IMPACT OF ECONOMIC GROWTH, ENERGY AND PUBLIC HEALTH EXPENDITURE ON LIFE EXPECTANCY IN NIGERIA: BOUND TEST APPROACH

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Abstract
This paper examines the impact of economic growth, energy and public health expenditure on life expectancy in Nigeria applying Autoregressive Distributive Lag (ARDL) model over the period of 1980 to 2018. The result shows that economic growth and public health expenditure positively affect life expectancy over the period of the study. On the other hand, energy negatively affect life expectancy. Consequently, It is however, recommended that, to improve the health status in Nigeria, health policymakers should focus on the factors which lie outside the healthcare system. These factors are mainly associated with economic growth and development level. Thus, the economic stabilisation policies with the aim of increasing the productivity, economic growth, and energy efficiency will certainly play significant roles in the improvement of health status and therefore, increasing the life span of Nigerians.

Keywords: *life expectancy, economic growth, public health expenditure, energy, Bound test, Nigeria*
JEL Classification: F43, K33, O13, P36

INTRODUCTION

Life expectancy is an important synthetic indicator for assessing the economic and social development of a country or a region. During the last 170 years, life expectancy has been constantly rising (Bilas et al., 2014).Yet enormous discrepancies still exist between developed and developing countries. This disparity in life expectancy is believed to have its roots in differential socio-economic backgrounds of different social groups. The underlying rationale is that the socio-economic and environmental factors do exert independent, as well as, interactive influence on the life expectancy level. Considering population ageing trends it is to be expected that in the future there will be a decline in the active workforce, an increase in public expenditures for pensions and in health care expenses. Such changes significantly affect health care systems in developed countries, which are also faced with challenges caused by technological changes.

Furthermore, life expectancy is one of the pivotal outcomes of health care facilities as well as important component of human development index (HDI). This however

encapsulates several variables and is itself determined by various factors, hence its comprehensiveness. Therefore, adequate health care facilities are presumed to see its reflections in stably high life expectancy. Thus, life expectancy can be only achieved if mortality rate, both infant and maternal, are dealt with from the root-cause rather than hitting its causes. Therefore, these root-causes of mortality are poor health care facilities, illiteracy, inadequate access to safe drinking water, erratic power supply, malnutrition and poor energy intake. However, low life expectancy in any country is attributed to so many factors including the aforementioned ones. Until recently, empirical evidence revealed that Nigeria records the following stylized facts as average year of life expectancy at birth: 49.8 in 2008; 50.4 in 2009; 50.9 in 2010; 51.3 in 2011; 51.7 in 2012; 52.1 in 2013; 52.4 in 2014; 52.8 in 2015 and income per capita growth of 3.5 in 2008; 4.1 in 2009; 5.0 in 2010; 2.1 in 2011; 1.5 in 2012; 2.6 in 2013; 3.5 in 2014; -0.01 in 2015. The trend of life expectancy is not in tandem with the income per capita growth which is puzzling. Meanwhile it is generally believed that, ceteris paribus, high income per capita seems to be translated in rapid sustainable increase in life expectancy at birth. This is because the more people have high income at their disposal on consumption the more life expectancy tends to increase. But it is different in Nigeria where the various trending in income per capita growth that do not reflect the increase in life expectancy at birth.

Moreover, it is clearly evident that income per capita growth is a times increasing at decreasing rate (e.g. from 2010 to 2012) or even decreasing (e.g. 2014 to 2015) with negative value (-0.01). Meanwhile life expectancy is increasing at increasing rate which is remarkable. Therefore, it is for this reason that necessitates research in this area in order to explore the reason behind this mishap. Therefore, it is against this background that this paper intends to answer the following research question:

i. To what extent does economic growth influence life expectancy in Nigeria?
ii. To what extent does energy influence life expectancy in Nigeria? and
iii. To what extent does public health expenditure affect life expectancy in Nigeria?

The paper is organized as follows: following this introduction is section 2 that contains conceptual as well as empirical literature reviews. Section 3 discusses the method of data collection and methodology. The major findings are presented in Section 4 and section 5 reports the conclusion and recommendations.

Literature Review

Life expectancy at birth is the average number of years a newborn infant would be expected to live if health and living conditions at the time of birth remained the same throughout life. It reflects the health of a people, the quality of care they receive when ill as well as social, economic and environmental conditions which mitigates or predisposes to morbidity and mortality. Furthermore, life expectancy at birth is the number of years a new born infant of either gender may be expected to live if prevailing patterns of mortality at the time of its birth stays the same throughout its life time (Muhammad and Sabo, 2018). Empirical studies investigating the determinants of life expectancy or the relationship between life expectancy and other relevant variables are abound such as Muhammad and Sabo (2018); Ngwen and Kouty (2015); Monsef and Mehrjardi (2015); Sufyan, (2013); Sanda and Oyerinola (2014); Kunot et al. (1994); Lokpriy (2013); Christensen and Vanpel (1996); Lin et al. (2012); Bilas et al. (2014); and

Balan and Jaba (2011); but specifically there is no research on the determinants of life expectancy in Nigeria. They are as follows:

Using Autoregressive Distributed Lag (ARDL) Model, Muhammad and Sabo (2018) examined the impact of economic growth and access to safe drinking water on life expectancy in Nigeria from 1980 to 2014. The paper found the existence of cointegration among the variables under study. Hence, the result revealed that economic growth and access to safe drinking water exert positive and statistically significant impact on life expectancy at birth over the period of the study. Similarly, Monsef and Mehrjardi (2015) surveyed the determinants of life expectancy in 136 countries for the period 2002–2010 using panel data analysis, fixed effects and random effect models. The results indicated that gross capital formation and gross national income have positive impact on life expectancy. For instance, Christensen and Vanpel (1996) analyze the determinants of longevity in the industrialized countries. The variables of choice are genetic, environmental and medical factors. It finds that high lifespan as well as mean lifespan increase substantially; there is remarkable improvement in survival amongst people of eighty and above; genetic factor contributes one-quarter of the variation in lifespan; the impact of both genetic and environmental factors on longevity can potentially be modified by medical treatment, behavioral changes and environmental improvements. Also, Lokpriy (2013) applied multiple regression technique to examine the socio-economic determinants of life expectancy in ninety lower income countries with a per capita GNI below $4035 in 2011. The variables of interest are improved sanitation facilities, improved water sources, secondary school enrolment, GDP per capita, and health expenditure per capita. The study finds that a higher GDP per capita combined with access to sanitation and safe water source as well as secondary school education have a positive impact on life expectancy; while relationship between life expectancy and health expenditure per capita is found to be contradictory. It is recommended that non-medical interventions are more positively robust determining factors of life expectancy in comparison with medical intervention.

Kunot et al. (1994) empirically assessed whether life expectancy is to the detriment of happiness. The dataset on 5 countries cover 6 years period from 1984 to 1989, using Sullivan Method. They addressed that life expectancies are not related to life satisfaction; because in Netherland, there is high life expectancy as well as high level of life satisfaction; while Ireland has high level of life satisfaction with low life expectancies; therefore, life satisfaction can be set up, in a country, irrespective of longevity; and in Greece and France, there is high life expectancies with lowest number of years in happiness. They that life at old age is not as gloomy as indicators of physical health.

In a similar study, Sufyan, (2013) examines the impacts of socio-economic determinants of life expectancy across one-hundred and six countries. These countries are categorized into three categories namely, countries with low life expectancy as group, countries with medium life expectancy as group, and countries with high life expectancy as group. Canonical discriminating analysis technique is used to discriminate the groups. The discriminating variables are population, living in Urban areas (%), currently married or in-union women of reproductive age (%), GNI purchasing power parity,

population density, rural population with access to improved water supply, infant mortality rate, total fertility rate, dependent population (%), and poverty. The study shows that the infant mortality is the most influential variable in discriminating among the three groups, seconded by poverty. The other important discriminating factors are total fertility rate, percentage of currently married or in-union women of reproductive age, percentage of rural population with access to improved water supply, population density, and percentage of urban population. More so, infant mortality rate, poverty and total fertility rate positively discriminate countries to belong to the group of low life expectancy at birth countries. While percentage of population living in urban areas, currently married or in-union women of reproductive age, and rural population with access to improved water supply negatively discriminate a country to the group of high life expectancy at birth countries.

In Nigerian studies, Sanda and Oyerinola (2014) examine the impact of life expectancy on economic growth in Nigeria over the period of 1980 – 2012. OLS and ARDL estimation techniques were used in the analysis. The finds revealed that life expectancy has a positive impact on economic growth in Nigeria. Similarly, Ogungbenle, Olawumi, and Obasuyi, (2013) analyzed the relationship among life expectancy, public health spending and economic growth in Nigeria using VAR model. The findings revealed that there is no bidirectional causality between life expectancy and public health spending as well as life expectancy and economic growth but there is bidirectional causality between public health spending and economic growth. The method used is not in harmony with the findings of the study.

Using linear regression model Balan and Jaba (2011) examine the determinants of life expectancy in Romania by its region for the year 2008. The variables of interest under investigation are net nominal monthly salary(wages), number of readers subscribed to libraries, illiterate population aged ten and over (% from the total population), ratio of the Roma population (%), number of beds in hospitals, and number of doctors. The study shows that wages, the number of beds in hospitals, the number of doctors and the number of readers subscribed to libraries are positively related to life expectancy. On the other hand, the ratio of the Roma population and the ratio of illiterate population are negatively related to life expectancy. Therefore, it is clearly observed that Romanian regions are homogeneous in terms of level of life expectancy and its determinants. Ngwen and Kouty (2015) determined the impact of life expectancy on economic growth in developing countries using a dynamic panel of 141 countries over the period 2000- 2013. The results showed that life expectancy has positive effect on economic growth.

Leading support to the work of Lin et al. (2012) applied linear mixed models in examining the influence of four political and socio-economic factors on life expectancy at birth in one-hundred and nineteen less developed countries from 1970 to 2004. The four political and socio-economic determinants are economy, educational environment, over nutritional status and political regime measured by GDP per capita at purchasing power parity, literacy rate of the adult population aged fifteen and over, proportion of undernourished people in the population, and regime score, respectively. It finds that these determinants generally explain fifty five percent to ninety eight percent increases in life expectancy given a lag period of ten years. Specifically, political regime has the

least contribution to life expectancy in LDCs but it contributes at increasing rate; while other three determinants have the highest contribution but they contribute at decreasing rate.

Similarly, Bilas et al. (2014) investigate the determinants of life expectancy at birth in twenty eight European countries from 2001 to 2011 using panel data analysis approach. The variables used in the study are GDP growth rate, level of education attained, education enrollment, GDP per capita, and life expectancy. The finds reveal that GDP per capita and level of education have positive and negative influence on life expectancy, respectively; these are the leading variables explaining between seventy three and eighty three percent of differences in life expectancy. Therefore, the negativity of educational level might be due to lifestyle factor of people with higher education that incorporate more stress as a result of more complex responsibility at work, bad nutrition habits, long working hours, less physical activities, etc.

Methodology

Data and Description of Variables

This paper employs Autoregressive Distributed Lag (ARDL) Model to examine the impact of economic growth, energy and public health expenditure on life expectancy. The data covers thirty five years i.e. 1980 to 2018. The data is sourced from a publication of World Bank, World Bank Indicators. The period was justifiably selected based on the availability of data in Nigeria. The paper used GDP growth as proxy for economic growth.

Model specification and Estimation Procedure

Following the work of Pesaran *et al.* (2001), the ARDL model is given as:

$$LEXPECTCY_{t-1} = \beta_0 + \beta_1 \sum_{i-1}^{m} HEALTH_{t-1} + \beta_2 \sum_{i-1}^{m} GDPPERK_{t-1} + \beta_3 \sum_{i-1}^{m} FFENGY_{t-1} + \beta_4 \sum_{i-1}^{m} ELCOENG_{t-1} + \mu_t \quad (1)$$

Although, ARDL model consists of two parts, the first part of the equations with β1 to β9 stands r the short-run dynamics of the models, while the coefficients a 1 to a 3 represents the long-run relationship. The null hypothesis of the above model is defined as H0: β1 = β2 = β3 = β4 = β5 = 0 which tell us that there is no evidence of long run relationship (Pesaran et al.2001).

We begin the estimation by conducting cointegration test. The calculated F-statistics is compared with the Critical Value as tabulated by Pesaran et al. (2001). If F-statistics exceeds or supersedes the upper critical value, then the decision rule will be to reject the null hypothesis of no long-run relationship (no cointegration) irrespective of whether the underlying order of integration of the variables is zero or one i.e. I(0) or I(1), whereas if F-statistics falls below a lower critical value, then the null hypothesis cannot be rejected and if F-statistics falls within these two critical bounds, then the result is inconclusive (Pesaran et al, 2001). Accordingly, the Error Correction Model of the ARDL approach is specified as:

$$LEXPECTCY_{t-1} = \beta_0 + \beta_1 \Delta \sum_{i-1}^{m} HEALTH_{t-1} + \beta_2 \Delta \sum_{i-1}^{m} GDPPERK_{t-1} + \beta_3 \Delta \sum_{i-1}^{m} FFENGY_{t-1} + \beta_4 \Delta \sum_{i-1}^{m} ELCOENG_{t-1} + \mu_t + \beta_5 \Delta ECM_{t-1} + \mu_t \quad (2)$$

Where ECM is the error correction representation of equation (1); however, before estimating equation (1), the study conducted a unit root test through the use of Augmented Dickey-Fuller and Dickey-Fuller Generalized Least Square.

Results and Discussion

Even though ARDL does not require stationarity test, but this study decide to determine the stationarity level of the variables under investigation before running ARDL bound test. This is because ARDL bound test is not capable of handling any series that go beyond first difference i.e. I(1) order of integration. Table 4.1, Show the results of the ADF and KPSS unit root tests and none of the series goes beyond I(1) order of integration. Based on the ADF stationarity test, the results show that life expectancy is stationary at level while health expenditure, GDP per capita, energy consumption, and electricity consumption are stationary at first difference.

Table 4.1: Unit Root test (ADF and DF-GLS)

Variables	ADF	
	Level	First Difference
Life Expectancy	-4.0265***	
Health Expenditure		-6.0196***
GDP Per Capita		-3.9060***
Energy Consumption		-4.8882***
Electricity Consumption		-6.0142***

Note: ***, **, and * indicating significant at 1%, 5% and 10% respectively.
Source: Authors computation using Eviews Version 9.

However, after unit root test, there is also need to know the value of F-statistics in order to determine the presence or existence of cointegration or otherwise among the variables under estimation. This has been carried out using ARDL bounds test and the result reveals the evidence of cointegration among the variables. From Table 4.2, F-statistics is 17.19505. This shows that the null hypothesis of no cointegration can be rejected at one percent significance level. This is because the value of F-statistics is greater than the upper bound critical value of 3.93 and 2.79 for lower critical bound value.

Table 2: ARDL Bounds Test for Cointegration

F-statistics value = 17.19505		
Critical Value of Bounds		
Significance	I(0) Bound	I(1) Bound
1%	2.79	3.93
5%	2.3	3.33
10%	2.05	3.02

Source: Authors Computation Using Eviews Version 9.0

However, the ARDL long-run coefficients are presented in Table 4.3. The results indicate that there is negative and statistically significant relationship between energy consumption and life expectancy. On the other hand it also reveals that there is positive relationship among public health expenditure, GDP per capita, and life expectancy in Nigeria throughout the study period. This implies that a unit increase in health expenditure and economic growth lead to 3%, and 0.4% increase in life expectancy, respectively. Contrariwise, a unit increase (decrease) in energy consumption is associated with 2.11% decrease (increase) in life expectancy.

Table 4.3: Result of the Estimated Long-Run Coefficients of the ARDL

Dependent Variable: LLIXP		
Variables	Coefficients	t-Statistics
Health Expenditure	0.0334	2.0139*
GDP Per Capita	0.0004	3.7683***
Energy Consumption	-0.0211	-3.0096**
Electricity Consumption	-0.0019	-1.1266
R^2 = 0.99, Adj. R^2 = 0.99, AIC = -3.9601, SIC = -3.0338, HQC = -3.7032, DW = 2.3297		

Significance at 1% (***), 5% (**) & 10% (*)
Source: Author's Computation using E-view 9.0

Moreover, once the variables under study are cointegrated, and then there is need to go further to test error correction model (ECM) that expresses the short-run nexus among the variables. The reason behind this ECM is that, it expresses the speed of adjustment from the short-run to the long-run equilibrium in case of any distortion in the economy. The results as depicted in Table 4.4 show that ECM coefficient is -0.999931 and statistically significant at 1% level. This shows high speed of adjustment to equilibrium level after a shock. For the other explanatory variables, the short-run analysis reveals the existence of positive and statistically significant relationship with dependent variable.

Table 4.4: Error Correction Estimate of the ARDL Model (Short-Dynamics)

Dependent Variable: LLIXP		
Variables	Coefficients	t-Statistics
Health Expenditure	0.025465	5.7119***
GDP Per Capita	-0.000007	-0.2249
Energy Consumption	-0.021653	-7.3104***
Electricity Consumption	-0.000405	-0.8644
Constant	42.318240	28.4767***
ECM(-1)	-0.999931	-28.5294***

Significance at 1% (***), 5% (**) & 10% (*)
Source: Author's Computation using E-view 9.0

Conclusion and Recommendation

The paper examines the impact of economic growth, energy and public health expenditure on life expectancy in Nigeria. Thus, Augmented Dickey-Fuller (ADF) was employed in testing the unit root properties of the variables under investigation. The paper further used Autoregressive Distributed Lag (ARDL) Model in examining the relationship between the variables.

Our results show that health expenditure has positive significant impact on life expectancy at birth in Nigeria. This implies that the more government spends on health facilities the higher the life expectancy at birth. Therefore, provision of health care facilities reduces both infant and maternal mortalities rates, which automatically increase life expectancy of the people. It is against this finding that the paper suggests that government should provide more health care facilities in the hospitals and medical dispensaries so that people will have more access to health care facilities in order to improve the health status in Nigeria, health policymakers should also focus on the other factors which lie outside the healthcare system.

The findings also revealed that economic growth has positive significant impact on life expectancy in Nigeria over the period of the study. Implying that increase in aggregate output produced in Nigeria will significantly enhance life expectancy of Nigerians. To achieve this there is need to increase energy efficiency as well as level of investment as they are among the pivotal drivers of economic growth. Thus, the aforementioned catalysts are mainly associated with economic growth and development level. Thus, the economic stabilisation policies with the aim of increasing the productivity, energy efficiency, and economic growth will certainly play significant roles in the improvement of health status and therefore, increasing life span of Nigerians.

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