demography on economic growth among selected low income African countries. First, a variation in the impact of changes in selected dimensions of age dependency ratio of the population on growth in GDP per capita among selected low income African countries was observed. While increase in age dependency ratio of aged (measured in % of working-age population) and age dependency ratio of the young (measured in % of working-age population) by 1% had negative and insignificant impact on growth in GDP per capita among selected low income African countries; increase in age dependency ratio of the entire population (measured in % of working-age population) by 1% had positive and insignificant impact on growth in GDP per capita among low income African countries. Secondly, the result also shows that there is a variation in the impact of changes in composition of gender population on growth in GDP per capita among selected low income African countries. While 1% increase in female population had negative but insignificant impact on growth in GDP per capita among selected low income African countries;

1% increase in male population also had a positive and insignificant impact on growth in GDP per capita among selected low income African countries. Thirdly, the result also shows that there is no variation in the impact of changes in population in urban and rural areas of the selected low income African countries. While changes in rural population had a positive and significant impact on economic growth; 1% increase in urban population also had a positive and significant impact on growth in GDP per capita among selected low income African countries. Lastly, there is no significant difference between the R^2 within (i.e. 0.102) and the R^2 overall (0.109) produced by the random effect method. Since Kunst (2013) posit that evidence for individual effects is not so important if the within and overall R^2 are close, we conclude that evidence for individual effects is not so important since there is no significant gap between the R^2 within and overall (i.e. 0.102& 0.109) respectively. Hence, the impact of the selected indicators of demography on economic growth is not the same for all low income African countries selected for this study.

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

This study has provided evidence on effect of changes in demography on economic growth of African countries. While the examined dimension of demography proved to have significantly influenced economic growth in Africa, the nature of the impact of changes in the examined dimensions of demography were found not to be the same. While age dependency ratio of the aged and young population appeared to have individually had positive and significant impact of growth of African economies, the total age dependency ratio has impacted negatively on the growth of African economies over the period examined. Worthy of mention, is that the magnitude of the impact of the age dependency ratio of the young population is about 400% that of the age dependency ratio of the aged population. Increase in female population, unlike male population, was observed to have contributed positively to the growth among African countries. Though increase in rural and urban population was observed to have contributed positively to growth, the magnitude of increase in urban population on growth appeared to higher. Growth in urban population has had positive significant impact on economic growth among high and upper-middle income African countries. While age dependency ratio of the aged and young population appeared to have individually impacted positively and significantly on growth of lower-middle income African economies, the total age dependency ratio has impacted negatively on the growth of lower-middle income African economies over the period examined. Increase in male population in lower-middle income African countries again had a negative significant impact on economic growth. Moreover, though increase in both rural and urban population had positive and significant impact on economic growth of low income African countries, growth in the rural population had more impact than that of growth in urban population. Lastly, except among low income countries, the effect of selected demography variables on growth of individual African countries varies.

Some conclusion could be drawn from the summary of findings above. Total age dependency ratio of the African population has made it difficult for the continent to achieve its growth potential over the years. And that age dependency ratio of the young population spurs growth than age dependency ratio of the aged. Increase in female population is a catalyst for economic growth among African countries. Increase in urban population accounted for the growth of high and upper-middle income African countries. Again, total age dependency ratio of the entire population of lower-middle income African countries reduces growth; and that age dependency ratio of the young population spurs growth than age dependency ratio of the aged among lower-middle income African countries. Increase in male population has also reduced growth among lower-middle income African countries. Low income countries, though benefit from growth in urban population, derive their economic growths more from growth in rural population. This may not be unconnected to the fact that most low income countries are mainly into rural agricultural production.

First, this study recommends that the efforts should be made by government of African countries to invest massively (both in education and health) in development of the young and ageing population. Economic empowerment programmes should concentrate more on the women population as women in African tend to be more enterprising in small businesses that has been considered as a catalyst for growth in the African continent. Low income countries should make significant investment in infrastructural facilities and agricultural sector in the rural areas.

REFERENCES

[1]. Adebisi, A. (2014). *Adverse Geography and the Challenge of Sustainable Development in Nigeria*. A paper presented at the 2014 Annual Conference of the Association of American Geographers (AAG), held in Tampa, Florida, USA, April 8 -12, 2014.

[2]. Aghion, P., & Howitt, P. (1992). A Model of Growth Through Creative Destruction. *Econometrica*, 60(2), 323–351.

[3]. Arthur, W. B. & McNicoll, G. (1977). Optimal time paths with age-dependence: A theory of population policy. *The Review of Economic Studies*, 44(1), 111–123.

[4]. Arthur, W. B. & McNicoll, G. (1978). Samuelson, population and intergenerational transfers. *International Economic Review*, 19(1), 241–246.

[5]. Athukorala, P.-C., & Tsai, P.-L. (2003). Determinants of household saving in Taiwan: growth, demography and public policy. *The Journal of Development Studies*, 39(5), 65-88.

[6]. Beall, J. & Fox, S. (2009). *Cities and Development*. London: Routledge.

[7]. Bloom, D. E. & Williamson, J. G. (1998). Demographic Transitions and Economic Miracles in Emerging Asia. *World Bank Economic Review*, 12(3), 419-455.

[8]. Brockerhoff, M. & Brennan, E. (1998). The poverty of cities in developing regions. *Population and Development Review*, 24(1), 75-114.

[9]. Crook, N. (1997) Principles of Population and Development, Oxford: Oxford University Press.

[10]. d'Albis, H., Carole B., Julien N., Jacques P., Hector T.& Franc¸ois-Charles, W. (2015) The lifecycle deficit in France, 1979–2005. *The Journal of the Economics of Ageing*, 5, 79–85.
[11]. Davies, B. R., & Robert III, R.R. (2006). *Population aging, foreign direct investment, and tax competition.* SAID Business School, 1HPWP 07/10.
[12]. de la Croix, D.& Philippe, M. (2002). A Theory of Economic Growth, vol. 1. Cambridge, UK: Cambridge University Press.
[13]. De Moor, T.,& Van Zanden, J. L. (2010). Girl power: the European marriage pattern and labour markets in the North Sea region in the late medieval and early modern period. *Economic History Review*, 63(1), pp.1-33.
[14]. Diamond, P.A. (1965) National debt in a neoclassical growth model. *The American Economic Review*, 55(5), 1126–1150.
[15]. Fox, S. and T. Dyson (2008). *On the relationship between population growth and economic growth: historical and sect oral considerations.* Unpublished paper, London School of Economics.
[16]. Galor, O., & Moav, O. (2002). Natural selection and the origin of economic growth. *Quarterly Journal of Economics*, 117, 1133-1191.
[17]. Galor, Oded, & Weil, D.N. (2000). Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and Beyond. *American Economic Review*, 90(4), 806-828.
[18]. Hall, R., Scoones, I., & Tsikata, D. (2017). Plantations, out growers and commercial farming in Africa: agricultural commercialization and implications for agrarian change.*The Journal of Peasant Studies*, 44(3), 515-537, DOI: 10.1080/03066150.2016.1263187.
[19]. Ho, C.P. (2016). Rise of Women in Unified Growth Theory: French Development Process and Policy Implications. *MPRA Paper* No. 73864.
[20]. Jacobs, J. (1972). *The Economy of Cities*. Harmondsworth: Penguin Books.
[21]. Kunst, R. M. (2013). *Econometrics Methods for Panel Data*. Institute of Advance Studies, University of Vienna, Vienna.
[22]. Lee, R. (1980). Age structure intergenerational transfers and economic growth: An overview. *Revue Economique*, 31(6), 1129–1156.
[23]. Lee, R. (1994). The formal demography of population aging, transfers and the economic life cycle. In *Demography of Aging*, pp. 8–49. Washington, D.C., U.S.A.: National Academy Press.
[24]. Lindh, T. (2004). Medium-term forecasts of potential GDP and inflation using age structure information. *Journal of Forecasting*, 23, 19–49.
[25]. Massey, D. S. (1996). The age of extremes: concentrated affluence and poverty in the twenty-first century. *Demography*, 33(4), 395-412.
[26]. Modigliani, Franco and Richard Brumberg (1954) Utility analysis and the consumption function: An interpretation of cross-section data. In *The Collected Papers of Franco Modigliani*, vol. 2, pp. 3–46. New Brunswich, NJ, USA: The MIT Press.
[27]. Morrison, A., Raju, D., & Sinha, N. (2007). Gender equality, poverty and economic growth. *Policy Research Working Paper* No. 4349.
[28]. Nagarajan, R., Teixeira, A.A.C., & Silva, S.(2013). The Impact of an Ageing Population on Economic Growth: An Exploratory Review of the Main Mechanisms. *FEP Working Paper* No. 504.
[29]. Nargund, G. (2009). Declining birth rate in Developed Countries: A radical policy re-think is required.F, V & V in *ObGyN*, 1(3), 191-193.
[30]. Ono, Tetsuo. (2003). Social security policy with public debt in an aging economy. *J Popul. Econ*, 16, 363-387.
[31]. Özpolat, A., & Yildirim, M. (2009, June). *In developing countries, relationship between women's education and growth*. Paper presented at EconAnadolu 2009: AnadoluInternational Conference in Economics, Eskisehir, Turkey.
[32]. Orlická, E. (2015). Impact of population ageing and elderly poverty on macroeconomic aggregates. *Procedia Economics and Finance*, 30, 598 – 605.
[33]. Prettner, K. (2012). Population ageing and endogenous economic growth. *Journal of Population Economics*, 26(2), 811–834.
[34]. Samuelson, P.A. (1958) An exact consumption-loan model of interest with or without the social contrivance of money. *Journal of Political Economy*, 66(6), 467–482.
[35]. Scheidel, W. (1996*). Measuring Sex, Age and Death in the Roman Empire: Explorations in Ancient Demography*. Ann Arbor.
[36]. Sheltzer, J. M., & Smith, J. C. (2014). Elite male faculty in the life sciences employ fewer women. *PNAS* 111, 10107–10112. doi: 10.1073/pnas.1403334111
[37]. Voigtländer, N., & Voth,H.-J. (2006). Why England? Demographic factors, structural change and physical capital accumulation during the Industrial Revolution. *Journal of economic growth*, 11(4), 319-361.
[38]. Walder, B. A. and Döring, T. (2012). The effect of population ageing on private consumption – a simulation for Austria based on household data up to 2050. *Eurasian Economic Review*, 2, 63-80.
[39]. Weil, P. (2008) Overlapping generations: The first jubilee. *Journal of Economic Perspectives*, 22(4), 115–134.
[40]. Wesley, E., & Peterson, F. (2017). The Role of Population in Economic Growth. *SAGE Open*, October-December, 1 –15.
[41]. Willis, Rober (1988) Life cycles, institutions, and population growth: A theory of the equilibrium interest rate in an overlapping generations model. In R. Lee, W. B. Arthur and G. Rogers (eds.), *Economics of Changing Age Distributions in Developed Countries*, pp. 106–138. Oxford, UK: Oxford University Press.
[42]. Yaari, M. E. (1965). Uncertain lifetime, life insurance, and the theory of the consumer. *The Review of Economic Studies*, 32(2), 137–150.
[43]. Zhang, J., Zhang, J., & R. Lee. (2003). Rising longevity, education, savings, and growth. *Journal of Development Economics*, 70, 83-101.