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Age Structure, Human Capital Development and Economic Growth: Evidence from Nigeria and South Africa

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Abstract: This study explores the relationship between age structure and economic growth by incorporating human capital development in the context of the two leading economies in Africa (Nigeria and South Africa) spanning the period of 1991 and 2017 using the Autoregressive Distributed Lag (ARDL) model. The empirical result indicates that age structure stimulates economic growth in both countries while human capital development impedes economic growth in Nigeria but improves economic growth in South Africa. Further, the result that interaction of age structure and human capital development hinders economic growth in Nigeria whereas positively influence economic growth in South Africa. Based on this result, the study therefore concluded that working age share alone cannot by itself enhance economic growth, but has to be supported by improved human capital investment. It is therefore, recommended that government of both countries should prioritize education at all levels and identify skills and competence that could make such education functional and productive.

Keywords: Age Structure; human capital development; economic growth; ARDL

JEL Classification: F63

1. Introduction

The influence of population on macro-economic performance has long been debated upon by social scientists (Vashundra, 2012). Age structure is the proportion of a population in different age classes and since individual economic behaviour varies at different stages of life, changes in age structure can significantly affect national economic performance. According to Bloom *et al* (2002), nations with a high proportion of youth tend to devote a relatively high proportion of resources to the young, often limiting economic growth. By contrast, nations in which a relatively large share of the population has reached the prime ages for working may enjoy a boost to income growth stemming from the higher share of the population that is working with the accelerated accumulation of capital, and reduced spending on dependants. The benefits of having an age structure with more working age people and lesser dependents works through many mechanisms (increased savings, higher labour force, and human capital development; the most obvious benefit comes from having a bigger labour force).

Theoretically, there are three major schools of thought in this regard. Population pessimists have insisted that rapid population growth inhibit development. Population optimists have argued the opposite position: that rapid population growth and large population size can promote economic prosperity by

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furnishing abundant human and intellectual capital and increasing market size. However, Population neutralists argued that population have no effect on economic growth. Proponents of these views have cited supporting evidences in the research records. Overall, the evidence has been inconclusive (Bloom, Canning, and Fink, 2011).

Recently, age structure development reveals a challenge for the developed world with an ageing population and opportunities for the developing world (Rutger, 2011). Long-term projections from the United Nations further confirm this picture. The developed regions will experience stagnation in the number of working-age people over the next decade whereas the developing regions will see a rise in the working-age share in the coming decades. Meanwhile, Africa's demographic trend reveals a growing aging population and unprecedented growth of the youth population. Middle-income countries, including Mauritius, Tunisia, Morocco, Algeria, Egypt, and South Africa, are experiencing the greatest increase in population aging; their populations aged 65 years and older range between 4.5%-7.3%. Other countries, such as Libya, Botswana, Zimbabwe, and Djibouti, have also witnessed a significant increase in their elderly population. Population ageing is expected to accelerate between 2010 and 2030, as more people live to age 65. Projections show that the elderly could account for 4.5% of the population by 2030 from 3.2 % in 2010 (Maurice, 2012).

Essentially, the empirical evidences on the impact of age structure on economic growth is unsettled. For instance, studies such as Lindh and Malberg 1999; Bloom et al, 2011; Paulo (2014), and Rutger 2011, have analyzed the impact of age structure on economic growth and concluded that the share of working population exercised a positive and significant influence on economic growth. Some other studies (such Vasundhra, 2012; Vimal and Shu (2014) have also found a negative effect of working population on economic growth. Therefore, given the unresolved nature of the relationship between age structure-growth, the importance of human capital investment come to mind. Moreover, the reputation of human capital development as an important channel towards economic growth has been affirmed in literature by several authors (for example Olayemi, 2012). In particular, education and health has been pointed out not only as the most important components of human capital (Goode, 1959; Schultz, 1961; and Khilji, 2005) but also as the major constituents for human capital development and the ensuing impact on economic growth (see Bashir, Herath, and Gebremedhin, 2012).

However, most of the existing have examined the nexus between age structure and economic growth without investigating the interaction of age structure and human capital development on economic growth. Thus, this study seeks to appraise the interaction effect of age structure and human capital development on economic growth in the context of the two leading economies in Africa (Nigeria and South Africa) over the period of 1991 and 2017. Also, findings from this study will have important implications to both policy makers and academics, both as support to the findings of previous studies and a basis for future policy decisions. The remainder of this paper is organized as follows. Section 2 presents are view of relevant empirical literature. Section 3 entails the methodology. Section 4 discusses the empirical results while Section 5 concludes the paper by recapping both the essence and findings of the study.

2. Review of Literature

The effect of population structure on economic outcomes is a widely studied topic. However, given that the dimension of age structure has only recently got attention, comparatively few papers have been published. An influential paper by Bloom and Canning (2004) undertakes a cross-country analysis on age structure-growth nexus 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. Rutger (2011) employed multilevel convergence growth model to analyse the changes in economic growth within 367 districts of 39 developing countries from all regions of the developing world. The empirical results demonstrate a robust positive effect of both the share of the working age population and its growth rate on economic growth. Using a 5-year panel data set over the period 1960 to 2010 for 172 countries, Paulo *et al* (2014) examined the impact of demographic change on economic growth. The study finds that initial size of the working age group and the change in working age share, have positive impacts on growth. The authors suggest that having a large working age population increases the economy's productive capacity from the outset. At the same time, a fast growing working age population further speeds up the growth process. In a similar study Vasundhra (2012) appraise the impact of age structure on economic growth across Indian States for the period 2001 to 2011 and found that rapid growth in working age had a negative consequence for economic growth.

Misbah (2010) examined the impact of the distribution of the population across different age groups on economic growth in China, India and Pakistan for the period 1961- 2003. The author found that GDP per capita growth is positively related to the growth differential between the working-age population and the total population, and negatively related to child and old-age dependency ratios. In addition, Misbah (2010) also investigated the impact of age dependency on labor Productivity and found that age dependency has a direct negative effect on labor productivity growth. The author opined that child dependency is more harmful for economic and labor productivity growth in developing and emerging economies than old age dependency.

The study of Ahmad and Khan (2018) explored the relationship between age structure, human capital and economic growth in a sample of 67 developing countries over the period of 1960-2014. The study employed the Generalized Method of Moment (GMM)and found that age structure and human capital enhances economic growth. The authors suggested that the negative short-run effect may be as a result of too much influence of finance on growth in these countries. Recently, Ogunniyi (2018) examined the nexus between human capital development and economic growth in Nigeria spanning 1981 and 2014. The result of the ARDL estimation technique disclosed that low human capital formation inhibit economic growth in Nigeria. Using the same estimation technique, Nduku and Simo-Kengne (2018) explore the role of age dependency ratio on saving rate in South Africa for the period 1970-2014 and established that a positive relationship between age dependency ratio and saving rate in both short and long run. More recently, Miri and Maddah (2018) investigated the effect of age structure on economic growth in Iran spanning 1987 and 2017. The result of the ARDL disclosed that age structure stimulates economic growth in Iran.

Mehrara and Musai (2013) studied the causal relation between human capital and the level of income for a sample of 101 developing countries extending over the period 1970 to 2010. The empirical results indicate strong evidence of causation running from investment and GDP to human capital and no such

evidence of feedback from human capital to GDP. This implies that it is output and investment that drives human capital in developing countries and not vice versa. Eigbiremolen (2014) engaged the use of the Augmented-Solow growth model to examine the influence human capital development impress on economic growth with quarterly data covering 1999 to 2012. In the spirit of the theory, empirical results indicated that human capital development exerts positive and significant impact on level of output. The implication of this finding is that in Nigeria, human capital development is essential for the attainment of sustainable growth.

In a country specific study on Ecuador, Rosado and Sanchez (2017) investigated the effect of age structure and saving rate on economic growth in Ecuador spanning 1975 and 2015. The result of the FMOLS showed that age structure is growth inducing. In investigating the effect of demographic change on growth and poverty reduction in 45 South Asia (SAS) and Sub-Saharan Africa (SSA) countries spanning 1950 and 2010, Cruz and Ahmed (2018) employed GMM and found that an increase in the working-age population share and a reduction in the child dependency ratio are associated with an increase in GDP per capita growth, with similarly positive effects on poverty reduction. Using a sample of 28 Chinese provinces covering the period of 1990 and 2005, Zhang *et al* (2014) utilized fixed-effect estimation technique to analysed the role of demographic age structure on economic growth. The result of the study indicates that changes in age structure has a positive impact on provincial economic growth rates. In addition, Gao and Shao (2016) also examined the effects of population transition on economic growth in 8 minority provinces over the period of 1992 and 2012. The study found evidence of positive relationship between human capital investment and economic whereas child dependency ratio impedes economic growth.

Furthermore, Uddin *et al* (2016) employed Dynamic Ordinary Least Squares (DOLS), Fully Modified Ordinary Least Squares (FMOLS) and the Vector Error Correction Model (VECM) to explore the relationship between the dependency ratio, savings rate and real GDP for Australia for the period 1971–2014. The authors found that changes in population age structure had a significant impact on real GDP per capita in Australia. In a panel study, Wongboonsin and Phiromswad (2017) employed panel least square technique to evaluate the effect of demographic structure and economic growth. Based on a sample of 122 developed and developing countries over the period 1960 – 2010, the study found that an increase in the share of middle-aged workers has a positive effect on economic growth through institutions, investment and education while an increase in the share of the senior population has a negative effect on economic growth through institutions and investment channels in developed countries. For developing countries, the result indicates that an increase in the share of young workers has a negative effect on economic growth through investment, financial market development and trade channels.

In summary, from the empirical literature surveyed above, most of the previous studies have focused on either the effect of age structure on economic growth or the effect of human capital development on economic growth. However, whether or not the working population will impact on economic growth depends on the level of human capital development. But previous studies have not examined the interaction between age structure, human capital development and economic growth. It is therefore needful to contribute to knowledge in this area by investigating these issues in the context of the two

leading economies in Africa, with a view to establishing the importance of human capital development in age structure-growth nexus.

3. Methodology

3.1 Model

Following the empirical literature, this study adopts the model employed by Eigbiremolen (2014) and Ahmad and Khan (2018) to examine the interaction of age structure and human capital development on economic growth. The model specified:

$$EG_t = f(AGS_t, HCI_t) \tag{3.1}$$

Where EG is economic growth, AGS denote age structure and HCI is human capital investment. Other variable such as trade openness as adopted by Bloom and Canning (2004) also seem to influence economic growth. Incorporating this variable into Eq. (3.1) gives:

$$EG_t = f(AGS_t, HCI_t, TOP_t) \tag{3.2}$$

Where EG is economic growth, AGS denote age structure and HCI is human capital investment while TOP is trade openness at time t.

The log-linear form of equation (3.2) is expressed as:

$$InEG_t = \alpha_0 + \beta InAGS_t + \delta InHCI_t + \phi InTOP_t + \varepsilon_t \tag{3.3}$$

All the variables are as already defined before and ε_t is the error term.

To examine the interactive effect of age structure and human capital investment on economic growth in Nigeria and South Africa. This study employs Autoregressive Distributed Lag (ARDL) approach to cointegration developed by (Pesaran, Shin, & Smith, 2001). This technique is applied because it can accommodate different orders of integration I(0), I(1) or I(0)/I(1). Furthermore, the ARDL approach integrates the short run dynamics with the long run equilibrium without losing any extended run information. Also, the ARDL approach provides better results for small sample data set compared to other traditional methods to cointegration (Engle & Granger, 1987); (Johansen & Juselius, 1990); and (Phillips & Hansen, 1990). Lastly, ARDL approach gets rid of endogeneity problem due to the selection of appropriate lag selection. Hence, residual correlation. The general ARDL representation of Eq (3.3) formulated as:

$$\begin{aligned}\Delta InEG_t = \alpha_0 &+ \sum_{j=1}^{p}\theta_j \Delta InEG_{t-j} + \sum_{j=0}^{q}\phi_j \Delta InAGS_{t-j} + \sum_{j=0}^{q}\beta_j \Delta InHDI_{t-j} + \sum_{j=0}^{q}\delta_j \Delta In(AGS*HDI)_{t-j} \\ &+ \sum_{j=0}^{q}\varphi_j \Delta InTOP_{t-j} + \pi_1 InEG_{t-1} + \pi_2 InAGS_{t-1} + \pi_3 InHDI_{t-1} + \pi_4 In(AGS*HDI)_{t-1} + \pi_5 InTOP_{t-1} + \varepsilon_t\end{aligned} \tag{3.4}$$

Where Δ represents first difference operator, $\pi_1 - \pi_5$ are the long-run multipliers, and $\theta_j, \beta_j, \delta_j$ and φ_j are the short-run dynamic coefficients, ε_t is white noise errors, α_0 is an example of drift term, *p* and *q* are the optimal lag lengths for the dependent and independent variables respectively. The existence of long-run relationships ascertained by conducting an F-test for the joint significance of the coefficients of the lagged values of the variables taking into account the null hypothesis of no cointegration, $H_0 : \pi_f = 0,$ against the alternative $H_a : \pi_f \neq 0$ where $f = 1, 2.....5$. The Wald test is applied in cases where there is more than one short-run coefficient of the same variable. The F-statistics compared with the upper and lower bounds critical values. If the F-statistic exceeds the high significant value, we conclude in favour of a long run relationship or otherwise. However, if the F-statistic lies between the lower and upper critical bounds, the inference would be inconclusive.

3.2 Data

The dataset utilized to examine the interactive effect of age structure and human capital development on economic growth in Nigeria and South Africa are annual GDP per capita (constant 2010 US$), age structure (proxy by working age group 15-64 years) and trade openness (proxy by trade as a ratio of GDP) was sourced from the World Bank's World Development Indicators, 2018 edition while annual data on human capital development (proxy by human capital development index) was sourced from United Nation Development Program Reports, 2018 edition.

4. Results and Discussion

4.1 Preliminary Analyses

Before estimating the ARDL model to investigate the interactive effect of age structure and human capital development on economic growth in Nigeria and South Africa, we conduct preliminary analyses on the data which comprise the descriptive statistics to disclose the characteristics of the series utilized for this study (i.e. mean, standard deviation, maximum and minimum) and unit root tests (Augmented Dickey-Fuller and Pillips-Perron) to show the order of integration of the variables utilized for this study. Table 1 presents the result of the descriptive statistics for Nigeria and South Africa and the result indicates that the average of economic growth proxied by GDP per capita for Nigeria is $1853.357 and $6508.421 for South Africa. This suggest that economic progress in South Africa in South Africa is larger than Nigeria. Also, the average of working population (15-64 ages) in Nigeria is 73768 whereas the average working population in South Africa stood at 30303. Lastly, the mean of human development index is Nigeria and South Africa are 0.416 and 0.644 respectively.

Table 1. Descriptive Statistics

Variables	GDP	AGS	HDI	TOP
Nigeria				
Mean	1853.357	73768	0.416	37.790
Max	2563.092	101661	0.532	53.277
Min	1347.892	50989	0.215	20.722
Std. Dev.	451.709	152302	0.101	8.861
South Africa				
Mean	6508.421	30303	0.644	53.645
Max	7583.590	372464	0.699	72.865
Min	5426.291	222404	0.610	37.487
Std. Dev.	839.4500	443545.	0.026	9.159

Note 1: GDP, AGS, HDI and TOP represents GDP Per Capita, age structure (proxy by working age group 15-64 years), Human Capital Development Index and Trade Openness respectively.

4.1.2. Unit root test

In an attempt to check for the order of integration of the series employed in this study, we used the Augmented Dickey-Fuller and Pillips-Perron unit root tests in which the null hypothesis is that there is a unit root and the alternative hypothesis is that there is no unit root. Table 2 reports the result of the ADF and PP unit root test which indicates that economic growth (LGDP), age structure (LAGS) and trade openness (LTOP) are stationary at first difference, that is, I(1) while human capital development (HDI) is stationary at level, that is, I(0) for both Nigeria and South Africa. Since the unit root tests (ADF and PP) confirm that there is no I(2) among the underlying variables, then the use of ARDL model becomes suitable to estimate the interactive impact of age structure and human capital development on economic growth in Nigeria and South Africa.

Table 2. Unit Root Tests

	ADF Test		PP Test	
Variables	**Level**	**First Diff**	**Level**	**First Diff**
A: Nigeria				
LGDP	-0.6616	-6.2366***	0.2085	-7.1849***
LAGS	-3.4104	-7.2205***	-1.3746	-8.4532***
HDI	-3.8335**	-8.0681***	-3.9633**	-9.5108***
LTOP	-0.4251	-6.0843***	-2.5014	-8.5222***
B: South Africa				
LGDP	-1.3894	-6.6464***	-0.1991	-7.6605***
LAGS	-2.8265	-7.2664***	-2.5600	-8.3325***
HDI	-3.0702**	-9.5506***	-3.3456**	-7.7497***
LTOP	2.3284	-5.4586***	-1.2466	-8.5592***

*Note 1: GDP, AGS, HDI and TOP represents GDP Per Capita, age structure (proxy by working age group 15-64 years), Human Capital Development Index and Trade Openness respectively. Note 2: ***, **, * indicate statistical*

significance at 1%, 5% and 10% respectively. The null hypotheses of Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test are that the underlying series are nonstationary

4.1.3 Cointegration Test

In order to establish the existence of long run relationship amongst age structure, human capital development and economic growth in Nigeria and South Africa, we employed the ARDL bounds test approach for cointegration by Pesaran *et al.* (2001). Table 3 report the result of the bound F-test results. Based on the result, the computed F-Statistic is 8.356 for Nigeria and 10.8557 for South Africa while the lower bound and the upper bound at 5% are 3.23 and 4.35 for both Nigeria and South Africa. Since the computed F-Statistic of 8.356 and 10.8557 is greater than upper bound at 5% (4.35), we reject the null hypothesis that there is no cointegration amongst the underlying variables and therefore, conclude that there is long run relationship amongst age structure, human capital development and economic growth in Nigeria and South Africa.

Table 3. ARDL Bounds Test Result for cointegration

Estimated Equation: *InGDP=f(InAGS, HDI, InTOP)*

	Nigeria	South Africa
F-Stat	8.3651	10.8557
Significance level	**Lower Bound**	**Upper Bound**
1%	4.29	5.61
5%	3.23	4.35
10%	2.72	3.77

4.2. Estimation Result

Table 4 report the ARDL (short and long run) result on the interactive effect of age structure and human capital development on economic growth in Nigeria and South Africa. The result indicates that age structure (proxied by working population) has a significant positive effect on economic growth in both short and long run for Nigeria and south Africa. This outcome supports the findings of Bloom and Canning (2004), Misbah (2010) and Rutger (2011). They suggest that age structure stimulates economic growth. With respect to the impact of human capital development on economic growth, the result indicates that human capital development exert a significant negative influence on economic growth in both short and long run in Nigeria. The negative effect of human capital development on economic growth in Nigeria could be attributed to low level of investment on human capital. The result corroborates with the finding of Ogunniyi (2018) who found that human capital development hinders economic growth in Nigeria. On the other hand, for South Africa, human capital development positively influences economic growth in both short and long run. This suggest that human capital development augment economic growth in South Africa which is in line with the findings of Ahmad and Khan (2018) in developing countries.

In addition, the result in Table 4 revealed that the interaction effect of age structure and human capital development exert a significant negative impact on economic growth in both short and long run in Nigeria. This result implies that the greater the working population, the less effective or valuable is an

extra investment on human capital. It also means that human capital development does not explain the effect of an increasing working population on economic growth. This result is a deviation from theory. However, a possible explanation of this result could be a case of human capital formation without utilization. Studies have shown that there is a phenomenon of human capital formation without utilization in Nigeria (see Oyebade, 2003; Lawanson, 2007; and Oladeji, 2014). Hence, intense manpower development, via human capital investment would impact on working population only when there is an efficient utilization of that manpower.

Meanwhile, in South Africa, the interaction between working age share and human capital development was found to be positive but not significant which point out that the greater the share of working population, the more valuable or effective is an extra investment in human capital. In the same vein, the insignificant interaction result could also be due to inadequate human capital investment. A lower investment in human capital could produce a workforce that is less productive or innovative to boost output. Besides, trade openness positively influences economic growth in both short and long run though insignificant in the long run for both Nigeria and South Africa.

In addition, the coefficient of the Error Correction Term (*ECT)* is negative and significant for both Nigeria and South Africa estimate. The result indicates an adjustment from the short-run to the long-run equilibrium path is 28.9% and 17.6% in Nigeria and South Africa respectively. Also, in both models, the R^2 was 90% and 92% respectively which is a measure of goodness of fit. Correspondingly, the F-statistics (F=404.776; 598.384) which measures overall significance of the model indicates that all the estimated regression coefficients are highly statistically significantly different from zero for both models.

Lastly, in order to check the robustness and efficiency of the model for the two countries under study, we examine few diagnostic tests such as Jarque-Bera normality test, Breusch-Godfrey serial correlation test, ARCH heteroskedacity test and Ramsey Reset test. The result of the Breusch-Godfrey serial correlation test disclosed residuals are serially uncorrected for the two the countries since the probability of the Obs*R-squared is greater than 5% for Nigeria and South Africa. Also, the result of the ARCH test for heteroskedacity indicates that the variance of the error term is constant which implies homoscedastic for the two models. Likewise, Ramsey RESET test (Regressions Specification Error Test) suggests that the model is correctly specified and the Jarque-Bera normality test revealed that the errors are normally distributed. Also, Figs. 1 and 2 show results of stability tests, that is, Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ) for Nigeria while Figs. 3 and 4 depict the Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ) stability test for South Africa. The results of CUSUM and CUSUMsq tests indicate that graphs of both are between the critical bounds at 5% level of significance. This connotes stability in the coefficients of the model and efficient.

Table 4. Estimated Short and Long run ARDL Result

Dependent Variable: InGDP	Nigeria		South Africa	
Variables	**Coeff**	**Prob.**	**Coeff**	Prob.
Long run Estimate				
InAGS	3.740	0.000***	16.347	0.004***
HDI	-117.048	0.017***	390.334	0.006***
InAGS*HDI	-6.626	0.019***	22.662	0.806
InTOP	0.412	0.110	0.305	0.204
C	-59.214	0.000***	-271.495	0.005***
Short run Estimate				
Δ InAGS	1.083	0.019***	2.877	0.001***
Δ HDI	-33.897	0.043***	68.700	0.002***
Δ InAGS*HDI	-1.847	0.047***	3.988	0.640
Δ InTOP	0.049	0.050**	0.077	0.012**
$ECT(-1)$	-0.289	0.022***	-0.176	0.001***
R	0.90		0.92	
F-Stat	404.776	0.000***	598.384	0.000***
Diagnostic Test				
Normality	1.549	0.460	3.431	0.179
Serial	0.872	0.646	1.057	0.589
Hetero	0.076	0.782	1.110	0.291
Ramsey Reset	0.608	0.553	0.059	0.81

*Note 1: GDP, AGS, HDI and TOP represents GDP Per Capita, age structure (proxy by working age group 15-64 years), Human Capital Development Index and Trade Openness respectively. Note 2: ***, **, * indicate statistical significance at 1%, 5% and 10% respectively.*

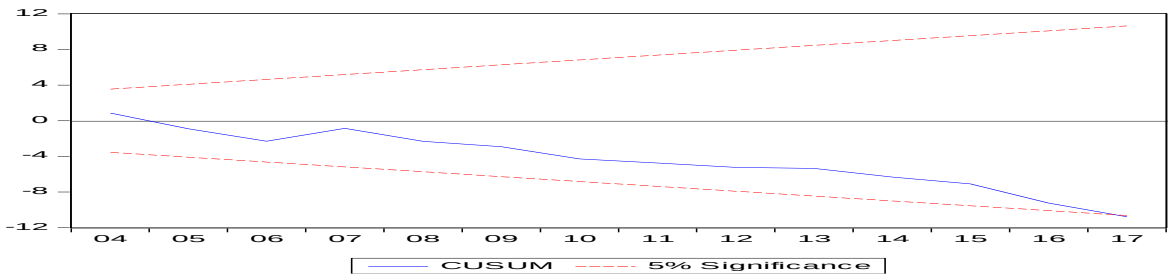

Figure 1. CUMSUM Test

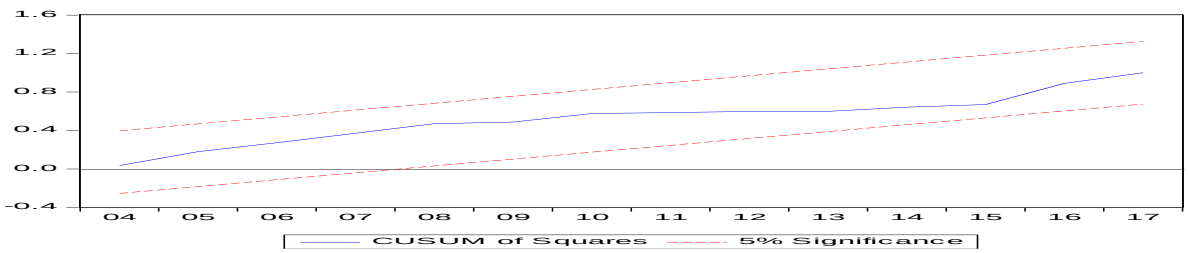

Figure 2. CUMSUM of Square Test

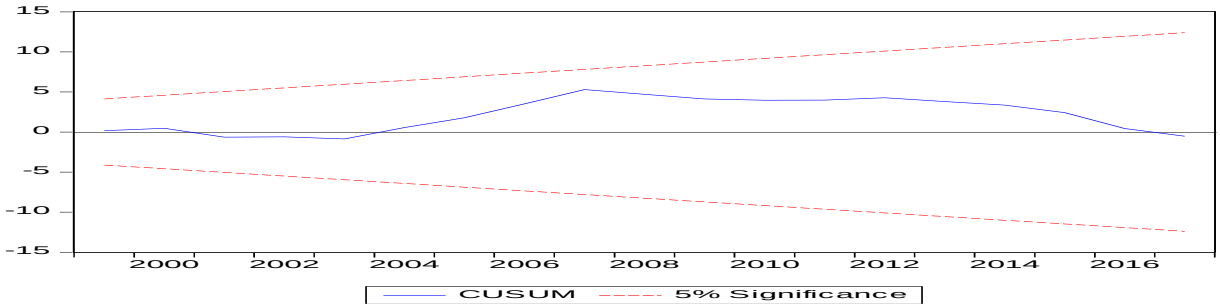

Figure 3. CUMSUM Test

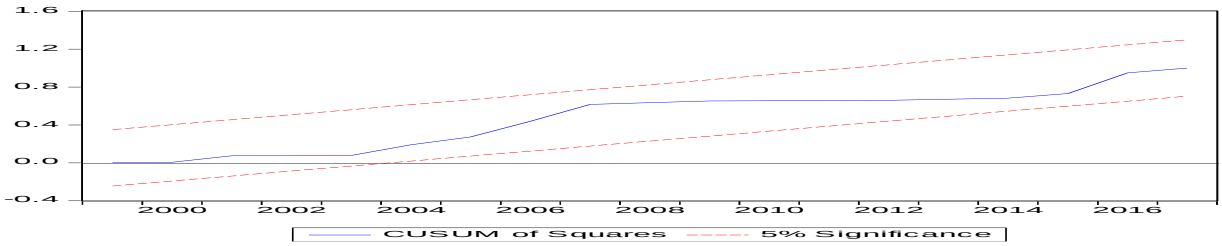

Figure 4. CUMSUM of Square Test

5. Conclusion and Policy Recommendation

The nexus amongst age structure, human capital development and economic growth in Nigeria and South Africa has not been documented in the existing literature. The bulk of empirical literatures have focused on the relationship between age structure and economic growth and between human capital development and economic growth while those on the three variables are largely non-existent especially for the case of Nigeria and South Africa. Thus, this study examines the interactive effect of age structure and human capital development on economic growth in Nigeria and South Africa. The nexus amongst the variables was assessed through Autoregressive Distributed Lag Model (ARDL) and annual data spanning 1991 and 2017. The empirical revealed that age structure stimulate economic growth in both countries while human capital development impedes economic growth in Nigeria but improves economic growth in South Africa. Further, the result indicates that the interaction of age structure and human capital development hinders economic growth in Nigeria whereas positively influence economic growth in South Africa. Based on this result, the study therefore concludes that working age share alone cannot by itself stimulate economic, but has to be supported by human capital investment. It is therefore, recommended that government of both countries should prioritize education at all levels and identify skills and competencies that could make such education functional and productive. Also, the government must ensure synergy between education and labour.

6. References

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