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Impact of Economic Growth and Access to Safe Drinking Water on Life Expectancy in Nigeria: Bound Test Approach

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Abstract: This study empirically examines the impact of economic growth and access to safe drinking water on life expectancy in Nigeria using Autoregressive Distributive Lag (ARDL) model as tool of analysis for the period 1980 - 2014. The result of this study indicates that economic growth and access to safe drinking water exert positive and statistically significant impact on life expectancy at birth. Consequently, upon the findings of this study, a number of recommendations are given which include: the need for the governments to intensify its existing policies in order to maintain inclusive economic growth that would increase employment generation and reduce poverty for better life expectancy. Moreover, there is also need for governments, Non-governmental organizations, international development partners and philanthropists to intervene in improving access to safe and portable drinking water in both rural and urban areas through construction of boreholes, pipe water, public taps or standpipes, tube wells, protected dug wells, protected springs, and rainwater collection reservoirs.
Keywords: economic growth, life expectancy, access to safe drinking water, ARDL model, Nigeria.

INTRODUCTION

Life expectancy remains for the health dimension of human development index (HDI). This however encapsulates several variables and is itself determined by various factors, hence its comprehensiveness [1].

Therefore, adequate health care facilities are presumed to see its reflections in stably high life expectancy at birth. This can be only attained if and only if safe drinking water is accessible to all and sundry. The level and variability of life expectancy has important implication for individual and aggregate human behavior; it affects fertility behavior, economic growth, human capital investment, intergenerational transfers, and incentives for pension benefit claims [2]. Thus, life expectancy is precursor of economic growth, adequate health care facilities, access to safe drinking water, energy consumption, among others. The relationship between economic growth and life expectancy is very important for assessing if a country has attained high level of human development. This is why United Nations Development Programme (UNDP) used life expectancy and GDP per capita in its computational process of human development index.

Empirical studies investigating the relationship between life expectancy and economic growth are abound, specifically on Nigeria [3-7]. The major gap common with these studies is that either failed to assess the stationary of the variables before carrying out the analysis [4, 3]; failed to account cointegration analysis [8, 9]; or used wrong method of analysis like using OLS to analyse time series data [6, 3]. Thus, the results are bound to be spurious. This study therefore seeks to contribute to this growing literature and fill the aforementioned gaps by investigating the impact of economic growth and access to safe drinking water on life expectancy using the Nigerian economy as a case study over the period of 1980 - 2015. Therefore, the paper intends to answer questions such as: Does economic growth influence life expectancy and does access to safe drinking water influence 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 conclusions.

LITERATURE REVIEW

Conceptual Issues

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 [1]. 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 [6]. More so, life expectancy is the clear reflection of social factors such as health care, disease control, immunization, overall living conditions, and nutrition. Drawing from the above life expectancy is a product of quality of life in a country.

There are significant numbers of empirical studies focusing on the impact of economic growth and access to safe drinking on life expectancy at birth albeit with mixed results. While some studies have found a positive relationship among economic growth, access to safe water and life expectancy [6, 4, 8]. Yet some empirical results tend to lend support to the view of neutrality of the relationships among the variables [10].

For instance, Lokpriy [11] 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 and GDP per capita. The study finds that a higher GDP per capita combined with access to sanitation and safe water sources 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. In another study, Berenger and Verdier [12] examined the effect of improving life expectancy on individual life longevity making use of prominent tools of analysis Gender-related Development Index (GDI) and the Gender Empowerment Measure (GEM) developed by UNDP for analysis of gender inequality through aggregation method based on Total Fuzzy Analysis. The finds portrayed strong compression of mortality since 1751 in many developed countries; Japan was found to be leading country in terms of longevity.

Lending support to the work of Cervellati and Sunde [10] estimated the causal effect of life expectancy on economic growth using panel data analysis for 47 countries over the period of 1940 – 1980 through finite mixture models (FMM). The variables of choice were GDP per capita and life expectancy at birth. The finds revealed that increase in life expectancy reduce GDP per capita growth before demographic transition took place and after the demographic transition increase in life expectancy had positive impact on GDP per capita. They concluded that life expectancy had no significant positive impact on GDP per capita growth.

In a similar study, Venhoven [13] studied happy life expectancy as happy-life-years in 48 nations using both secondary data and survey data on subjective appreciation-of-life. His empirical results established that happy life expectancy are systematically higher in nations that are most affluent, free, equal, educated and harmonious which are attribute of North West European nations with 60 years life expectancy, while African nations have the lowest happy life expectancy. Additionally evidence suggested that happy life expectancy is not significantly related to unemployment, state welfare and income equality, religiousness and trust in institutions.

In Nigerian studies, Sanda and Oyerinola [4] examined 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. Ogungbenle, Olawumi, and Obasuyi [5] 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. Isaac *et al.*, [6] examined the impact of GDP per capita, access to safe water and etc. on life expectancy of selected countries in comparison with that of Nigeria towards achieving a robust life expectancy by the year 2020; using OLS regression analysis. The finds suggested that the determinants contribute most significantly to the growth of life expectancies. More so, maternal mortality rate had significant negative relationship with life expectancy; while GDP per capita and access to safe water had significant positive impact on life expectancy. Moreover, Nigeria was ranked 175th position in terms of life expectancy with 47.8 years, in comparison with the selected countries.

In cross country studies, Ngwen and Kouty [8] 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. More so, Weisbrot and Ray [7] examined the impact of economic growth on social indicators for 193 countries over the past 50 years which were divided into three periods: 1960 – 1980, 1980 – 2000 and 2000 – 2010. The variables used were HIV/AIDS, adult, infant and child mortality, life expectancy, expenditures on education, among others. The study discovered that after slowdown in economic growth and in progress on social indicators during the period (1980 - 2000) period, there had been a recovery on both economic growth and in progress on social indicators for many countries; these social indicators were life expectancy, adult, infant and child mortality, and education. This happened during the past decade.

Using linear regression model Balan and Jaba [3] examine the determinants of life expectancy in Romania by its region for the year 2008. 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. Lin *et al*., [14] 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 increase 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.

Furthermore, Bilas *et al*., [9] 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, GDP per capita, and life expectancy. The finds reveal that GDP per capita has positive and negative influence on life expectancy, respectively; this is the leading variable 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

Source of Data and Description of Variables

This paper employs Autoregressive Distributed Lag (ARDL) Model to examine the impact of economic growth and access to safe drinking water on life expectancy. The data covers thirty five years i.e. 1980 to 2014. 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. Access to safe drinking water is measured as the percentage of the population using an improved drinking water sources such as piped water on premises, public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection [15]

Model specification

Following the work of Pesaran *et al.*, the ARDL model is given as [16]:

$$\Delta LIXP_t = \beta_o + \sum_{i=1}^{m} \beta_1 \Delta LIXP_{t-i} + \sum_{i=1}^{m} \beta_2 \Delta GDPK_{t-i} + \sum_{i=1}^{m} \beta_3 \Delta AIMW_{t-i} + \alpha_1 LIXP_{t-1} + \alpha_2 GDPK_{t-1} + \alpha_3 AIMW_{t-1} + \mu_t \quad (1)$$

Although, the ARDL model consist of two parts, the first part of the equations with β_1 to β_3 stand for the short-run dynamics of the models, while the coefficients α_1 to α_3 represents the long-run relationship. The null hypothesis of the above model is defined as H_0: $\alpha_{1=} \alpha_{2=} \alpha_{3=0}$ which tell us that there is no evidence of long run relationship [16].

We begin the estimation by conducting cointegration test. The calculated F-statistics is compared with the Critical Value as tabulated by Pesaran *et al*., [16]. 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 [16]. Accordingly, the Error Correction Model of the ARDL approach is specified as:

$$\Delta LIXP_t = \beta_0 + \sum_{i=1}^{m} \beta_1 \Delta LIXP_{t-i} + \sum_{i=1}^{m} \beta_2 \Delta GDPK_{t-i} + \sum_{i=1}^{m} \beta_3 \Delta AIMW_{t-i} + \beta_4 ECM_{t-1} + \mu_t \quad (2)$$

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 DISCUSSIONS

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-1, Show the results of the ADF and DF-GLS unit root tests and none of the series goes beyond I(1) order of integration. Based on the ADF test, the results show that access to drinking water is stationary at level while economic growth is stationary at first difference. Additionally the results from the DF-GLS show that life expectancy is stationary at level value.

Table-1: Unit Root test (ADF and DF-GLS)

Variables	ADF		DF-GLS	
	Level	First Diff.	Level	First Diff.
LIXP			-3.205709***	
GDPK		-3.68157***		
AIMW	-4.956251***			
Note: ****, **, and * indicating significant at 1%, 5% and 10% respectively.*				
Source: *Authors computation using Eviews Version 9.*				

However, after unit root test, there is 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-2, F-statistics is 104.58. 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 5.00 and 4.13 for lower critical bound value.

Table-2: ARDL Bounds Test for Cointegration

F-statistics value = 104.58		
Critical Value of Bounds		
Significance	I(0) Bound	I(1) Bound
1%	4.13	5.00
5%	3.10	3.87
10%	2.63	3.35
Source: *Authors Computation Using Eviews Version 9.*		

However, the ARDL long-run coefficients are presented in Table-3. The results indicate that there is positive and statistically significant relationship between economic growth and life expectancy in Nigeria throughout the study period. This implies that increase in economic growth is associated with the increase in life expectancy. A unit increase (decrease) in economic growth will leads to about 7.57% increase (decrease) in life expectancy. In another development, the results show that access to safe drinking water has positive and statistically significant influence on life expectancy. It means that a one percentage change in access to safe drinking water will leads to about 16.4% change in life expectancy.

Table-3: Result of the Estimated Long-Run Coefficients of the ARDL

Dependent Variable: LLIXP				
Variables	Coefficients	std. Error	t-Statistics	Prob.
Constant	0.0886	0.0199	4.4459	0.0003
LGDPK	0.0757	0.0067	11.3470	0.0000
LAIMW	0.164	0.0156	6.8835	0.0000
R^2 = 0.99, Adj. R^2 = 0.99, AIC = -13.1675, SIC = -12.9701, HQC = -13.1179, DW = 1.0240				
Source: *Authors Computation Using Eviews Version 9.*				

Moreover, when the variables under study are cointegrated, then there must be 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 show that ECM coefficient is -0.1886 and statistically significant at 1% level going by the p-value of 0.0000. 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: Error Correction Estimate of the ARDL Model (Short-Dynamics)

Dependent Variable: ΔLLIXP				
Variables	Coefficients	std. Error	t-Statistics	Prob.
Δ(LGDPK)	0.0116	0.0026	4.4677	0.0003
Δ(LAIMW)	0.0193	0.0069	2.7948	0.0116
ECM(-1)	-0.1886	0.0108	-17.4721	0.0000
Source: *Authors Computation Using Eviews Version 9.*				

To ensure the stability of the equation and parameters under estimation, stability test was conducted using CUSUM technique and the result is presented in Figure-1. The equation is said to be stable if the entire sum of the recursive error lies between two critical lines. From the test conducted, the result indicated that the CUSUM line has crossed the critical bounds showing instability of the parameters under investigation.

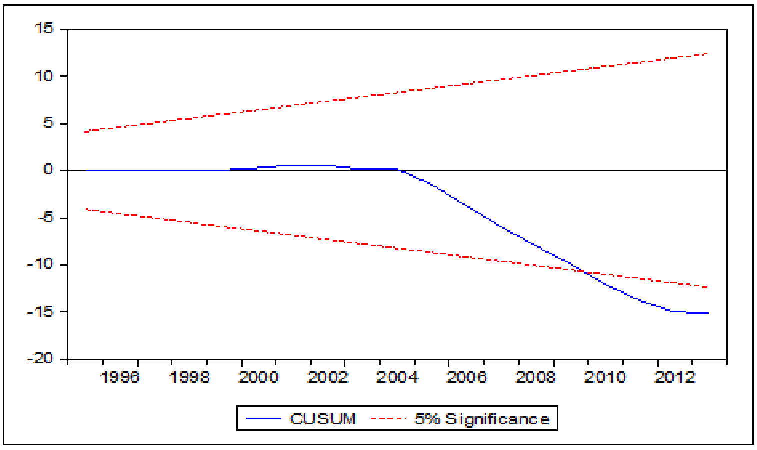

Fig-1: Cumulative Sum of Recursive Residual Test.

CONCLUSION AND RECOMMENDATIONS

The study investigates the impact of economic growth and access drinking water on life expectancy in Nigeria. Augmented Dickey-Fuller and Dickey-Fuller Generalized Least Square were used in testing the unit root properties of the variables. The study further employed Autoregressive Distributed Lag (ARDL) Model in examining the relationships among the variables under estimation. The study shows that economic growth and access to safe drinking water have important role to play in improving life expectancy in Nigeria. Therefore, the study suggested that government should intensify its existing policies in order to maintain inclusive economic growth that would increase employment generation and reduce poverty for better quality of life. Furthermore, there is need for government, Non-governmental organization, international development partners and philanthropists to intervene in improving access to safe and portable drinking water in both rural and urban areas through construction of boreholes, pipe water, public taps or standpipes, tube wells, protected dug wells, protected springs, and rainwater collection reservoirs.

REFERANCES

1. UNDP. (2016). United Nations Human Development Report For Nigeria.
2. Shaw, J. W., Horrace, W. C., & Vogel, R. J. (2005). The determinants of life expectancy: an analysis of the OECD health data. *Southern Economic Journal*, 768-783.
3. Balan, C., & Jaba, E. (2011). Statistical analysis of the determinants of life expectancy in Romania. *Romanian Journal of Regional Science*, *5*(2), 25-38.
4. Sanda, U. A., & Oyerinola, S. D. (2014). Impact of Life Expectancy on Economy Growth in Nigeria:1980-2012. https://www.unilorin.edu.ng/ejournals/index.php/ijms/article/view/1957: 75 – 85.
5. Ogungbenle, S., Olawumi, O. R., & Obasuyi, F. O. T. (2013). Life expectancy, public health spending and economic growth in Nigeria: A vector autoregressive (VAR) model. *European Scientific Journal, ESJ*, *9*(19).
6. Isaac, O. A., Awogbemi, C. A., & Ewumi, T. O. (2011). Toward Achieving a Robust Life Expectancy by the Year 2020: A Statistical Examination of Major Global Determining Factors. *Ozean Journal of Applied Sciences,* 4(3), 307 – 316.
7. Weisbrot, M., & Ray, R. (2011). *The Scorecard on Development, 1960-2010: Closing the Gap?* UN.
8. Ngangue, N., & Manfred, K. (2015). The impact of life expectancy on economic growth in developing countries. *Asian Economic and Financial Review*, *5*(4), 653.

9. Bilas, V., Franc, S., & Bošnjak, M. (2014). Determinant factors of life expectancy at birth in the European Union countries. *Collegium antropologicum*, *38*(1), 1-9.
10. Cervellati, M., & Sunde, U. (2011). Disease and development: The role of life expectancy reconsidered. *Economics Letters*, *113*(3), 269-272.
11. Parimala, A., Lokpriya, S., Revathi, R., Kaviyarasi, I., & Meena, M. (2013). Energy-Efficient Resource Allocation and Spectrum Sensing for Heterogeneous Cognitive Radio Network based on Two-Tier Crossover Genetic Algorithm.
12. Bérenger, V., & Verdier-Chouchane, A. (2011). From the Relative Women Disadvantage Index to Women's Quality-of-Life. *Journal of Human Development and Capabilities*, *12*(2), 203-233.
13. Venhoven, R. (1996). Happy Life Expectancy: A Comprehensive Measure of Quality of Life in Nations. *Social Indicators Research*, 39(01), 1 – 58.
14. Gajski, D. D., Dutt, N. D., Wu, A. C., & Lin, S. Y. (2012). *High—Level Synthesis: Introduction to Chip and System Design*. Springer Science & Business Media.
15. World Bank. (2015). World Development Indicators. World Bank database.
16. 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.