ON THE ECONOMIC FORECAST OF WORKING AGE POPULATION STRUCTURE IN NIGERIA

Supported by tetfund TERTIARY EDUCATION TRUST FUND

Ekperiware, Moses C.[1]*, Olatayo, O. Timothy[2] and Andrew Mayor[3]
[1]Department of Science Policy & Innovation Studies, National Centre for Technology Management, Obafemi Awolowo University, Ile-Ife, Nigeria
[2]Department of Mathematical Sciences, Olabisi Onabanjo University, Ago-Iwoye, Ogun State Nigeria
[3]Delta State Polytechnic, Otefe, Oghara, Delta State, Nigeria
*Corresponding author: mosekperi2002@yahoo.com

Received: November 28, 2018 **Accepted:** April 09, 2019

Abstract: The Nigerian economy as at 2016 stands the most population African nation and the most populous black nation on earth with 185,989,640 people with a dominating working age population. The working age population in any nation is sensitive to enduring economic growth. The study examined the dynamic possible behaviours among human capital formation, population structure, and economic growth as a result of increased working age population, using the vector autoregressive scenario conditional forecasting model. The increase of working age population led to a fall in economic growth in most of the forecast periods but increased human capital formation as a result of the working-age bracket acquiring skills. However, such education should be tailored towards acquiring requisite skills that will make the working age population directly contributing to economic growth (demographic dividend) in the country.

Keywords: Population structure, economic growth, demographic dividend, human capital formation

Introduction

In the Nigeria economy, population is ranked 7th most populated in the world and the most populous black nation on earth. Population proponents posit is an asset to economic growth, while population pessimists advocate its anti-growth (Malthus, 1826; 1978). An operational audit of studies from some populated economies that experienced development indicates that there are more into population than just the population size (Billeter, 1954, Bloom *et al*. 2003; Ekperiware, 2016). According to Weber (2010), variables responsible for demographic changes (predicting population structure) are; fertility rate, mortality rate, and migration. Olatayo and Adeboye (2013) examined the prediction of population growth through births and deaths rate in Nigeria. Their study focuses on the socio-demographic analysis of the factors which led to high births and deaths rate in South-western region of Nigeria and its consequences on the populous economy.

The argument of what population is to economic growth shifted to the examination of the structure of the population in terms of the number of children (before 15), those in the working age, and the aged population (above 64) at any time to determine what population pertains to economic growth. Findings indicated that these differences in population structures have different economic meanings and effects on economic growth. Those in the dependency group are believed to constitute economic stress to an economy, while those in the economically active group (age 15-64) are an asset to economic growth.

According to Billeter (1954), population structure of an economy is specified into three economic groups. Pre-productive (children generation) age 0–14; Productive (parent generation) age 15–64; and Post-productive (grandparent generation): age 64+. Billeter further developed an index (Billeter index) to establishing the productive generation of a population structure as thus;

$$J = \frac{P_{0-14} - P_{65+}}{P_{15-64}}$$

Billeter index is a measure of what a young population means to a particular economy. It shows that a positive ratio indicates pre-productive generation, while a negative ratio reveals aging generation. All these indices has an effect on long-run economic growth because they either fed or contributed to economic growth of a nation (Ekperiware, 2016).

An examination of the Nigerian population structure reveals a peculiar and promising pattern with a consistently dominating working age. This means that more of the population are in their most economically active stage and are in their productive generation. According to Bloom *et al*. (2003), this domination working age population is expected to constitute a great asset, as there would be more active labour force to contribute more in the economic growth process. However, recent studies have questioned if population and even a productive population generation is not sufficient for enduring economic growth (Ekperiware and Tenny 2017). That is why this study set to investigate the actual effect of active working age population structure and a forecast of what happens when the working age population keeps increasing in the Nigeria economy. Though a myriad of important theoretical and empirical contributions on populations and economic growth exist, these are prolix and lack critical examination of population structure and distinct mechanisms through which working age population group affects economic growth. A study focus on the economically active population group is essential in that this is the powerhouse of whatever potential a population holds and to provide for other depending population groups in an economy.

There is need to look at past theories and empirical studies that have contributed to population subject matter of this research. Theories on how population affects economics, environment as well as societies abound There are different theoretical perspectives on the relationships between population and economic growth. The pessimists theory holds that population is anti-growth. It asserts that population shows a constant tendency to outrun the food supply (Malthus, 1826, 1978). One would immediately debunk the pessimist view of population with a population dominated with economically active group of population structure. A French economist Bastiat (1789-1846), posited populated lands are more prosperous than relatively unpopulated, and no reason to set limits to the capacity of the earth, which could undoubtedly support many times its present population l*et al*one that population, can be controlled. The theory of Nitti (1894) expects the deliberate action of man, rather than any decrease in human fertility, to conform population to subsistence in any society in which wealth is justly distributed, individuality strongly developed, and individual activity maintained at a high level of efficiency. According to Nitti, the action of man is what counts, especially the economically active population. If they positively contribute to economic growth, it would

reflect in the output and per capita income while if they remain redundant and unproductive, output will fall. In the slogan of demographers, these would turn to either demographic dividend or demographic disaster, especially with a dominating working age population in such as economy.

The empirical literature of population and economic growth is flowed with different perspectives and findings. This study looked at some findings relating to populations, working age population, human capital formation, and economic growth perspectives. Starting with Rosenzweig (1987), he discussed and evaluated three basic but not mutually exclusive assertions in population literature; how population growth and human capital investments jointly reflect and respond to changes in the economic environment, how large families directly impede human capital formation, and how fertility affects investment in human capital. Using economic-biological models of household behaviour, the evidence showed strong correlations among population growth, human capital and economic growth variables. The study revealed that high-income countries have low rates of population growth and high rates of schooling and literacy. Countries with high rates of population growth recorded low rates of schooling and literacy. In country specific studies, Rosenzweig further found that large family size recorded lower levels of schooling and health care services between the periods 1970 to 1980 in 94 countries. The study found families with low fertility rate with high human capital investments per person. In addition, early and prolonged child bearing directly diminishes human capital development. Fertility control appeared to have increased human capital development. However, the statistical significance of the causal relationships among the variables was quite low. In addition, the study did not indicate how the economically active population counts in family income, human capital and fertility.

Gideon *et al.* (2013) further put forward three assertions; population growth stimulates economic growth, population growth adversely affects economic growth, and population growth is a neutral factor in economic growth and it is determined outside standard growth models. Using Vector Auto Regression (VAR) estimation technique with annual time series data for the period 1963 to 2009 from Kenya, the results indicated that population growth and economic growths correlate positively. An increase in population affected economic growth positively in Kenya. The test showed that causality runs in both directions. The bi-directional causality runs from population growth to economic growth, and vice versa. This portrays that a mutually reinforcing bilateral causality between population growth and economic growth existed in Kenya.

Put differently, Ceyhun and Semih (2012) asked, 'can sustained economic growth and declining population coexist?' Their theoretical framework predicted a constant creation of young workforce towards human capital-oriented technologies that support an ageing population called 'endogenous efficiency-augmenting mechanism. This is to replace the increasing degree of falling returns to human capital in traditional production technologies. The study disclosed that the degree of increasing returns to human capital has been falling over time in the world along with population growth rates, and increasing returns to human capital and population growth rates. This suggests that sustained economic growth and a declining population can coexist through the long-run endogenous efficiency-augmenting human capital mechanism.

From the above empirical literature reviewed so far, attention has only been paid to causes and impact of population on long-run economic growth with little interest on population structure (especially working age population) and human capital on economic growth, which can reveal more dynamics of population and human capital in these countries. For instance, Tsen and Furuoka (2006) found population to be casually relating to economic growth in China. China has been at the forefront of promoting policies that support demographic transition. As at 2008, the population growth rate of China was just 0.5 per cent from 1.4 per cent in 1990 whilst that of Sub-Saharan African countries has been growing at about 2.0 per cent (Amsalu, 2011). In addition, the above reviewed studied have not forecast the possible future demographic change and their effect scenarios.

Looking at age structure of population, Maestas *et al.* (2014) provided evidence of age structure differentials on economic growth. They examined differential aging patterns (transition) at the state level in the United States between 1980 and 2010 to isolate the effect of aging population on economic growth. The study employed a natural research approach that separated the impact of aging patterns on economic growth to estimate the impact of aging population on Gross Domestic Product (GDP), growth rate, and its constituent parts (labour-force and productivity growth). The results from the estimation showed that a 10% increase in the fraction of the population age 60+ decreased GDP per capita by 5.7%. This reduction in economic growth was because aging population in the United States leads to a decrease in the growth in the supply of labour and consequently, to a reduction in productivity growth.

In another study, Chaudhry *et al.* (2010) analysed the role of human capital and employed labour force in the relationship between trade openness and economic growth in Pakistan, using the Vector Error Correction Model (VECM) econometric technique with time series of the period 1972-2007. Data on trade openness and economic growth were taken from the world development indicators, while human capital index is constructed based on the data from Pakistan economic survey. The empirical results revealed both short run and long run relationships among variables in the growth model. Labour-force and trade openness recorded direct relationship with long-run economic growth while human capital and physical capital had inverse relation with long-run economic growth. Causality was found to run from labour-force and human capital to economic growth. Such a study needs to be carried out in populous nation like Nigeria.

Examining the role of human capital in a high fertility scenario, Akintunde *et al.* (2013) examined the effect of life expectancy and fertility on economic growth in thirty-five SSA countries from 1970 to 2005. The study is motivated by the high population in SSA and low economic development, compared to other regions of the world. The dynamic panel data analysis show that total fertility rate negatively impacts on economic growth while, life expectancy at birth shows a positive influence on economic growth. The study suggests that SSA region needs to address the high population growth like the developed countries.

Paying emphasis on the demographic transitions and human capital in developed countries, Basu *et al.* (2013) examined demographic component in BRICS countries using panel data analysis. They asserted that demographic transition is changes in age structure due to reduction in both mortality as well as fertility. Many developed countries are at the last stage of the demographic transition whereas most of the African countries are at the second stage of it. Good for many developing nations, the second to third stage of demographic transition is associated with the stage of demographic dividend. Demographic dividend according to them is the window of opportunity to a nation for rapid economic growth through human capital development if effective policies are in place. The study reveals that the potential growth of BRICS economies is largely dependent on the skill formation capacity

of its working age population. However, life expectancy at birth shows positive effect in BRICS regression, though not statistically significant.

In a comparative study between Nigeria and Ghana, Awobode (2015) examined labour-force participation and economic growth. The study used both descriptive and econometric techniques with time series data from 1990 to 2012 such as female labour-force participation rate, economic growth rate, primary enrolment, secondary enrolment, and fertility rate sourced from Central Bank of Nigeria Statistical Bulletin, Ghana Statistical Bulletin, World Development Indicators, Federal Reserve Economic Data, and International Labour Organisation Statistics. The descriptive analysis showed that Nigeria recorded lower (55.5%) labour-force participation compared to Ghana (70.4%) in 2010. In Ghana, fertility rate and secondary enrolment positively determine female labour-force participation while in Nigeria, only primary enrolment accounts for female labour-force participation. The granger causality test between female labour-force participation and economic growth showed that causality runs from female labour-force to economic growth. The study showed that demographic transition is higher in Ghana than Nigeria but only recognised the effect of enrolment on female labour-force participation instead of the entire labour-force participation. However, the study failed to examine likely feedback among human capital formation, labour-force participation, and economic growth.

For population growth equation, the study showed that highly educated people control family size in West Virginia. This shows that countries that report high initial percentage of income are more likely to have higher growth rate of education compared to other countries. In addition, higher investment in education occurs with higher income level, and the educated were found to be less populated. Furthermore, the revealed significant and positive relationship between unemployment rates and population density indicates that lower income and lower education with high unemployment rate may lead to bigger family sizes.

Materials and Method

The Vector Auto-Regression (VAR) model is used in this study to forecast the dynamic effects of increasing working age population structure on Nigerian economy through VAR scenario analysis. The VAR model is a dynamic auto-regressive model that allows dynamic structural relationship than the normal static Ordinary Least Square (OLS) estimation (Lutkepohl, 2005:4).

$$\text{VAR (j)}\quad Y_t = \alpha + \phi_1 Y_{t-1} + \ldots + \phi_j Y_{t-j} + \varepsilon_t \qquad (3.1)$$

Where Y_t is a 5x1 vector of endogenous variables, α is a 5x1 vector of intercepts, Y_{t-j} is a vector of lagged variables (exogenous in the study), with ε_t as the disturbance terms, and ϕ is a 5x5 matrix of coefficients. Equation 3.1 represented in matrix form to be able to derive the standard VAR model (Ekperiware, 2016):

$$\text{VAR(1)}\begin{bmatrix} POPG_t \\ GEHC_t \\ ENROL_t \\ LF_t \\ GDPN_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \alpha_5 \end{bmatrix} + \begin{bmatrix} \phi_{11} & \phi_{12} & \phi_{13} & \phi_{14} & \phi_{15} \\ \phi_{21} & \phi_{22} & \phi_{23} & \phi_{24} & \phi_{25} \\ \phi_{31} & \phi_{32} & \phi_{33} & \phi_{34} & \phi_{35} \\ \phi_{41} & \phi_{42} & \phi_{43} & \phi_{44} & \phi_{45} \\ \phi_{51} & \phi_{52} & \phi_{53} & \phi_{54} & \phi_{55} \end{bmatrix} \begin{bmatrix} POPG_{t-1} \\ GEHC_{t-1} \\ ENROL_{t-1} \\ LF_{t-1} \\ GDPN_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \end{bmatrix} \qquad (3.2)$$

The matrix (equation 3.2) is specified further in a linear system as thus:

$$POPG_t = \alpha_1 + \phi_{11} POPG_{t-1} + \phi_{12} GEHC_{t-1} + \phi_{13} ENROL_{t-1} + \phi_{14} LF_{t-1} + \phi_{15} GDPN_{t-1} + \varepsilon_{1t} \qquad (3.3)$$

$$GEHC_t = \alpha_2 + \phi_{21} POPG_{t-1} + \phi_{22} GEHC_{t-1} + \phi_{23} ENROL_{t-1} + \phi_{24} LF_{t-1} + \phi_{15} GDPN_{t-1} + \varepsilon_{2t} \qquad (3.4)$$

$$ENROL_t = \alpha_3 + \phi_{31} POPG_{t-1} + \phi_{32} GEHC_{t-1} + \phi_{33} ENROL_{t-1} + \phi_{34} LF_{t-1} + \phi_{15} GDPN_{t-1} + \varepsilon_{3t} \qquad (3.5)$$

$$LF_t = \alpha_4 + \phi_{41} POPG_{t-1} + \phi_{42} GEHC_{t-1} + \phi_{43} ENROL_{t-1} + \phi_{44} LF_{t-1} + \phi_{15} GDPN_{t-1} + \varepsilon_{4t} \qquad (3.6)$$

$$GDPN_t = \alpha_5 + \phi_{51} POPG_{t-1} + \phi_{52} GEHC_{t-1} + \phi_{53} ENROL_{t-1} + \phi_{54} LF_{t-1} + \phi_{55} GDPN_{t-1} + \varepsilon_{5t} \qquad (3.7)$$

Estimates of equations 3.3 to equation 3.7 can be summarised given that *p* represents the number of lagged periods which is determined through the popular criteria on lag length criteria selection test and *Y* the variables used in the model as thus:

$$VAR_{(p)} \approx \ddot{Y}_t = \alpha + \ddot{\phi}_1 Y_{t-1} + \ddot{\phi}_2 Y_{t-2} + \ldots + \ddot{\phi}_p Y_{t-p} \qquad (3.8)$$

This is a condensed form of the entire model for this study. The VAR technique is applied to equation 3.8 where p is equal to lag length three (p=3) in the ordering array of equation 3.8. Testing for unit roots and lag length criteria are carried out to avoid spurious estimates (Gujarati and Sangeetha, 2007). A crucial assumption in using VAR is that the variables have to be stationary at levels. If the variables are not stationary but only stationary after first differencing them, then the Vector Error Correction Model (VECM) is the appropriate analytical model after checking for possibly long-run relationships among the variables (cointegration) (Pedro, 2010). ϕ in the 5×5 matrix captures the contemporaneous structure among the variables. For instance, how GDPN relates with increased labour force. The coefficients of the model are to reveal the impact of various shocks. The error term (ε_t) are linear combinations of the uncorrelated shocks (ε_t) such that each individual error term is serially uncorrelated with zero mean and a constant variance. The VECM presents the causal effects of variables in the model. It is an extension of VAR and it incorporates the possibly cointegrating error term (ECT_{it-1}) into the VAR model.

$$\text{VAR (j)}\quad Y_t = \alpha + \phi_1 Y_{t-1} + \ldots + \phi_j Y_{t-j} + \pi ECT_{t-1} + \varepsilon_t \qquad (3.9)$$

This model handles issues of co-integration found in the study. The VECM is crucial in investigating both short-run and long-run causal effects. The VAR or VECM model is useful in two regards in this study: forecasting and interpreting the relationships among variables. In this study, emphasis will be placed on the forecasting analysis of working age population which comprises the labour force on the Nigerian economy.

Forecasting the possibility of demographic dividend in Nigeria

This section is keen on finding out what the Nigeria youthful population holds in the nearest future. The term forecasting is used more frequently in recent economic time series literature than the word prediction. However, most forecasting results are described from a general theory of linear prediction developed by Kolmogorov (1941). Olatayo and Alabi (2011) investigated forecasting modelling in stochastic time series process and observed that efficient planning system requires forecasting future events for an effective management, to achieve this, an appropriate mathematical model should be designed to describe the behaviour of the system, especially when there is choice between analogous models. The idea underlying forecasting with a VAR model was first summarized by the dynamic interrelationships among observed data series instead of using a single data series in predicting likely future values for each series from the summary (Robertson and Tallman, 1999). Taiwo and Olatayo (2013) analysed the forecasting performances of vector autoregressive VAR model and concluded that VAR models offer a parsimonious representation for a multivariate process. According to Sims (1986), A VAR model expresses the current value of each of the time series as a weighted average of the recent past of all the series plus a term that influences all the current values. The scenario analysis of increased human capital formation (GEHC and ENROL) and labour-force supply for 15 periods (1999 to 2014) from the VAR model (especially from equation 3.9) showed the effect of increased labour-force scenarios on human capital investments and economic growth in Nigeria. The need for a forecasting model was to be able to predict and assume a scenario of say the influence 0.5 to 5% increase in working age population from its current figures on the human capital investments and economic growth in the country. This examined whether the country experienced enduring economic growth as a scenario of increased working age population, which is the necessary condition for demographic dividend hypothesis. More crucial is that the forecast results further serve as a check and inform policy making on economic policy and population structure in the country.

Table 1: Data source, description, and measurement of variables

S/N	Variable	CODE	Definition	Source of Data
1	Gross Domestic Product	GDPN	This is the yearly nominal gross domestic product (GDP).	Central Bank of Nigeria (CBN) various issues
2	Enrolment	ENROL	The total primary and secondary education pupils	World Development Indicator (WDI) online database published by World Bank Organisation, accessed 2015
3	Life Expectancy	LEXP	This is life expectancy at birth which is the number of years a newborn infant would live	World Development Indicator (WDI) online database published by World Bank Organisation, accessed 2015
4	Population Growth	POPG	Growth rate of head census of population of humans in a country overtime	World Development Indicator (WDI) online database published by World Bank Organisation, accessed 2015
5	Labour-force	LF	The working-age population (15-65 years old)	World Development Indicator (WDI) online database published by World Bank Organisation, accessed 2015
6	expenditure on education and health	GEHC	Yearly federal government budgetary expenditure on education and health	Central Bank of Nigeria (CBN) various issues

Source: Author's Compilation, 2016

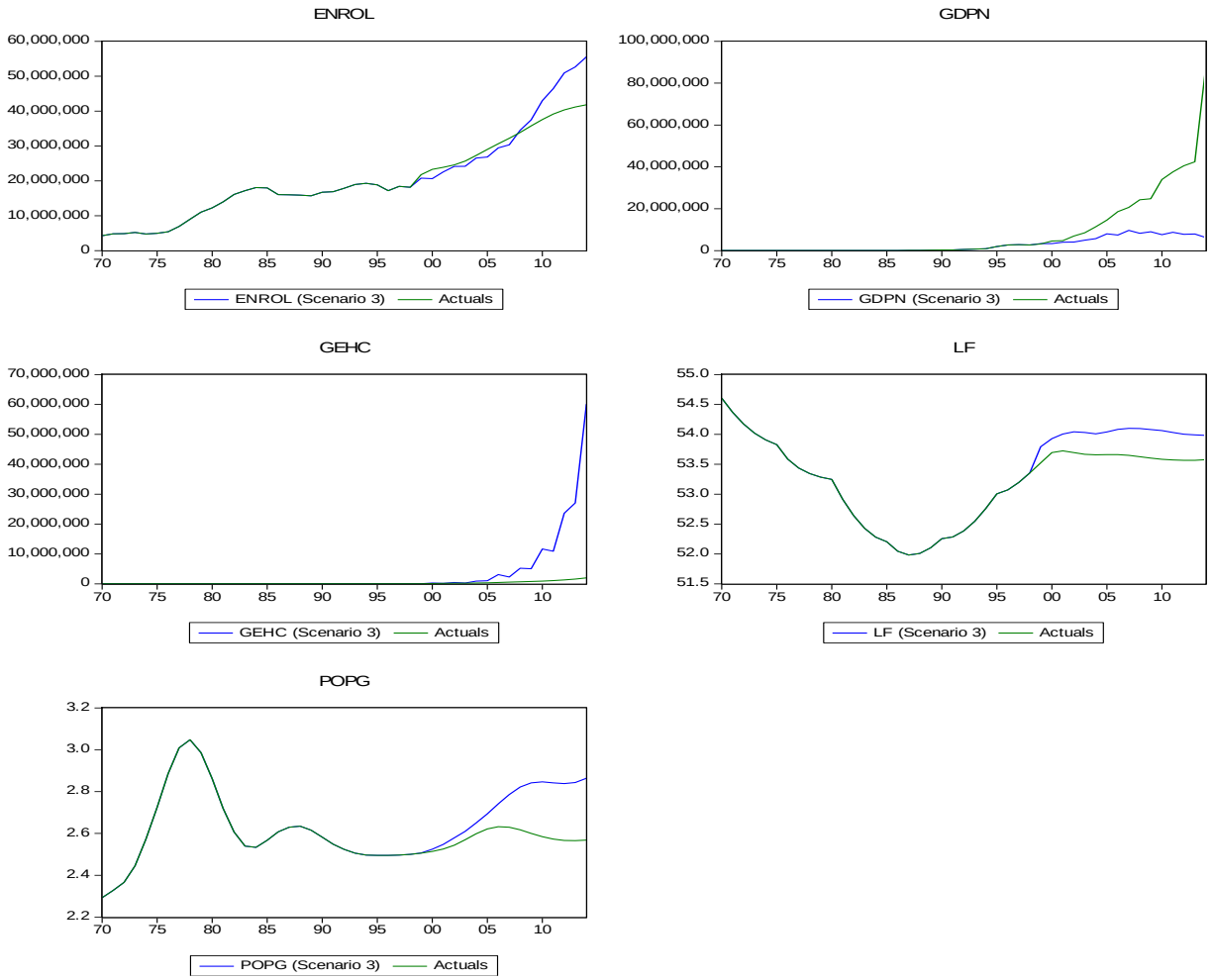
Results and Discussion

Further scenarios of increasing the number of population in the working-age bracket by additional 0.5, 1, 2, 2.7, 4, and 5% in the Nigerian economy respectively constitute a great stress to the economy (figure 4.1, 4.2, 4.3, 4.4, 4.5, 4.6). The basis of increasing labour-force supply from 0.5, 1, 2, 2.7, 4, and 5% was to predict the economic situation of the country at various scenarios and its impact on the Nigerian economy. When the labour-force is increased with additional 0.5, 1, 2, 2.7, 4, and 5% from its current 53.58% of the Nigerian population as at 2014, without the attending investment in human capital, it led to fall in the overall growth rate of the economy. The Nigerian labour-force growth rate is higher (2.76%) than the population growth rate (2.66%), hence, additional increment without productivity is not an economically rational position. Therefore, the study further examined the effect of increased labour-force supply in 2014 from its actual size (94,379,786) as at 2014 by 2% increased labour-force (96,267,382) without consideration for investment in human capital in the country. Such upsurge in labour-force alone without increased human capital formation showed that it requires increased government investment in human capital and school enrolment. This further led to increased population since they are the most active population. However, this respective scenario increase in labour-force constituently led to a fall in economic growth all through the conditional forecast periods in Nigeria. It shows that increase in labour-force, without investment in human capital just increased the population size with no contribution to economic growth (Malthus, 1798). A scenario increase of working-age population only increased the working-age population beyond what the economy can afford in terms of equipping them with the requisite skills, hence may lead to social vices, and fall in economic growth because these increased working-age population cannot productively engage in economic activities but would want to benefit from the society (demographic disaster).

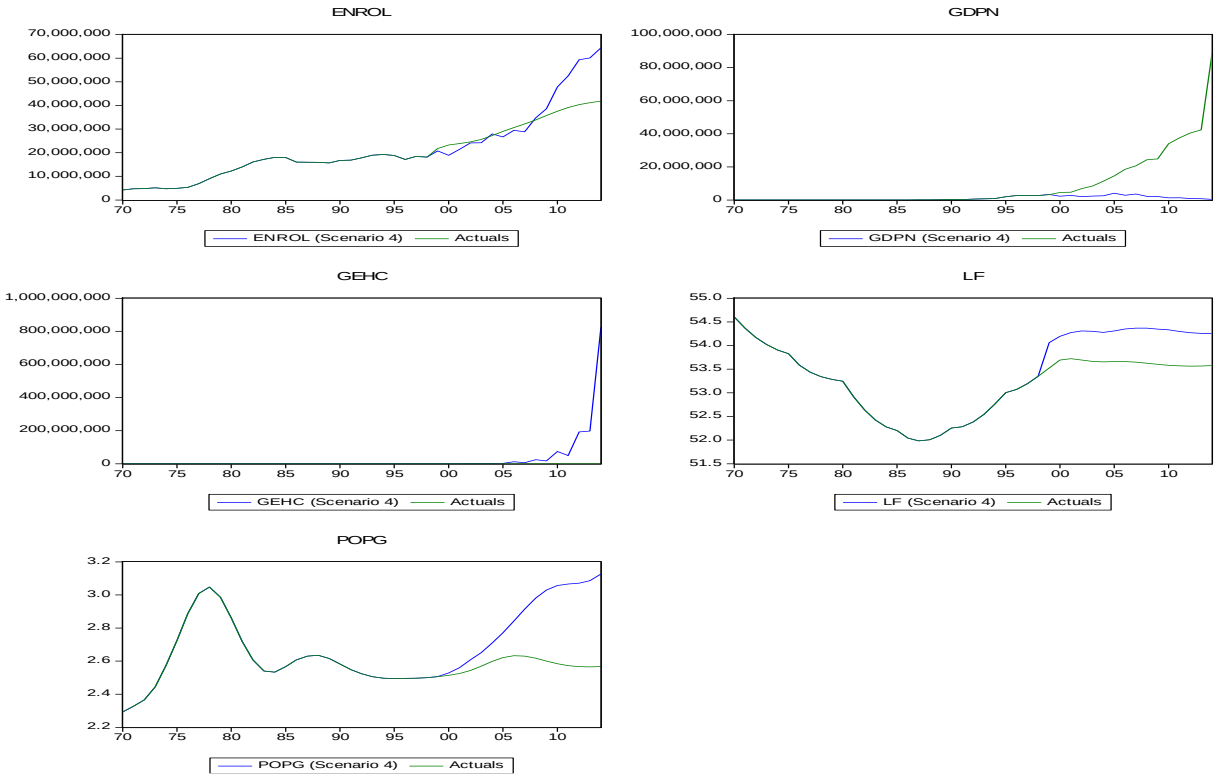
The discussion in the scenario analysis showed the dynamic relationship among human capital formation, population structure, and economic growth in Nigeria as a result of increased working age population. It clearly shows that human capital formation is indispensably a major requirement improving the quality of labour-force for enduring economic growth (Ekperiware, 2016). The conditional forecasting showed that increasing the working-age population in an economy constitutes catastrophe to economic growth if investment in human capital formation is not targeted at. The observed upsurge in Nigeria youth population structure without additional investment in human capital and school enrolment would only constitute high rate of unemployment and dismal performance in economic growth. Investing on equipping such economically active population with the requisite skills needed in the production process and engaged in economic activities such as creating jobs rather than been indolent is sensitive for enduring economic growth. Whether the Nigerian youth is an asset for enduring economic growth is a matter of huge investment in equipping them with the requisite skills that are needed in the production process. Emphasis must be placed on the right skills, as it might require such labour-force creating their own space of economic activities through technical skill acquisition.

From the foregoing, economic growth and development make no sense if job creation is not an outcome (Ekpenyong and Emmanuel, 2014). Hence, besides what increased working-age population hold for economic growth, reducing unemployment is crucial in the populated Nigerian economy. Even if the labour-force is equipped with the requisite skills, it is when they are engaged in the production process of the economy before they can spur sustainable economic growth (Oladeji, 2014).

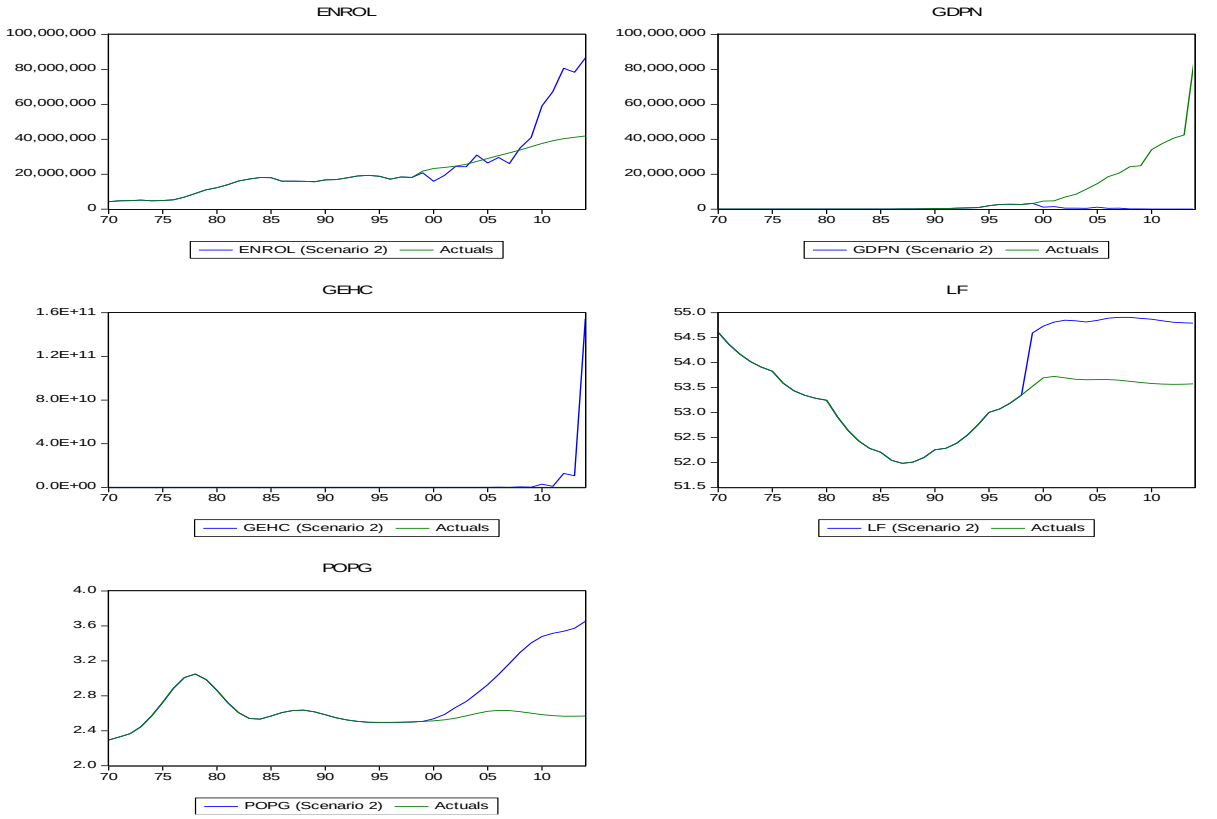
In addition, the findings that increased working-age population lead to decreasing economic growth is in line with the Nigerian economy reality with a large working-age population according to the UN press (2013). The low economic growth might be because of low skilled working-age population and high unemployment in such scenario. Except the Nigerian population is further equipped with massive investment in human capital formation through requisite skills that would reduce the present unemployment situation by engaging the current huge working-age population, the prospect of realising enduring economic growth would be an illusion. Rather demographic disaster would be the reality with further increase in unemployment rate and other economic vices called time bomb (World Bank, 2015).



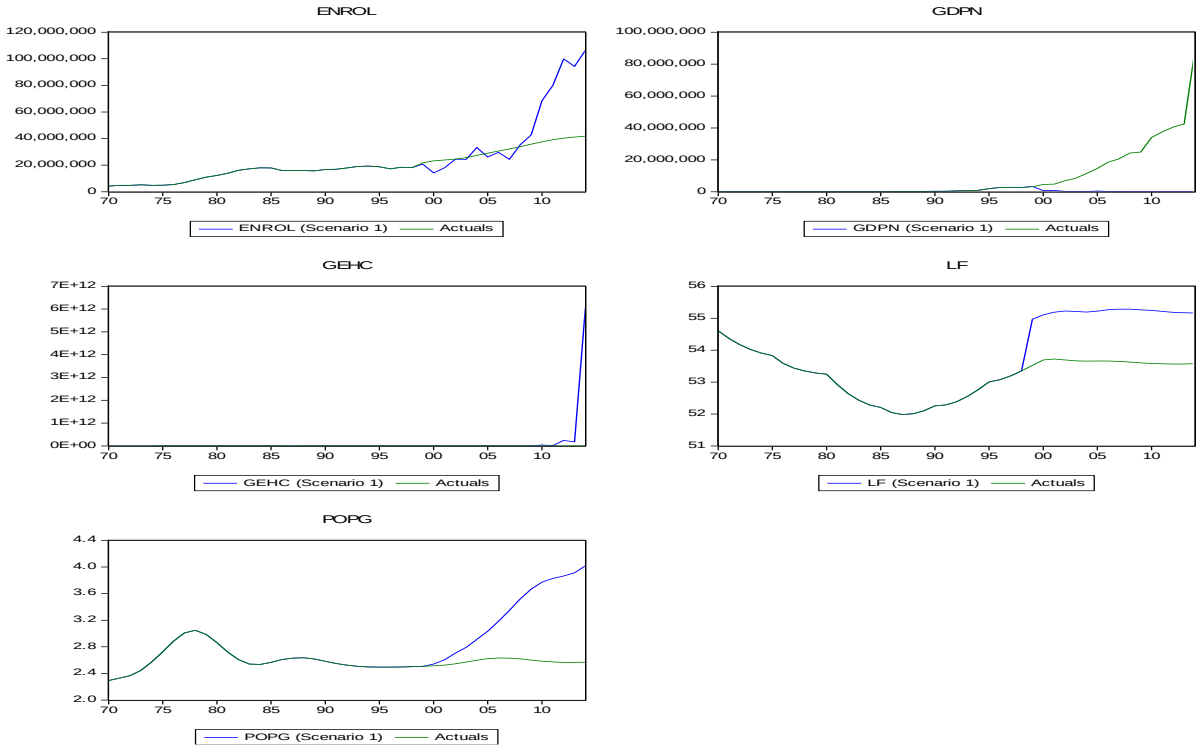
Source: VECM Scenario Analysis and compiled by Author (2017)
Fig. 1: Effect of increased labour-force supply by 0.5%



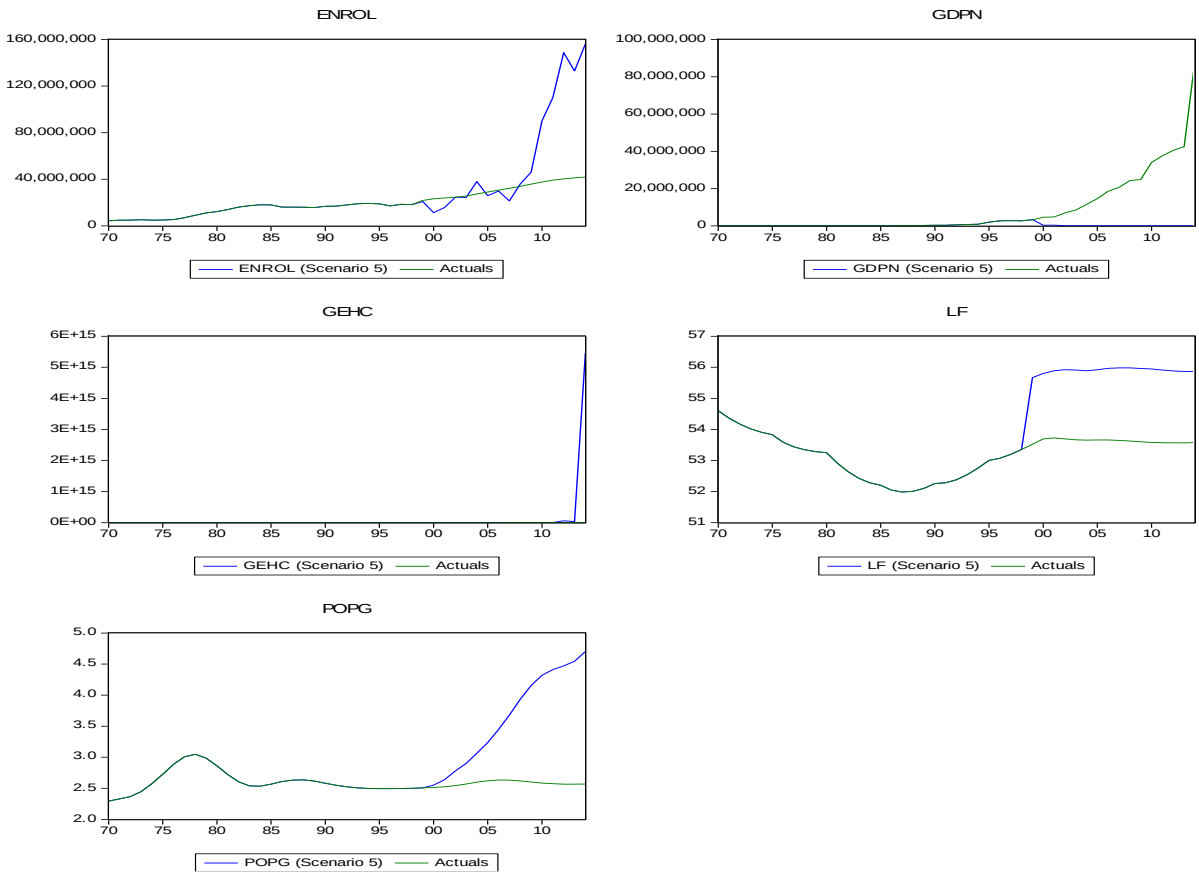
Source: VECM Scenario Analysis and compiled by Author (2017)
Fig. 2: Effect of Increased Labour-Force Supply by 1%



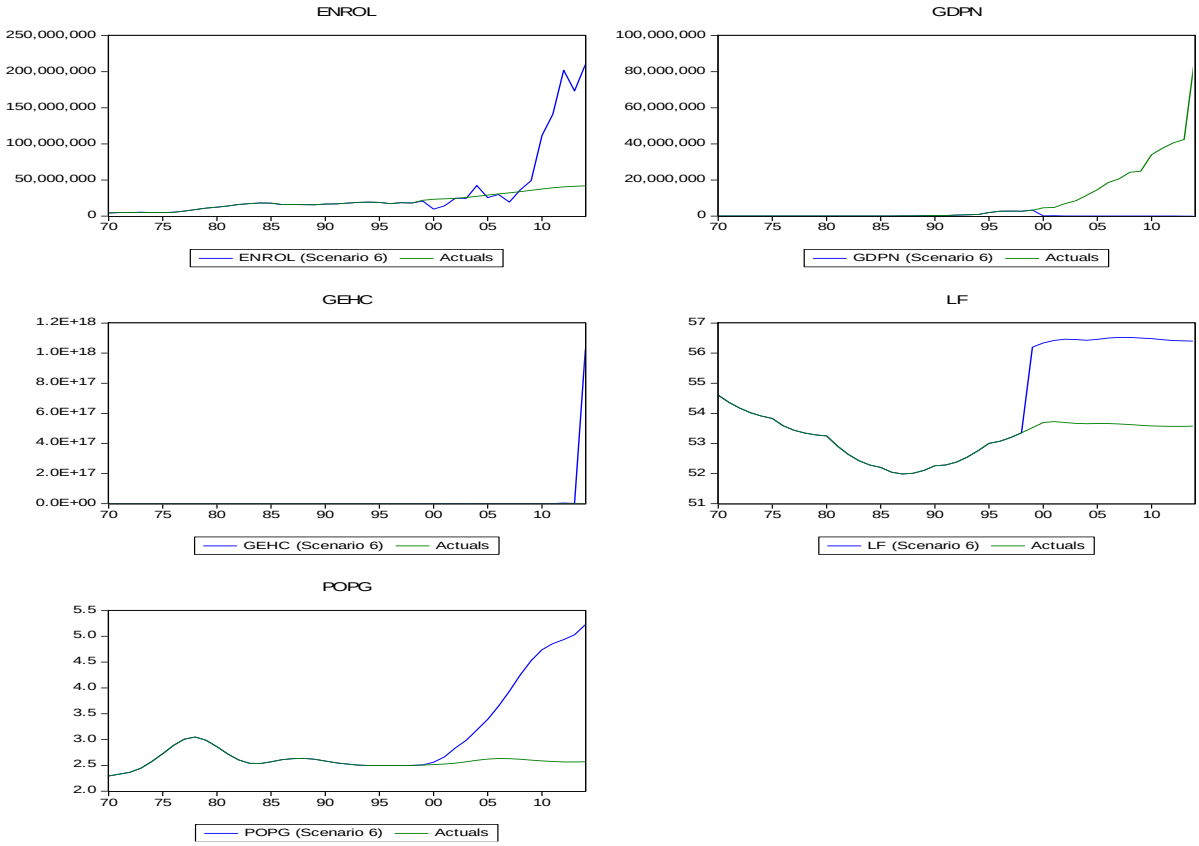
Source: VECM scenario analysis and compiled by Author (2017)
Fig. 3: Effect of increased labour-force supply by 2%



Source: VECM scenario analysis and compiled by Author (2016)
Fig. 4: Effect of increased labour-force supply by 2.7%



Source: VECM scenario analysis and compiled by Author (2017)
Fig. 5: Effect of increased labour-force supply by 4%



Source: VECM scenario analysis and compiled by Author (2016)
Fig. 6: Effect of increased labour-force supply by 5%

Conclusion

The study showed that a scenario where the working-age population is increased by additional 0.5, 1, 2, 2.7, 4 and 5% without a consideration for investment in human capital formation. Such respective increase indicated that economically active population (Labour Force) with no requisite skill constitutes a fall in GDP and stress on human capital formation (GEHC and ENROL) all through the forecast periods (1999–2014). Such respective increase in labour-force further amounted in government budgetary allocation to education and health, school enrolment and population growth. The study therefore concluded that increased working-age population is a disaster to economic growth and rather leads to a further boom in population growth.

Conflict of Interest

Authors declare that there is no conflict of interest reported on this work.

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