Impact of Labour Force Dynamics on Economic Growth in Nigeria: An Empirical Analysis Using ARDL Bound Testing Approach

Ademola Obafemi Young
Department of Economics, Mountain Top University, Ogun State, Nigeria

Abstract
This paper examined empirically the impact of labour force dynamics on economic growth in Nigeria over the period 1970–2015 using the newly developed bounds testing approach to co-integration. The results obtained revealed that both the short-run and long-run growth impacts of labour force dynamics in Nigeria are significant and positive. In particular, the results showed that for a one-percentage point increase in labour force dynamics, 1.0825 percent per capital real GDP is induced in the long-run. Having ascertained the significance of labour force dynamics in positively influencing economic growth in Nigeria, the study, thus, recommends that the government should implement a broad set of employment generating policies with the ultimate aim of fostering a sustained increase in the growth rate of real GDP.
Keywords: Labour Force Dynamics; Demographic Transition; Economic Growth.

1. Introduction

As of 1970, with an estimated population of 55.98 million and growing at nearly 3 percent annually between 1973 and 1980 (World Development Indicator, WDI, 2017) and; with an approximately 25 percent annual real GDP growth, Nigeria was one of the fastest growing economies in the world, the most populous country in Africa and accounts for one in five of Sub-Sahara’s people (Tartiyus, Dauda, and Peter, 2015). However, as impressive as the above figures may appear, the country tends to be least able to cope with the development and environmental consequences arising from rapid population growth owing to low per capita incomes, indebtedness, and limited capacity for investments (Adewole, 2012). In particular, a considerable amount of the country’s resources is, undoubtedly, consumed instead of being accumulated as capital for development purposes (Onwuka, 2013).

Consequently, in the mid-1980s, in view of these negative development impacts and challenges posed by Nigeria’s population size and rapid rate of increase occasioned by lag between the decline in infant mortality and fertility, government in 1988 promulgated its first explicit population policy tagged the *National Policy on Population for Development, Unity, Progress, and Self Reliance.* This policy document has a number of quantitative demographic targets. Paramount among these is the intention to reduce, fertility- the average number of children that would be born per woman if all women were to live to the end of their child-bearing years and bear children at each age in accordance with prevailing age specific fertility rates- to four by the year 2000 (Mba, 2002). As noted in the Baseline Report (1994), the major goal of the policy was to reduce the growth rate of the nation’s population by means of fertility regulations. Eight out of the ten specific objectives were directed on how to reduce the level of fertility and one on how to reduce the mortality rate, particularly the infant mortality rate (Omohan and Maliki, 2007).

Although the contents of the policy are plausible and a positive demographic change was noticed statistically after the implementation, however, the implementation is constrained by unfavourable cultural norms, religious beliefs, low status and education of women, poor quality of family planning services, and so on. Thus, in 2004, the policy was revised to give way to the *National Policy on Population for Sustainable Development* launched in 2005. The revised version admitted the diversities in the country as well as the implementation challenges. It went further to identify new challenges that emanated from 1991 National Population Census, 1994 International Conference on Population and Development, the 1999 HIV/AIDS Summit in Abuja, and was equally envisaged among other targets to achieve: a reduction of national annual population growth rate of 2% or lower by the year 2015, a reduction in the total fertility rate of at least 0.6 children every five years, a reduction in the infant mortality rate to 35 per 1,000 live births by 2015, a reduction in the child mortality rate to 45 per 1,000 live births by 2010 (Enang and Ushie, 2012).

Consequent upon the introduction of these policies, fertility has been found to be in neighbourhood of 4 having plummeted from an average of 7 in 1980s while infant mortality rate (i.e. the number of children who die under a year of age divided by the number of live births that year) has fallen from 195.4 in 1970s to 69.4 per 1000 population in 2015 (World Development Indicator, 2017). In essence, Nigeria, like other countries around the world, is in the midst of demographic transition (i.e. the transition from high fertility and mortality rates to lower fertility and mortality rates). In the context of the literature, one of the profound effects of demographic transition on the economy, has been changes in the size and demographic composition of the population particularly the labour force. For instance, the classical demographic transition model identifies four phases of demographic transition, corresponding to different combinations of stages of mortality and fertility decline, with specific characteristics of population age structure that come from the time lag between the declines of mortality and fertility (see figure 1 in appendix 1).

At the initial phase, mortality and fertility rates are both high with minimal population growth. In the second phase mortality, particularly among infants and children driven by improvement in health care facilities through the control and eradication of infectious communicable diseases as well as improved nutrition, is falling. Adult mortality also declines. However, unlike mortality, fertility rate remains high. The lag between the mortality declines and fertility leads to a rejuvenation of the age distribution as the proportion of children increases. As the survival probability of each child increases, parents perceive fewer children are needed to reach desired family sizes. Thus, during the late transition phase, the decline in infant mortality brings about a steady fertility decline. Precisely, during the third phase, as birth rates decline the youth share of the population contracts and the working age share expands thereby trigger an increase in labour force. Finally, in phase four, the decline in mortality accompanied by increase in life expectancy and arrival of population bulge at retirement age swells the number of old dependents and cause the dependency ratio to rise again.

Most of the developed world, notably the East Asian nations and Europe, are at the advanced stage of the transition; other regions, including Latin America and the Caribbean, began their transitions in the 1960s and 1970s (Bloom, Canning and Sevilla, 2001). In Sub-Saharan Africa (SSA), however, evidence of sustained mortality and fertility decline became clear in the 1980s, with a 20-year lag compared to what has been observed in Asia, Latin America and the Caribbean (Guengant and May, 2011). As is the case in other parts of SSA, Nigeria is in the third phase of the transition: a transition from age structures dominated by children to age structures concentrated in working ages. In particular, these changes in age structures marked the outset of a period, known as demographic window of opportunity, in which the proportion of population in potentially productive ages notably the labour force, grows increasingly relative to the proportion of people in potentially unproductive ages.

More importantly, as argued in the literature, this increase in labour force population appears to position a country for increase productive potentials. This is because during the demographic window, firstly, consumption per effective consumer can rise at the same time that the share of GDP consumed declines, because of the more favourable age distribution. This means that a larger share of national output can be diverted from consumption into investment opportunities without sacrificing current living standards. Secondly, the demand for resources to support old age consumption begins to emerge. Thirdly, since fertility decline can free up time from child care, relatively more women are likely to enter the labour market. This brings about an increase in labour force participation and correspondingly labour supply, and by extension, raising economic support ratio (the ratio of the share of the working age population to the overall population) and similarly per capita income. Taken together, these effects are known as demographic dividends that is "the economic growth potential that can result from shifts in a population's age structure".

Nigeria's demographic trends in the coming decades hold potentials for rapid economic growth. Declining infant and child mortality helped to spur lower fertility effectively resulting in a temporary baby boom. As this cohort moves into working ages Nigeria finds itself with a potentially higher share of workers as compared with dependents. In the developed world this dividend provided a tailwind to growth for several decades leading up to the present, but rapid ageing and an expanding elderly dependent population have now turned demographics into a headwind. However, as the window closes in the developed world it is just opening in the developing world including Nigeria. Hence, to ascertain whether such improvement can be translated into better economic performance and development remains an empirical inquiry that needs to be confronted with statistics in Nigeria.

Although the literature hold a reservoir of empirical evidences of these immense demographic changes, however, most of them are based on European or Asian countries, which makes scanty the literature on the impact of labour force dynamics on economic growth that focus on developing world. In the case of Nigeria, while there is a sizeable literature on demographic trends and their economic implications (for instance, Agunwamba, Bloom, Friedman, Ozolins, Rosenberg, Steven, and Weston, 2009; Alao, 2010; Bloom, Finlay, Humair, Mason, Olaniyan, and Soyibo, 2010; Guengant and Kamara, 2012; Bloom, Humair, Rosenberg, Sevilla, and Trussell, 2013; Reed and Mberu, 2014), the econometric evidence for the growth impact of the demographic transition is limited.

This study, thus, attempts to investigate the impact of labour force dynamics (i.e. the short-term and long-term changes in the size of labour force occasioned by demographic transition) on economic growth in Nigeria. Hereafter, the rest of this paper is organized as follows: section 2 presents a review of literature while section 3 discusses the methodology; section 4 presents the results of the study and in section 5, we conclude the paper.

2. Literature Review

Assessing the consequences of population growth on the pace and process of economic growth is one of the oldest themes in the literature. Over the years, different views have come up regarding the consequences of population change on economic growth and development. Broadly speaking, there are three schools of thought to this debate, namely; the pessimistic, optimistic and neutral. The pessimists (Coale and Hoover, 1958; Ehrlich and Lui, 1997; Ehrlich and Ehrlich, 2009) argue that population change has negative impact on economic growth and development. However, the optimists (Boserup, 1981; Simon and Bartlett, 1985; Simon, 1981, 1986, 1990, 1996) contend that population pressure invokes technological changes leading to positive growth in the economy. Still, some studies (for instance, Bloom and Freeman, 1986, Thornton, 2001; Easterly and Levine, 1997, 2001, 2002) found no significant effects of population change on economic growth, giving rise to 'population neutralism'. Furthermore, as a reconciliation to the three scenarios, some studies, for instance Kelley and Schmidt (1994); Weeks (2011) state that the different perspectives of the relationship between population change and economic growth just reflect different phases a country goes through. A reversed U-shaped curve best explains this position that population growth tends to increase with economic growth at early stages of development while flattening out and eventually decreasing at higher levels of economic development. Empirically, studies have failed to suggest an overall dominance of one view over the other. Recently, to break the impasse in the population debate, a body of empirical literature examining the connection between population age structure and economic growth has emerged.

This strand of literature is influenced by the Life Cycle Hypothesis (LCH) which posits that a person's behaviour alters as he/she passes through different age groups, which translates into different economic outcomes over time. A young child is simply a net consumer and investments are needed for the child's health, education and other needs. However, a person becomes a net producer when he/she moves into the working age group. The person supports his/her dependents and at the same time will save for their retirement when their productivity levels are not expected to be as high. As old age dawns, the person is again a net consumer living off what they had saved in the past. This micro-level behaviour has big implications for the economy as a whole, in particular, during demographic transition. A country with a favourable age structure, i.e. when the proportion of population in potentially productive ages grows steadily relative to the number of people in potentially unproductive (inactive) ages, will be able to save more rather than diverting their excess incomes towards the upkeep of their dependents.

In line with this hypothesis (LCH), Bloom and Williamson (1997) find that demographic factors are important determinants of economic growth. Their results show that it is not overall population growth rate that drives economic performance but age distribution. The age distribution effect operates through the difference in growth rates of the working-age and the dependent population. The study found that increase in working age population explains as much as 1.4 to 1.9 percentage points of the GDP per capita growth in East Asia or as much as one third of the average East Asian miracle GDP per capita growth rate (1.9/6.1). In Southeast Asia, the estimated effect ranges from 0.9 to 1.8 points of economic growth or about half (1.8/3.8) of the recorded growth in GDP per capita.

Similarly, Bloom, Canning, and Malaney (1999) examines the links between demographic change and economic growth in Asia during 1965-90. They show that the overall rate of population growth had little effect on economic growth, but that changes in life expectancy, age structure, and population density have had a significant impact on growth rates. They also find strong evidence of feedback from higher income to population change via lower fertility, though a significant component of the demographic changes appears to have been exogenous. The results suggest that the demographic transition can act both as a catalyst and as an accelerator mechanism, and that demographic effects can explain most of East Asia's economic "miracle". East Asia benefited from a "virtuous spiral" of income growth and fertility decline, while South Asia seems to remain caught in a low-level population-income trap. Correspondingly, Becker, Glaeser, and Murphy (1999) revealed that the working age population had a greater positive impact on per capita output than the total population.

Bloom, Canning and Sevilla (2001) find that increases in the size of the working age population can produce a "demographic dividend" to economic growth. In an empirical study of US states, Persson (2002) finds that the age structure of the entire population affects output. Bloom and Canning (2004) undertakes a cross-country analysis from 1965 to 1995. They find that a favorable age structure has a positive impact on income growth provided that the country has a high degree of openness to trade. Feyrer (2008) examines the relationship between workforce demographics and aggregate productivity. Changes in the age structure of the workforce is found to be significantly correlated with changes in aggregate productivity. Different demographic structures may be related to almost one quarter of the persistent productivity gap between the OECD and low income nations as well as part of the productivity divergence between 1960 and 1990.

Evaluating the role of demographics for Europe, Kelley and Schmidt (2005) also found that the decline in child dependency ratio had a strong positive effect on the rate of growth in output per worker during the 1970s and 1980s. The general conclusion from these analyses is that, regardless of the method applied and set of additional control variables considered, the relationship between economic growth rate and demographic change seems to be robust.

Bloom, Canning, Fink and Finlay (2007) examines whether the determinants of growth in general, and the effects of demography in particular, are different in Africa, which still faces unfavorable demographic factors, than for the rest of the world. They find that Africa is on the brink of earning the demographic dividend. However, they remain cautious about this translating into economic growth because to harness the dividend efficiently, good institutions must be in place. While some African countries have undergone institutional reform, the others countries facing significant increases in their productive age groups like Ghana, Malawi and Namibia need to improve their institutional and policy environment. Similarly, Bloom *et al* (2007) in their study titled 'Does age structure forecast economic growth?' estimated the parameters of an economic growth model using a cross section of countries over the period 1960 to 1980, and investigated whether the inclusion of age structure improved the model's forecasts for the period 1980 to 2000. They found that including the age structure improved the forecast, although there is evidence of parameter instability between periods with an unexplained growth slowdown in the second period. They used the model to generate growth forecasts for the period 2000 to 2020.

Wei and Hao (2010) in their study titled 'Demographic Structure and Economic growth: Evidence from China' examine the economic implications of demographic change in the Chinese context. They extend the growth equation by incorporating age structure dynamics and applied it to China's provincial-level data during the period 1989–2004. They found that changes in demographic structure especially the contribution of fertility decline to lower youth dependency, have helped fuel China's economic growth since 1989. The effect of demographic change on income growth operates mainly through its impact on steady state income levels and the effect of age structure is more pronounced in provinces that are more open to market forces. They also found a significant feedback effect of economic growth on demographic behaviours through the mechanisms of birth rates, marriage age and life expectancy.

Using an economic growth model, Song (2013) in his study titled "Demographic Changes and Economic Growth: Empirical Evidence from Asia" examines the effects of demographic changes on economic growth in thirteen Asian countries (China, Hong Kong, Japan, South Korea, Singapore, Indonesia, Malaysia, the Philippines, Thailand, India, Bangladesh, Pakistan and Sri Lanka), which covers East, Southeast and South Asia during the period from 1965 to 2009. The results indicate negative effects of growth in the total population and the young population on economic growth while showing positive effects of growth in the working-age population and the working-age population ratio.

Huluka (2015) finds that while population growth has a large negative effect on per capita income growth, this effect is counteracted by large positive effect from growth in the share of the population that is economically active. Thus, the effect of population growth on economic development depends largely on the proportions of the working age and the policy mixes used to encourage people to work, save and invest. Iqbal, Yasmin, and Yaseen (2015) examines the impact of demographic transition and economic growth of Pakistan by using the time series data over the time period of 1974 to 2011. The study used the bound testing approach to co-integration; Autoregressive Distributed Lag (ARDL) model was also applied for analyzing the long run relationship whereas Error Correction Mechanism (ECM) was applied for analyzing the short run link of the demographic variables with economic growth. The numerical simulation of the study exhibited that the demographic transition positively affected the economic growth in the long run and negatively in the short run. The estimation of role of the demographic transition in Pakistan also proclaims the existence of demographic dividend.

In summary, from the review of literature above on population age structure-economic growth nexus, it is found that, firstly, though the literature hold a reservoir of empirical evidences, nonetheless, most of them are based on European or Asian countries. Secondly, the review on the nexus also reveals that, although, the setup of the models (with respect to the choice of explanatory variables and time periods) and the methods of estimation (single-country vs. cross-country vs. panel regressions) differ, yet the results of the various studies are generally compatible. Finally, an important finding on the nexus is the fact that the growth rate of the working-age population has a positive effect on the growth rate of output per capita. A phenomenon known as the demographic dividends (*i.e. an economic growth potential that is created by favourable shifts in the age distribution of the population*). In Nigeria, aside from the fact that empirical studies on the impact of labour force dynamics on economic growth were scanty, most available studies that were available (Eniang, 1977; Theodore, 2006; Adewole, 2012; and Nwosu, Dike, and Okwara, 2014) focused on the relationship between population change and development by following either pessimistic or optimistic views which by its nature have been far from being definitive on the effects of population age structures (most importantly labour force dynamics) on economic growth.

3. Data and Methods

3.1 Sources and Type of Data

The study made use of annual time series secondary data on real GDP, working age population, rate of natural increase in population, and gross domestic savings sourced from the publications of Central Bank of Nigeria

Statistical Bulletin (2016), Africa Development Indicators (2016), World Development Indicators (2017), and National Bureau of Statistics (2016).

3.2 Model Specification
In accordance with the literature, the logical starting point of determining the impact of labour force dynamics on economic growth lies in establishing a theoretical link between population change and economic performance. Since Malthus' 1798 book on population, many scholars have considered the imbalance between population and resources in general, and the implications of this imbalance in particular. Specifically, three alternative positions define this debate, namely; the pessimistic, optimistic and neutral. The pessimists argue that population change has negative impact on economic growth and development. Yet, the optimists contend that population pressure invokes technological changes leading to positive growth in the economy. Still, some studies found no significant effects of population change on economic growth, giving rise to 'population neutralism'. Furthermore, as a reconciliation to the three scenarios, some studies state that the different perspectives of the relationship between population dynamics and economic growth just reflect different phases a country goes through. A reversed U-shaped curve best explains this position that population growth tends to increase with economic growth at early stages of development while flattening out and eventually decreasing at higher levels of economic development.

Empirically, studies have failed to suggest an overall dominance of one view over the other. In this regard, the common practice is to employ the growth rate (or size) of total population for the former and the growth rate (or size) of GDP per capita for the later. Using size or growth rate of total population, however, ignores the heterogeneity within the population in terms of age structure (dependents versus independents) and economic activity (those in the labour force as employed or unemployed versus those economically inactive) among others. Two hypothetical countries identical in all aspects (including population size), except that one has more of its population in the labour force and lower rate of unemployment than the other does, are not expected to show the same relationship between demographic and economic variables (Wako, 2012).

Dissatisfaction with the use of a single measure of demographic factors – size or growth rate of total population – has led to the examination of various aspects of the demographic side of the equation. Bloom and Williamson (1998), Bloom, Canning and Sevilla (2001), Darrat and Al-Yousif (1999), Barro and Sala-i-Martin (2003), Yousif (2009), Prettner and Prskawetz (2010), Choudhry and Elhorst (2010) and Wako (2012) are among works calling attention to the need for and the significance of such a shift owing to demographic trends in the developing world. Consequently, disaggregating the effect of population growth into the effects of population in various age groups most notably into dependents (child and adult dependent population) and working-age populations (labour force), rate of natural in population increase or population growth rate emerged. Besides, considering birth rates and death rates separately instead of population growth rate has also joined the literature in the area. Kelley and Schmidt (1995) is one of the works forerunning both such practices. They have found significantly differing conclusions on population-development debate arising just from using traditional measures of demography or the disaggregated ones.

Hence, in line with these arguments and by taking cognizance of the fact that working age population, government policy on duration of education, minimum working age, dependency ratio, rate of natural increase in population have been identified in the literature as potential factors influencing labour force dynamics, consequently and for simplicity, labour force dynamics will be proxied by the growth rate of working age population defined in this study as population aged 15-64. Subsequently, following the previous literature, the estimation of the effect of labour force dynamics on economic growth in Nigeria the following four variables: per capita real GDP, rate of natural increase in population, growth rate of working-age population and gross domestic savings. Accordingly, the basic econometric model consisting of the logarithmic transformation of the four variables is written as follows:

$$\ln RGDPPC_t = \beta_0 + \beta_1 \ln RNI_t + \beta_2 \left(\partial \ln WAP_t\right) + \beta_3 \ln GDS_t + \mu_t \quad (1)$$

where $\ln RGDPPC_t$, $\ln RNI_t$, and, $\partial \ln WAP_t$ are natural log of per capita real GDP, natural log of rate of natural increase in population, growth rate of working-age population (proxy for labour force dynamics); the control variable which is $\ln GDS_t$, natural log of gross domestic savings respectively.

3.3 Methods of Data Analysis and Estimation Techniques
The study employs Autoregressive Distributed Lag (ARDL) Model. This is in view of the fact that an application of an ARDL approach offers considerable advantage in the sense that variables could have different order of integration I(0) and I(1), could have varying lag orders and could provide estimates of both short-run and long-

run coefficients simultaneously (Pesaran and Shin, 1999; Pesaran, Smith and Shin 2001). In addition, the endogeneity problems and inability to test hypotheses on the estimated coefficients in the long-run associated with the Engle-Granger (1987) method are avoided.

In view of the above advantages, following Pesaran *et al* (2001), the ARDL model representation of equation (3.1) is thus specified as follow:

$$\Delta \ln RGDPPC_t = \alpha_0 + \sum_{i=1}^{a} \alpha_{1i} \Delta \ln RGDPPC_{t-i} + \sum_{i=0}^{b} \alpha_{2i} \Delta \ln RNI_{t-i} + \sum_{i=0}^{c} \alpha_{3i} \Delta(\partial \ln WAP_{t-i}) + \sum_{i=0}^{d} \alpha_{4i} \Delta \ln GDS_{t-i}$$
$$+ \beta_1 (\ln RGDPPC)_{t-1} + \beta_2 (\ln RNI)_{t-1} + \beta_3 (\partial \ln WAP)_{t-1} + \beta_4 (\ln GDS)_{t-1} + \mu_t \quad (2)$$

Equation (2) is *ARDL* of order (*a, b, c, d*) which holds that economic growth is predisposed to be determined by its own lag, the lag values of rate of natural increase in population (*RNI),* labour force dynamics proxied by growth rate of working-age population *(WAP),* and gross domestic savings *(GDS).* The structural lags were determined on the basis of Hannan-Quinn information criteria (HQ), the Akaike information criteria (AIC), the Schwarz information criteria (SIC), the Log Likelihood (LL) and the Final Prediction Error (FPE). The $\beta's$ correspond to the long run effects (elasticities) whereas $\alpha's$ capture the short-run dynamics (elasticities) of the model. Also, Δ denotes the first difference operator, α_0 is the drift component and, u_t is white noise residual. Thus, from equation (3.2) in applying cointegration tests the study tested the null hypothesis of no cointegration $H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ against the alternative hypothesis $H_1 : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$ using the F-test (or Wald test).

Due to limitations of the conventional Wald-test F-statistic, Pesaran *et al* (2001) have suggested two critical values (lower and upper bound) to examine the relationship. Therefore, if the computed *F*-statistic is less than the lower bound value, the null is not rejected. On the contrary, if the computed *F*-statistics is greater than the upper bound value, it implies existence of long-run relationship among the variables. Finally, if the computed *F*-statistics lies between the lower bound and upper bound, long run association between the variables becomes inconclusive. Once a long-run cointegrating relationship has been confirmed, stage two of the ARDL model includes the estimation of the error correction model (ECM) associated with equation (2).

Thus, the error correction representation of the ARDL model is written as:

$$\Delta \ln RGDPPC_t = \alpha_0 + \sum_{i=1}^{a} \alpha_{1i} \Delta \ln RGDPPC_{t-i} + \sum_{i=0}^{b} \alpha_{2i} \Delta \ln RNI_{t-i} + \sum_{i=0}^{c} \alpha_{3i} \Delta(\partial \ln WAP_{t-i}) + \sum_{i=0}^{d} \alpha_{4i} \Delta \ln GDS_{t-i} + \lambda ECM_{t-1} + \varepsilon_t \quad (3)$$

where λ is the parameter capturing the speed of adjustment towards the long-run equilibrium path of the estimated ARDL model and ECM_{t-1} is the residuals (lagged by one term period) from the estimated cointegration model. The error correction term captures the deviations of real GDP per capita from the long-run equilibrium and gradually brings the economy back to its long-run growth path. Thus, the coefficient of the error correction term is expected to be negative and statistically significant; and the magnitude of this coefficient should be less than one (Collier and Goderis, 2012). However, prior to testing for cointegration among the variables, the study investigates the presence of unit roots among the variables using Augmented Dickey- Fuller (ADF) and Phillips-Perron (PP) unit root tests (Dickey and Fuller, 1979; Dickey and Fuller, 1981). Unit root testing is done to ensure that none of the variables is integrated of order two, *I (2)* or higher since ARDL bounds testing framework is only applicable in case of *I (0)*, *I (1)* variables or combinations of the two.

4. Empirical Results and Discussion

4.1 Unit Root Test

In attempt to conduct the estimation of model 2 (i.e. the ARDL representation of equation 1) the study tested for the stationarity status of the employed variables to determine their order of integration. This is done in order to avoid spurious results and also ensure that none of the variables are integrated of order two, *I(2)*. To this end, Augmented Dickey-Fuller (ADF) and Philips-Peron (PP) were applied. Both tests statistics were done for two alternative specifications. First, it was tested with intercept but no trend, and then it was tested with both intercept and trend. The results are presented in tables 1 and 2 in appendix II. As can be seen from the tables both tests consistently suggest that apart from the natural log of rate of natural increase in population which is stationary at level, all other variables become stationary when converted to first differences, suggesting that each is integrated of order one, denoted as *I (1)*.

4.2 Cointegration Test

Following the suggestion of Granger (1988), a test of possible cointegrating relationship among the series was conducted. Basically, in this study, the newly proposed ARDL model is utilized to check co-integration and to estimate short run and long run relationships. This is because, firstly, unlike other methods of estimating cointegrating relationships, the ARDL representation does not require symmetry of lag lengths (i.e. each variable can have a different number of lag terms). Secondly, the bounds test allows a mixture of I*(1)* and *I(0)* variables as regressors, that is, the order of integration of appropriate variables may not necessarily be the same. Third, this technique is suitable for small or finite sample size (Pesaran *et al,* 2001).

Thus, in the next step, we estimated model 2 using the appropriate lag-length selection criterion. In this study, VAR lag order selection criteria attributed to Hannan-Quinn information (HIC), Log Likelihood (LL), Schwarz information (SIC), Final Prediction Error (FPE) and Akaike information criteria (AIC) were taken as our guide. Based on the results presented in table 3 a maximum lag order of three was chosen for the ARDL model. Hence, the three lags were selected for this ARDL analysis. Therefore, with that maximum lag lengths setting, during the analysis, 192 different ARDL models specifications were considered and the most suitable model (2, 1, 0, 0) for this study was selected. Figure 2 in appendix I, which provides a graph of the AIC of the top twenty models, shows the relative superiority of the selected model against alternatives. It is evident from the figure that the selected ARDL (2, 1, 0, 0) model is better than other ARDL models. It is notable that 14 out of 20 top models use 2 lags of the dependent variable.

Next "Bounds Test" of cointegration is performed to check the joint significance of the coefficients specified in equation 2 by imposing zero restrictions on the estimated long-run coefficients of real GDP per capita, rate of natural increase in population, growth rate of working age population and gross domestic saving. The null hypothesis is that there is no long-run relationship. Applying the ARDL procedures {i.e. the computed F-test is then compare with the critical values provided by Pesaran and Shin (1995, 1998) for the hypothesis testing. Hence, if the computed F-statistic is less than the lower bound value, the null is not rejected. On the contrary, if the computed F-statistics is greater than the upper bound value, it implies existence of long-run relationship among the variables. Lastly, if the computed F- statistics lies between the lower bound and upper bound, long run association between the variables becomes inconclusive}, we find cointegration result. As depicted in Table 4 in appendix II the value of F statistics is 10.08693, which clearly exceeds the upper among the variables bounds at 10%, 5%, 2.5% and 1% significant levels respectively. Accordingly, we reject the hypothesis of "no long run relationship". Results, thus, confirm that the model fulfills the criterion of cointegration or long run relationship.

Having determined the existence of a long run equilibrium, the long run coefficients (elasticities) and short run coefficients (elasticities) are estimated. The estimated long-run dynamics of the selected ARDL (2, 1, 0, 0) model along with the short-run coefficients are presented in tables 5 and 6 respectively in appendix II. In addition, a variety of diagnostics and stability tests which will enhance the credibility of the model were carried out. In particular, the model was tested for autocorrelation (Breusch-Godfrey serial correlation LM test), for heteroskedasticity (White test), for normality (Jarque-Bera test), and for specification error/omitted variables (Ramsey RESET test). The results of the respective diagnostic test are presented in the lower segment of Table 5. Further, following Pesaran and Shin (1998) the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) were also employed in performing parameter stability tests. A graphical presentation of this test for our ARDL model is provided in figures 3 and 4 in appendix I.

4.3 Long Run Impact of Labour Force Dynamics on Economic Growth

An examination of the results presented in Table 5 in appendix II shows that on the part of individual significance of each explanatory variable, it is evident that labour force dynamics proxied by growth rate of working age population is vital for stimulating economic growth in Nigeria. As can be observed there is a statistically long-run equilibrium relationship between labour force dynamics and economic growth as shown by the t-statistic and p-value. As it were, the coefficient of the growth rate of working age population is positive (1.082465) and statistically significant with probability value p = 0.0000 which is less than 0.05 (5%) level of significance and t-statistic t = 8.710497. Specifically, in the long run, holding other things constant, a one percent change in the growth rate of working age population will bring about 1.082465 percent change in per capital real GDP. This result is in line with the study's expectation and thus implies that labour force is a major element for a sustainable rate of economic expansion as well as the engine of economic growth for labour intensive economies like Nigeria. This result is consistent with economic theory and the findings of Weil (2005); Todaro and Smith (2006); Danquah (2006); Antwi, Mills, and Zhao (2013) and Gebrehiwot (2015).

Unlike its short run significant impact, the rate of natural increase in population (defined as the difference between the number of live births per year per 1000 population and the number of deaths per year per 1000 population) with the coefficient 0.082175, probability value p = 0.7333 and t-statistic t = 0.343279 has a positive but insignificant long run impact on economic growth. Concretely, a one unit increase in the rate of natural increase raises economic growth by 0.082175 in the long run. This insignificant impact probably suggests that in terms of the effects of the rate of natural increase in population on population age structures, one can distinguish three distinct phases. During the first which usually starts with a reduction in mortality, there is a rejuvenation of the age distribution as the proportion of children increases. During the second, triggered by fertility reductions, the proportion of children begins to decline while the proportion of adults and older persons rise. During the third phase, reached usually after lengthy periods of fertility and mortality decline, the proportions of both children and adults of working age decline and only the proportion of older persons rises. During the second stage of the transition, adults of working age constitute a significantly larger proportion of the total population than during the first stage of the transition, so that the number of adults of working age per dependent (that is, children and older persons) increases for a certain period until it reaches a maximum. During that period, a population is optimally placed to benefit from economically productive investment because its levels of economic dependency are low and there are relatively more potential workers to support persons in the non-productive ages (children and the older population)- demographic window of opportunity. Although the period of the demographic bonus can last several decades, if fertility reductions are sustained it eventually gives way to the third stage of the transition, where the proportion of adults of working age ceases to rise and only the proportion of older persons continues increasing. This period of rapid population ageing poses new challenges for the adaptation of society to an unprecedented situation and requires the development of sound public policy to facilitate the adjustments that will be necessary in a variety of spheres, including the provision of health care and old-age support. This result is in line with the study's expectation.

More so, on the effect of gross domestic saving on economic growth in Nigeria a cursory look at Table 5 reveals that the coefficient of gross domestic saving (0.02144) is statistically insignificant with probability value p = 0.1514 which is greater than 0.05 (5%) level of significance and t-statistic t = 1.464707 but has a positive impact on economic growth. Hence, a unit increase in gross domestic savings will bring about 0.02144 increase in economic growth proxied by per capita real GDP. By implications gross domestic savings which serves as a tool for capital mobilization towards financing aggregate investment needed for economic growth is very low. Similar findings were also observed in other studies (see for instance, Aghion, Comin, Howitt, 2006; Prskawetz, Kogel, Scherbov, 2007; Budha, 2012; and Iqbal, Yasmin, Yaseen, 2015).

Also, since ARDL models are estimated by simple least squares, all of the views and procedures available to equation objects estimated by least squares are also available for ARDL models. The R^2, the adjusted R^2, the F-statistic and the Durbin-Watson statistic for the selected model is shown in panel B of Table 5. As observed from the result presented in Table 5 the explanatory power *(R^2)* of the model is high (0.851518). In essence, the proportion of variation in economic growth measured by log of per capita real GDP that is jointly explained by labour force dynamics, rate of natural increase in population and gross domestic savings is about 85%. Moreover, the Adjusted R^2 that is the proportion of variation in economic growth measured by log of per capita real GDP that is jointly explained by the explanatory variables after the effect of insignificant regressor has been removed is about 73%. Furthermore, the F-statistic which is used to measure the overall significance of the estimated model is significant at 7.009208 with probability value p = 0.000018. This indeed is a re-enforcement of the goodness of fit. In effect, these suggest that the rate of natural increase in population, labour force dynamics proxied by rate of growth of working age population and gross domestic saving are significant determinants of economic growth in Nigeria. This further reinforces the fact that the results reported are of policy significance. In essence the model can be used in making joint policy conclusion, inferences, and forecasting. Besides, the Durbin-Watson statistic which is used to test for autocorrelation of residuals in the model, in particular, the first order autocorrelation indicates the absence of serial autocorrelation at 2.036395.

Further, after estimating the selected ARDL model (2, 1, 0, 0), misspecification test, normality test, serial correlation test, heteroscedasticity test and cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) test for stability of the model were undertaken to check the robustness of the model. In particular, Jacque-Bera normality test for residual is conducted to see if the residuals are normally distributed or not. This is very necessary because one of the assumptions of classical linear regression model is that residuals are normally distributed. Moreover, Breusch-Godfrey serial correlation LM test, Autoregressive Conditional Heteroscedasticity (ARCH) as well as Breusch-Pagan-Godfrey (to check for the autocorrelation in the variance of the error term) tests and Ramsey RESET specification test were conducted. All the tests disclosed that the model possesses the desirable BLUE properties. Indeed, the model's residuals are serially uncorrelated, normally distributed and homoskedastic. Therefore, the estimated set of results is devoid of the econometric problems of autocorrelation, misspecification and heteroskedastcity.

4.4 Short Run Impact of Labour Force Dynamics on Economic Growth

In order to determine the effect labour force dynamics on economic growth in the short run, assess the short run adjustment mechanism to equilibrium as well as the speed of adjustment, the short-run dynamics of the equilibrium relationship were obtained directly as the estimated coefficients of the first-differenced variables in the *ARDL* model (2, 1, 0, 0) and the results are presented in Table 6 in appendix II. As can be seen from the results presented in Table 6 it is evident that the coefficient of the error correction term for the estimated equation is both statistically significant and negative with probability value p = 0.0000 and t-statistic t = -5.985332. In essence, the speed of adjustment implied by the coefficient of CointEq (-1) suggests that the deviation from short run to long run is corrected by 54.13 percent each year. Therefore, there is stable long run relationship among real GDP per capita, rate of natural increase in population, growth rate of working age population and gross domestic saving.

Additionally, the estimated short-run model revealed that contrary to its insignificant long run impact the rate of natural increase in population is the main contributor to real GDP per capita followed by labour force dynamics and gross domestic savings. Precisely, a unit increase in the rate of natural increase in population will cause real GDP per capita to increase by 5.970518, ceteris paribus. This significant impact in the short run suggests that the rate of natural increase in population defined as the difference between the number of live births per year per 1000 population and the number of deaths per year per 1000 population, seems to be approaching each other over the short run and as the difference between these rates shrinks, a slowing population growth with fewer dependent children relative to the number of productive workers would result and thus creating demographic dividend.

Similarly, labour force dynamics proxied by growth rate of working age population has a positive significant short run impact on real GDP per capita at the 5 percent significance level. Specifically, a one percent increase labour force will cause real GDP per capita to increase by 0.586 percent approximately, ceteris paribus. This result is consistent with economic theory and the findings of Danquah (2006). Finally, the impact of gross domestic saving on growth was found to be positive though statistically insignificant. The insignificant impact probably could be attributed to low level of savings which resulted from lack of continuous saving behaviour in Nigeria over time which is in turn primarily attributable to the subsistence nature of the economy where output is barely enough for consumption. This insight suggests that any long-term growth strategy that aims at increasing per capita income levels at a sustainable rate over the next 10-15 years needs to envision policies and reforms that are likely to foster domestic savings both in terms of private savings (household and enterprise savings) and public savings.

4.5 Stability of the Model

In addition to the above diagnostic tests, the stability of long run estimates was tested by applying the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) test. Such tests are recommended by Pesaran, Shin and Smith (1999, 2001). The test for the stability is necessary because according to Bahmani-Oskooee and Brooks (1999), the fact that variables are cointegrated does not necessarily imply that the estimated coefficients are stable. Following Pesaran and Pesaran (1997), the study tested for long-run coefficient stability on the basis Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ) tests (i.e. cumulative sums and sums square of residuals) developed by Brown, Durbin, and Evans (1975) are applied. The hypothesis of the test is as follows:

$H_0:$ All coefficients are stable in the model

$H_1:$ All coefficients in the model is unstable

If the plot line does not crosses the boundary at any level then accept the Null hypothesis and reject the alternative hypothesis. Figures 5.1 and 5.2 plot the *CUSUM* and *CUSUM* of squares statistics. The results clearly indicate the absence of instability of the estimated coefficients because the plot of the *CUSUM and CUSUMSQ* statistic(s) is within the confines of the five percent critical bounds. In effect therefore, the estimated long-run parameters are stable as there are no structural breaks. By implication, our parameters are reliable.

5. Conclusion and Policy Implications

In this paper, we empirically determined the impact of labour force dynamics (i.e. labour force growth and contraction) on economic growth in Nigeria over the period 1970–2015 using the newly developed bounds testing approach to co-integration. To this end, the study made use of annual time series secondary data on per capita real GDP, rate of natural increase in population, growth rate of working-age population and gross domestic savings sourced from the Central Bank of Nigeria Statistical Bulletin (2016), Africa Development Indicators (2016), World Development Indicators (2017), and National Bureau of Statistics (2016).

Flowing from the empirical results, thus, is the fact that labour force dynamics has a positive and significant effect on economic growth both in the short and long run periods in Nigeria. In particular, the results showed that for a one-percentage point increase in labour force dynamics, 1.0825 percent per capital real GDP is induced in the long-run. Similar findings were obtained by Weil (2005); Todaro and Smith (2006); Danquah (2006); Antwi, Mills, and Zhao (2013) and Gebrehiwot (2015).

Having established the significance of labour force dynamics in positively influencing economic growth in Nigeria, the study recommends that the government should implement a broad set of employment generating policies that can help abridge unemployment. This is because, having a larger, healthier, and better-educated workforce will only bear economic fruit if the extra workers can find jobs. Besides, policies should be put in place to intensify existing employment promotion programmes. Emphasis should be placed on the creation of new jobs in expanding economic sectors that become available in a manner synchronized to the production of skilled labour. This is highly desirous considering the urgent need to pertinently enhance the growth prospect of the economy.

References

Adewole, A. O. (2012). Effect of population on economic development in Nigeria: A quantitative assessment. *International Journal of Physical and Social Sciences*, *2*(5), 1-14.

Adewole, A. O. (2012). Effect of population on economic development in Nigeria: A quantitative assessment. *International Journal of Physical and Social Sciences*, *2*(5), 1-14.

Aghion, P., Comin, D., & Howitt, P. (2006). *When does domestic saving matter for economic growth?* (No. w12275). National Bureau of Economic Research.

Antwi, S., Mills, E. F. A., & Zhao, X. (2013). Impact of macroeconomic factors on economic growth in Ghana: A cointegration analysis. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, *3*(1), 35-45.

Bahmani-Oskooee, M., & Brooks, T. J. (1999). Bilateral J-curve between US and her trading partners. *Weltwirtschaftliches Archiv*, *135*(1), 156-165.

Barro, R. J., & Sala-i-Martin, X. (2003). Economic Growth, volume 1 of MIT Press Books.

Becker, G. S., Glaeser, E. L., & Murphy, K. M. (1999). Population and economic growth. *The American Economic Review*, *89*(2), 145-149.

Bloom, D. E. (2010). Nigeria The Next Generation Report.

Bloom, D. E., & Canning, D. (2004). *Global demographic change: Dimensions and economic significance* (No. w10817). National Bureau of Economic Research.

Bloom, D. E., & Freeman, R. B. (1986). The effects of rapid population growth on labor supply and employment in developing countries. *Population and Development Review*, 381-414.

Bloom, D. E., & Williamson, J. G. (1997). Demographic change and human resource development. *Emerging Asia: Changes and Challenges. Manila: Asian Development Bank*.

Bloom, D. E., & Williamson, J. G. (1998). Demographic transitions and economic miracles in emerging Asia. *The World Bank Economic Review*, *12*(3), 419-455.

Bloom, D. E., Canning, D., & Malaney, P. N. (1999). *Demographic change and economic growth in Asia*. CID.

Bloom, D. E., Canning, D., & Sevilla, J. (2001). *Economic growth and the demographic transition* (No. w8685). National Bureau of Economic Research.

Bloom, D. E., Canning, D., & Sevilla, J. (2001). *Economic growth and the demographic transition* (No. w8685). National Bureau of Economic Research.

Bloom, D. E., Canning, D., Fink, G., & Finlay, J. (2007). Realizing the demographic dividend: Is Africa any different. *Program on the Global Demography of Aging, Harvard University*, 1-23.

Boserup, E. (1981). *Population and technology* (Vol. 255). Oxford: Blackwell.

Brown, R. L., Durbin, J., & Evans, J. M. (1975). Techniques for testing the constancy of regression relationships over time. *Journal of the Royal Statistical Society. Series B (Methodological)*, 149-192.

Budha, B. (2012). A multivariate analysis of savings, investment and growth in Nepal.

Choudhry, M. T. (2010). *Demographic transition, economic growth and labor market dynamics*. University of Groningen.

Choudhry, M. T., & Elhorst, J. P. (2010). Demographic transition and economic growth in China, India and Pakistan. *Economic Systems*, *34*(3), 218-236.

Choudhry, M. T., & Elhorst, J. P. (2010). Demographic transition and economic growth in China, India and Pakistan. *Economic Systems*, *34*(3), 218-236.

Coale, A. J., & Hoover, E. M. (1958). *Population Growth and Economic Development in Low-income: A Case Study of Indian's Prospects*. Princeton University Press.

Collier, P., & Goderis, B. (2012). Commodity prices and growth: An empirical investigation. *European Economic Review*, *56*(6), 1241-1260.

Danquah, M. (2006). Sources of growth in Ghana. *Abstract Retrieved April 14, 2009, from http//unpan1.*

un.org/intradocgroups/public/document/IDEP/UNPAN023359pdf.

Darrat, A. F., & Al-Yousif, Y. K. (1999). On the long-run relationship between population and economic growth: Some time series evidence for developing countries. *Eastern Economic Journal*, *25*(3), 301-313.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American statistical association*, *74*(366a), 427-431.

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica: Journal of the Econometric Society*, 1057-1072.

Easterly, W., & Levine, R. (1997). Africa's growth tragedy: policies and ethnic divisions. *The Quarterly Journal of Economics*, *112*(4), 1203-1250.

Easterly, W., & Levine, R. (2001). What have we learned from a decade of empirical research on growth? It's Not Factor Accumulation: Stylized Facts and Growth Models. *the world bank economic review*, *15*(2), 177-219.

Easterly, W., & Levine, R. (2002). *It's not factor accumulation: stylized facts and growth models* (Vol. 6, pp. 061-114). Central Bank of Chile.

Ehrlich, I., & Lui, F. (1997). The problem of population and growth: a review of the literature from Malthus to contemporary models of endogenous population and endogenous growth. *Journal of Economic Dynamics and Control*, *21*(1), 205-242.

Enang, E. E., & Ushie, M. (2012). Culture and policy implementation: An appraisal of population policy in Nigeria. *International Journal of Humanities and Social Science*, *2*(17), 226-229.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: journal of the Econometric Society*, 251-276.

Eniang, R. A. (1977). The Consequences of Rapid Population Growth on Nigeria's Economic Development: A Simple Econometric Analysis.

Feyrer, J. (2008). Aggregate evidence on the link between age structure and productivity. *Population and Development Review*, *34*, 78-99.

Granger, C. W. (1988). Some recent development in a concept of causality. *Journal of econometrics*, *39*(1-2), 199-211.

Huluka (2015) Population change and economic development: Case Studies and Reflections on the Ethiopian Demographic Transition Developing Country Studies, ISSN 2224-607X (Paper) ISSN 2225-0565 (Online) Vol.5, No.15, 2015, http://www.iiste.org/journals

Iqbal, K., Yasmin, N., & Yaseen, M. R. (2015). Impact of demographic transition on economic growth of Pakistan. *Journal of Finance and Economics*, *3*(2), 44-50.

Kelley, A. C., & Schmidt, R. M. (1994). Population and income change: recent evidence.

Kelley, A. C., & Schmidt, R. M. (1995). Aggregate population and economic growth correlations: the role of the components of demographic change. *Demography*, *32*(4), 543-555.

Kelley, A. C., & Schmidt, R. M. (2005). Evolution of recent economic-demographic modeling: A synthesis. *Journal of Population Economics*, *18*(2), 275-300.

Mason, A., Lee, R., & Lee, S. H. (2010). The demographic transition and economic growth in the Pacific Rim. In *The Economic Consequences of Demographic Change in East Asia, NBER-EASE Volume 19* (pp. 19-55). University of Chicago Press.

Mba, C. J. (2002). Nigeria's population policy and future fertility decline. *Institute of African Studies Research Review*, *18*(2), 23-37.

Nigeria, (1988) National Policy on Population for Development, Unity, Progress and Self-Reliance. Federal Ministry of Health, Lagos.

Nigeria, (2004) National Policy on Population for Sustainable Development. Federal Ministry of Health, Abuja.

Nwosu, C., Dike, A. O., & Okwara, K. K. (2014). The effects of population growth on economic growth in Nigeria. *International Journal of Engineering and Science*, *3*(11), 07-18.

Omohan, M. E. & Maliki, A. E. (2007). Counselling and Population Control in Nigeria. J. Hum. Ecol., 22(2): 101-105 (2007).

Onwuka, E. C. (2013). Another Look at the Impact of Nigeria’s Growing population on the Country’s Development. *African Population Studies*, *21*(1).

Persson, J. (2002). Demographics, human capital, and economic growth: a study of US States 1930-2000. *FIEF, Stockholm, Sweden*.

Pesaran, M. H., & Pesaran, B. (1997). *Working with Microfit 4.0: interactive econometric analysis;[Windows version]*. Oxford University Press.

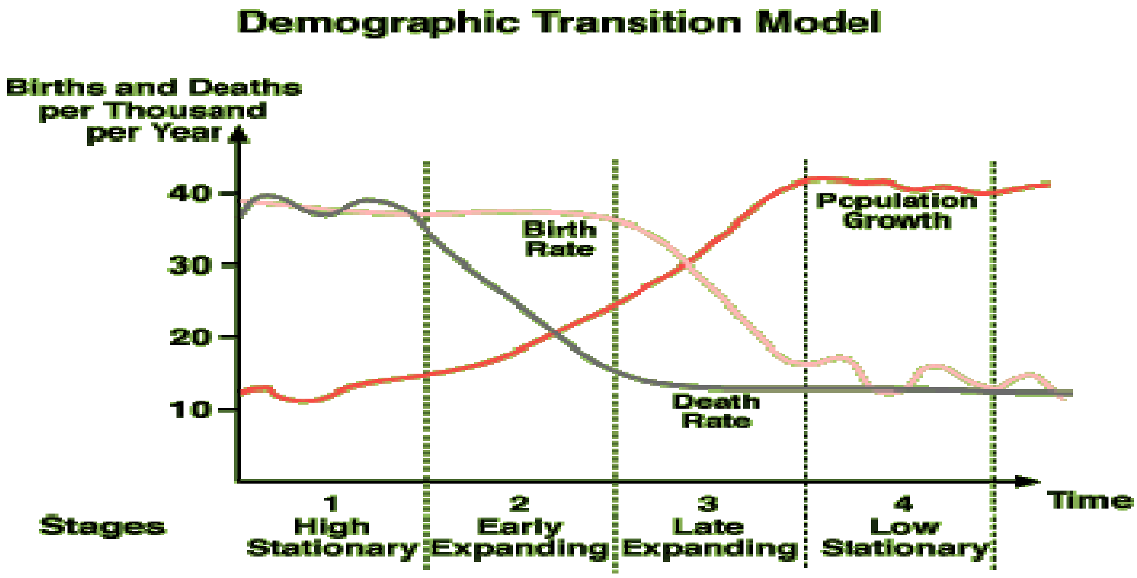
Pesaran, M. H., & Shin, Y. (1995). *Long-run Structural Modelling. Cambridge, Department of Applied Economics, University of Cambridge* (No. 9419). DAE Working Paper

Pesaran, M. H., & Shin, Y. (1998). An autoregressive distributed-lag modelling approach to cointegration analysis. *Econometric Society Monographs*, *31*, 371-413.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.
Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association*, *94*(446), 621-634.
Prettner, K., & Prskawetz, A. (2010). Decreasing fertility, economic growth and the intergenerational wage gap. *Empirica*, *37*(2), 197-214.
Prskawetz, A., Kögel, T., Sanderson, W. C., & Scherbov, S. (2007). The effects of age structure on economic growth: An application of probabilistic forecasting to India. *International Journal of Forecasting*, *23*(4), 587-602.
Simon, J. L., & Bartlett, A. A. (1985). The ultimate resource.
Simon, J.L (1981). The Ultimate Resource 1. Princeton University press, Princeton.
Simon, J.L (1986). Theory of population and economic growth. New York: Basil Blackwell
Simon, J.L (1996). The Ultimate Resource 2. Princeton University press, Princeton.
Song, S. (2013). Demographic changes and economic growth: empirical evidence from Asia.
Tartiyus, E. H., Dauda, M. I., & Peter, A. (2015). Impact of Population Growth on Economic Growth in Nigeria. *IOSR Journal of Humanities and Social Science (IOSR-JHSS) Volume*, *20*, 115-123.
Theodore, O. I. (2006). The effects of population growth in Nigeria. *Journal of Applied Sciences*, *6*(6), 1332-1337.
Thornton, J. (2001). Population growth and economic growth: long-run evidence from Latin America. *Southern Economic Journal*, 464-468.
Todaro, M., and Smith, S.C. (2006), "Economic Development," Ninth edition, Pearson Addison- Wesley Printing Press.
United Nations Statistics Division, UNSD, (2015).
Wako, H. A. (2012). Demographic changes and economic development: Application of the vector error correction model (VECM) to the case of Ethiopia. *Journal of Economics and International Finance*, *4*(10), 236.
Weeks, J. (2011). *Population: An introduction to concepts and issues*. Nelson Education.
Wei, Z., & Hao, R. (2010). Demographic structure and economic growth: Evidence from China. *Journal of Comparative Economics*, *38*(4), 472-491.
Weil, D.N. (2005), "Economic Growth," United States of America; Elm Street Publishing, Services, Inc.
World Bank (2017). World Development Indicators 2017. New York, World Bank.
Yousif, H. (2009). How Demography Matters for Measuring Development Progress in Africa. *Afr. Stat. J*, *8*, 12-27.

Appendix I

Figure 1: The Classical Stages of Demographic Transition



Source: http://geographyfieldwork.com/demographic transition.htm

Figure 2: Model Selection Graph (Summary of the top 20 model selection)

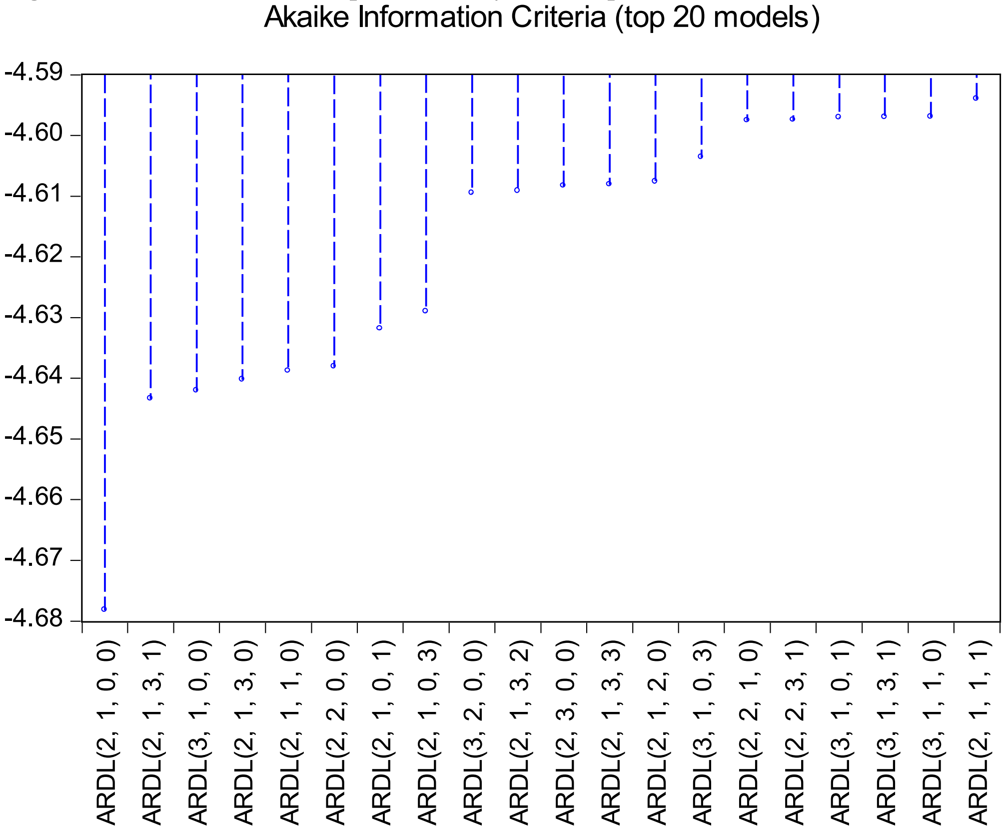


Figure 3: Plot of Cumulative Sum of Recursive Residuals CUSUM (Stability Test)

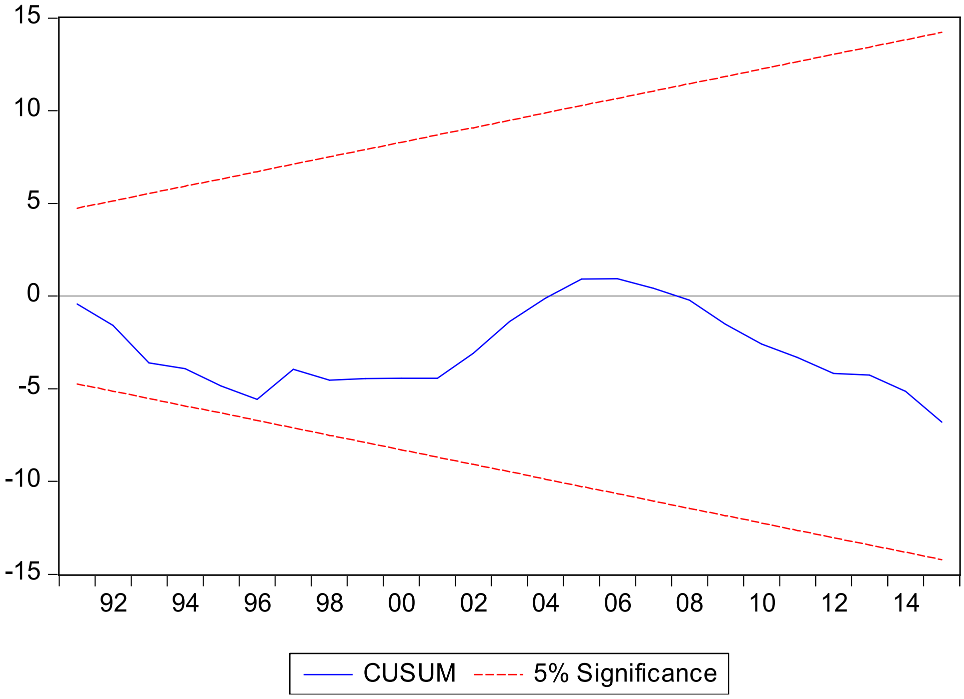
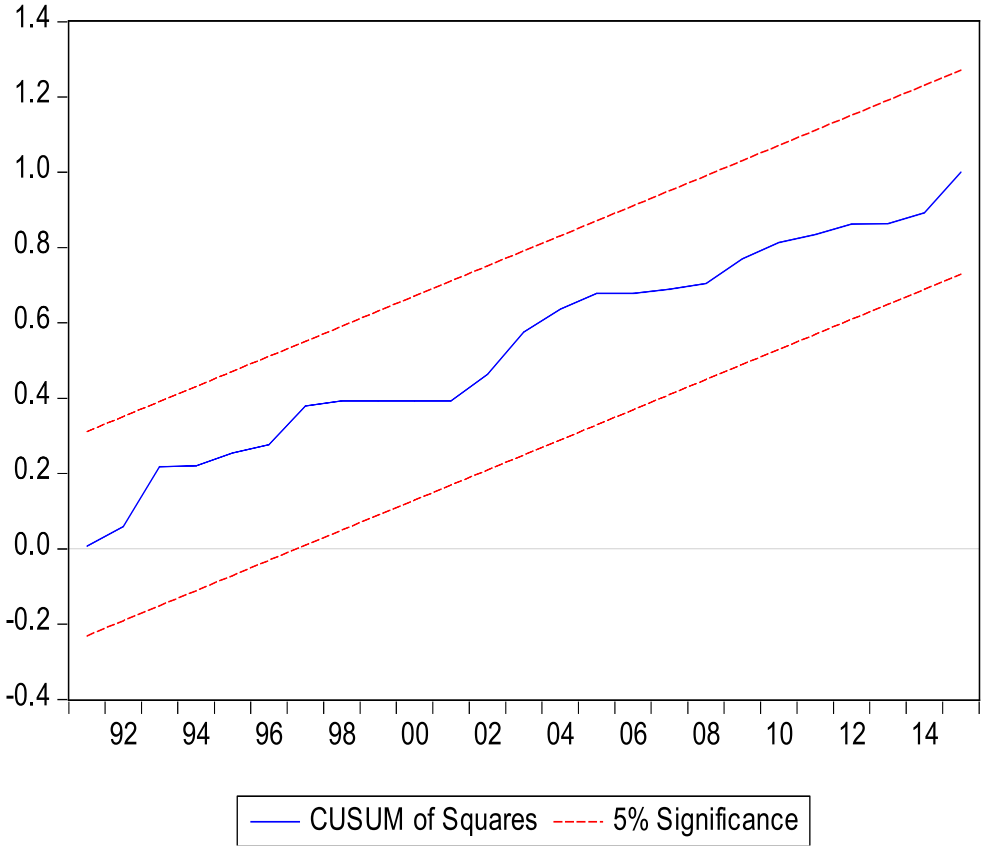


Figure 4: Plot of Cumulative Sum of Squares of Recursive Residuals CUSUMQ (Stability Test)



Appendix II

Table 1: Result for the Augmented Dickey-Fuller Unit Root Test

Augmented Dickey-Fuller (ADF) test with intercept only								
Variables	**Level**				**1st Difference**			
	Test Statistic	Critical values	P-value	Remarks	Test Statistic	Critical values	P-value	Remarks
ln*RGDPPC*	-2.683146	1% -3.584743	0.0848	---	-6.167567	1% -3.588509	0.0000***	I(1)
		5% -2.928142				5% -2.929734		
		10% -2.602225				10% -2.603064		
$\partial \ln WAP_t$	-1.892574	1% -3.615588	0.3322	---	-2.943427	1% -3.621023	0.0015***	I(1)
		5% -2.941145				5% -2.929719		
		10% -2.609066				10% -2.610263		
Ln*RNI*	-11.28825	1% -3.588509	0.0000***	I(0)	---	---	---	---
		5% -2.929734				---		
		10% -2.603064				---		
Ln*GDS*	-0.615422	1% -3.588509	0.8567	---	--4.389407	1% -3.588509	0.0011***	I(1)
		5% -2.929734				5% -2.929734		
		10% -2.603064				10% -2.603064		
Augmented Dickey-Fuller (ADF) test with trend and intercept								
ln*RGDPPC*	-2.220381	1% -4.175640	0.4672	---	-6.518892	1% -4.180911	0.0000***	I(1)
		5% -3.513075				5% -3.515523		
		10% -3.186854				10% -3.188259		
$\partial \ln WAP_t$	-2.073743	1% -4.211868	0.5489	---	-3.779892	1% -.211868	0.0285***	I(1)
		5% -3.529758				5% -.529758		
		10% -3.196411				10% -.196411		
Ln*RNI*	-4.034789	1% -4.205004	0.0153***	I(0)	---	---	---	---
		5% -3.526609				---		
		10% -3.194611				---		
Ln*GDS*	-3.515523	1% -4.180911	0.2865	---	-4.331565	1% -4.180911	-	I(1)
		5% -3.515523				5% -3.515523	0.0067***	
		10% -3.188259				10% -3.188259		

Source: Author's computation using E-view 9 (2017)
***depicts that the variable is stationary at 5%

Table 2: Result for the Philips-Peron (PP) Unit Root Test

Variables	Level: Test Statistic	Critical values	P-value	Remarks	1st Difference: Test Statistic (1st Diff)	Critical values	P-value	Remarks
Philips-Peron (PP) test with intercept only								
Ln*RGDPPC*	-2.220381	1% -3.584743 5% -2.928142 10% -2.602225	0.4672	---	-4.970063	1%- -3.588509 5% -2.929734 10% -2.603064	0.0002***	I(1)
$\partial \ln WAP_t$	-2.362273	1% -3.588509 5% -2.929734 10% -2.603064	0.1581	---	-12.44734	1% -3.592462 5% -2.931404 10% -2.603944	0.0000***	I(1)
Ln*RNI*	-2.929734	1% -3.588509 5% -2.014761 10% -2.603064	0.0000***	I(0)	---	--- --- ---	---	---
Ln*GDS*	-0.219498	1% -3.584743 5% -2.928142 10% -2.602225	0.9283	---	-4.261784	1% -3.588509 5% -2.929734 10% -2.603064	0.0015***	I(1)
Philips-Peron (PP) test with trend and intercept								
Ln*RGDPPC*	-2.249117	1% -4.175640 5% -3.513075 10% -3.186854	0.4520	---	-7.041920	1% -4.180911 5% -3.515523 10% -3.188259	0.0000***	I(1)
$\partial \ln WAP_t$	-2.467284	1% -4.180911 5% -3.515523 10% -3.188259	0.3420	---	-13.27652	1% -4.186481 5% -3.518090 10% -3.189732	0.0000***	I(1)
Ln*RNI*	-7.788926	1% -4.180911 5% -3.515523 10% -3.188259	0.0015	I(0)	---	--- --- ---	---	---
Ln*GDS*	-1.671836	1% -4.175640 5% -3.513075 10% -3.186854	0.7473	I(1)	-4.202496	1% -4.180911 5% -3.515523 10% -3.188259	0.0005***	I(1)

Source: Author's computation using E-view 9 (2017)
***depicts that the variable is stationary at 5%

Table 3: Optimal lag length selection criteria

Lag	LR	FPE	AIC	SC	HQ
0	NA	1.79e-07	-4.185066	-4.021234	-4.124650
1	747.5420	1.08e-15	-23.11304	-22.29387	-22.81096
2	153.1151	2.57e-17	-26.87224	-25.39774	-26.32849
3	58.64070*	8.09e-18*	-28.08274*	-25.95292*	-27.29733*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 4: Results of Bound Test Approach to Cointegration (Wald test)

Level of Significance $(\alpha\%)$	**Critical value: Lower bound I(0)**	**Critical value: Upper bound I(1)**	**F-calculated / Computed F-statistic**
10	2.72	3.77	***10.08693***
5	**3.23**	**4.35**	
2.5	3.69	4.89	
1	4.29	5.61	

Source: Author's computation using E-view 9 (2017)

Table 5: Estimated Long Run Dynamics Results for the selected ARDL Model (2,1,0,0)

Regressand: DLNRGDPPC				
Panel A: Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRNI	0.082175	0.239382	0.343279	0.7333
∂LNWAP	1.082465	0.124271	8.710497	0.0000
LNGDS	0.02144	0.014638	1.464707	0.1514
C	-12.168969	0.691136	-17.607188	0.0000
Panel B: Goodness-of-fit Measures				
R^2	0.851518			
Adjusted R^2	0.730032			
F-statistic	7.009208			
Prob(F-statistic)	0.000018			
Durbin-Watson stat	2.036395			
Panel C:Diagnostic Statistical Checking				
	Test Statistic	**Probability**		
Breusch- Godfrey serial correlation LM test	1.439579	0.6963		
Breusch-Pagan-Godfrey test for heteroskedasticity	11.78036	0.0671		
ARCH test for heteroskedasticity	0.431780	0.5111		
Jacque-Bera normality test	2.199162	0.333011		
Ramsey RESET specification test	8.571531	0.5900		

Source: Author's computation using E-view 9 (2017)

Table 6: Estimated Short Run Dynamics Results for the selected ARDL Model (2,1,0,0)

Regressand: DLNRGDPPC				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNRGDPPC(-1))	0.39431	0.10583	3.725867	0.0006
D(LNRNI)	5.970518	1.201866	4.967708	0.0000
D(∂LNWAP)	0.585973	0.129937	4.509676	0.0001
D(LNGDS)	0.011606	0.007711	1.505161	0.1408
CointEq(-1)	-0.541332	0.090443	-5.985332	0.0000
Cointeq = LNRGDPPC - (0.0822*LNRNI + 1.0825*LNWAP + 0.0214*LNGDS-12.1690)				

Source: Author's computation using E-view 9 (2017)