The Impact of Life expectancy on economic growth in Nigeria.

Submitted by

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Abstract

This paper examines the impact of life expectancy on economic growth from 1981 to 2014 with major reference to familiar economy. The important of health as a tool of economic growth cannot be overemphasized as such the mere saying of health is wealth is not far from the truth. This work extracts data from the World development index to estimate ARDL model after a pre-test analysis that proved that the variables are of two different orders of integration (that is order zero and one). Post - test was performed to determine correlation and long run associative of variables to establish a priori expectation. The study found positive long run relationship between output per capita and life expectancy and an inverse relationship between population growth rate and the formal.

JEL CODE: 115-O40-O47

Key words: Economic growth, Life expectancy, Population and health.

1.0 Introduction

One of the important components of the human capital as a factor of production is good health. Improvements in health and life expectancy allow the accumulation of knowledge and skill. People in good health live longer and are much more likely to invest in education (Ngangue and Kouty, 2015). The major question that lingers in the mind of many discussants is that, do improvements in life expectancy positively affect growth? According to Cervellati and Sunde (2009), increasing life expectancy may have negative or positive effect. On one hand, it may increase output of available resources on the other hand it may increase population and thereby stagnates growth.

There is also a growing consensus that improving health can equally have large indirect payoffs through accelerating economic growth (Acemoglu and Johnson, 2009). But they affirmed that the evidence supporting this recent consensus is not yet conclusive, however. Although cross-country regression studies show a strong correlation between measures of health (for example, life expectancy) and the level of both economic development and recent economic growth. Ngangue and Kouty (2015) argued that this link between improved health and economic growth has generated excited interest in developing countries. Indeed the debt crisis of the 80s that experienced by developing countries (DC) and panaceas implemented by donors as part of structural adjustment programs have led to these countries to withdraw from the social sectors (especially health and education).This result in a reduction in public funding essential to the accumulation of human capital and improving the living conditions of the populations in most DC .

Ecevit (2013) argued that the answer to the link between them is embedded in growth theories or models. He stated that modern explanation of economic growth began with the classical economists, notably Smith (1776) and Ricardo (1817), argued that industrial growth can help the expansion of domestic and international markets was the driving force behind economic growth (Barro, 1996). Harrod (1939) and Domar (1946) cited in Ecevit (2013), who are the pioneers of Keynesian economics, argued that economic growth depends on policies to increase investment, by increasing saving, and using that investment more efficiently through technological advances. The Harrod-Domar model was extended by the neo-classical economists (Solow, 1956; Swan, 1956) by including productivity growth. But neo-classical growth models could not explain the source of technological progress.

Moreover, in these models health and determinants of health were not taken into consideration. Nowadays, it is known that investment in human capital, innovation and knowledge are significant contributors to economic growth. Two key components of human capital are education and health. Human capital theory, which is primarily developed by Schultz (1961), Becker (1962), Denison (1962) and Mincer (1974), is about the role of human capital in the production process and about the incentives to invest in skills, including in the forms of schooling and training.

The first generation endogenous growth models, such as Romer (1986, 1990), Grossman and Helpman (1991) and Aghion and Howitt (1992), focused on education, R&D and innovation rather than health. Mushkin (1962), who first emphasized the importance of health, averred that health constitutes an important form of investment unlike other forms of human capital formation like education. Nelson and Phelps (1966) argued that a higher stock of health could stimulate growth by facilitating technological innovation.

With the identification of health as one of the determinant of growth, simona (2014) explained that most commonly used indicators of health outcomes at the macroeconomic level are life expectancy at birth and infant mortality rates. Those indicators are considered reflecting the general health outcomes and supposed to be positively associated with economic growth.

The life expectancy rate varies across countries due to different factors such as income, environment, health inequalities and so on. In 2014, the WHO report shows that life expectancy for both men and women are less than 55years in Sub- Sahara Africa which Nigeria is not excluded. The report shows that only Liberia, Ethiopia and Rwanda made progress with an average increase in life expectancy from 1999-2012 while Nigeria did not record improvement in Life expectancy as at these periods. Despite the low life expectancy in Nigeria as compared with other Africa countries, do life expectancy have impact on economic grow? This paper aims to answer this question through the use of endogenous model and contribute to exiting literature through methodology and theoretical modification. The next section focuses on literature review, the third segment emphasizes on theoretical framework, the fourth part present the results and the last segment focuses on conclusion and findings.

2.0 Review of Literature

Literature abound this work deviate in terms of theory, methodology, the peculiarities of area covered, data characteristics and results. Public discourse on the relationship between health and economic growth approaches it from two directions; health inputs and health outcomes. Health inputs are factors available to improve health such as nutrition, hygiene, environment, health services, health utilization and health financing while health outcomes are the resulting outcomes generated from available inputs such as Life expectancy, infant mortality, number of school enrolment, labour productivity, psychomotor and cognitive functioning. Weil (2005 cited in Ecevit, 2013) summarized the relationship between health investment and economic growth in relation to macroeconomic and microeconomic foundations. According to Weil cited in Ecevit, (2013) affirmed that studies that relate health and economic performance have generally investigated health inputs or health outcomes. Health inputs are the physical factors that influence the individual's health and health outcomes include life expectancy, the ability to work hard, and cognitive functioning. Thus, to explain income differences among countries, life expectancy can be one of the key variables of health outcomes.

Ngangue and Kouty (2015) viewed the role of health and economic growth as ambiguous because of its direct positive and indirect negative effects. In theory, he claimed that the former effect can be explained through the endogenous growth models while the latter effect is analysed by the neoclassical and Keynesian theories. In the growth models, improving health causes labour productivity and encourages people to invest in human capital. The lengthening of life expectancy translates into more long-term investment in education and in a greater accumulation of knowledge for a lot of individuals. These models also show that, over the cost of low health care, most people tend to increase other productivity investments. On the other hand the neoclassical theory emphasizes the harmful effects of the public funding on economic growth. It states further that improvement of health requires significant public funding care and consequently an increase in government levies which slowdowns economic activity. Moreover, in the Keynesian analysis, increased saving rate due to the improvement of life expectancy gives rise to negative effect on economic activity by reducing aggregate demand.

Empirically, different scholars have analysed the effect of life expectancy on economic growth through micro and aggregate analyses using different models such as 3-periods

overlapping generation model, 2- periods overlapping generation model, Solow model and augmented Solow model. Different results were generated from different estimation technique(s). Some found weak positive relationship between life expectancy and economic growth while some found strong positive relationship and others found uni-direction relationship. The table below summarizes it all.

2.1 Table 1:An overview of selected Literature

Author and Year	County and Scope	Methodology		Findings
		Variables	Estimated Model	
Ngangue Ngwen and Manfred Kouty (2015)	141 developing countries (2000-2013).	Gross National Income, Life Expectancy, Human Capital, Capital and Governance	Regression Model.	Positive relationship exists between life expectancy and economic growth. However, the results are mixed when they classified developing countries according to their level of income.
Cervellati Matteo and Sunde Uwe (2009)	Pre- transitional and post-transitional countries. 1940-2000	GDP, GDP per capita, population size, human capital and Life expectancy at birth.	Regression Model	They use theory to predict that before the demographic transition improvements in life expectancy increase population. Improvements in life expectancy reduce population growth and foster human capital accumulation after the onset of the demographic transition. This implies that the effect of life expectancy on population, human capital and income per capita is not the same before and after the demographic transition. Moreover, a sufficiently high life expectancy is ultimately the

				trigger of the transition to sustained income growth.
Acemoglu Daron and Johnson Simon (2009)	America, Asia, Africa, Southern and Eastern Europe. (1960-2000).	Life Expectancy, population, GDP , Total birth and coding diseases.	Neo Classical (Solow) growth Model Using 2- stage least square method.	They found increase in life expectancy leading to a signifi- cant increase in population; birth rates did not decline to compensate for the increase in life expectancy. In addition, they found a small positive effect of life expectancy on total GDP over the first 40 years, and this effect grows somewhat over the next 20 years, but not enough to compensate for the increase in population. Overall, the increases in life expectancy (and the associated increases in population) appear to have reduced income per capita. There is no evidence that the increase in life expectancy will lead to faster growth of income per capita or output per worker. This evidence sheds doubt on the view that health has a first-order impact on economic growth.
Castelló-Climenta Amparo and Doménechb Rafael (2002)	92 countries picked from Africa, Latin America and South Asia	Life expectancy, Human capital , School enrolment and Income.	An Overlapping Generation Model in which an individual lives for at	They found that rich individuals born into families whose parents have high level of education, have high life expectancy. Their long life expectancy encourages them to spend a large number of years in education. On the contrary,

			most 2 periods.	individuals who are born into poor families have low life expectancy. Accordingly, since the time they expect to benefit from the returns to education is very short, they devote little time to accumulating human capital.
Simona Dogan Mihaela (2014)	European Union Countries (1990-2012)	GDP, Sex, Life expectancy	Panel Model	He found direct connection between Life expectancy and economic growth which is positive.
Acemoglu Daron and Johnson Simon (2005)	59 countries, from Western Europe, Oceania, the Americas, Asia, and North Africa. Eastern European and Communist bloc countries are excluded from the base sample (1940-1980)	Coding disease, Life Expectancy at birth and GDP	Solow Model using Oldinary Least Square.	They found no evidence that the large exogenous increase in life expectancy has led to a significant increase in economic growth. The results shed doubt on claims that unfavourable health conditions are the root cause of poverty for some nations.
Ecevit Eyyup (2013)	OECD Countries (1970-2012)	Real per capita GDP, Life expectancy, energy used per capita and real export	Regression model using Cointegratio n test	He found uni-direction causality between life expectancy and economic growth. In addition, life expectancy was found to be positively related and important to economic growth.
Browser Diana (2010)	United States (1970-2000)	Per Capita net earnings, sex, population, mortality, years of schooling,	Regression model using 2-stage least	The results are ambiguous across states (null, positive and negative) but a strong positive relationship

		unemployment, consumer price index and Life expectancy.	square.	between life expectancy and economic growth within state.
Turan Belgi (2009)	Sub-Saharan Africa (1987-2007)	Birth rate, Gender, Infant and child Mortality, Adult mortality rate, Education and Fertility.	A 3- period overlapping generation model using Ordinary Least Square test.	A weak positive relationship between life expectancy and labour force participation for females, but no relationship among males. Results suggest that in sub-Saharan Africa, increase in life expectancy will have a positive impact on growth through fertility and education but the effect will be small.
Mahumud Rashidul Alam, Lal B Rawa, Golam Hossain,Ripter Hossain and Nurul Islam (2013)	Bangladesh (1995-2011)	Health expenditure per Capita, Life expectancy per capita, Total Health expenditure, out-of-Pocket expenditure and Life Expectancy.	Regression Model Using Ordinary Least square test.	They found increased life expectancy to have direct impact on increased per capita real income and higher expenditure on health.
Leung Michael C. M. and Wang Yong (2003)	Developed and developing countries (1990 - 1998)	Life expectancy, GDP per worker, GDP per capita and population.	A 2-Period Overlapping Generation model using	Countries that spend more on health care tends to enjoy higher life expectancy that translate to higher labour productivity and vice versa for countries that spend little on health.
Bloom, Canning and Sevilla (2004).	140 countries (1960 -1990)	Year of schooling, Technology, Governance, Capital, Labour and Life Expectancy	Panel Model using 2-stage Least Square.	They found life expectancy to be weakly related to economic growth.
Ogungbenle S., Olawumi	Nigeria 1977-2008)	GDP, Public health expenditure and Life	Vector Auto Regressive	There is no bi-directional relationship between life

O.R. and Obasuyi F.O.T (2013)		Expectancy	Model (VAR)	expectancy and economic growth including public health.

3.0 Theoretical Framework

This paper deviates from other contributors using endogenous model developed by Romer because other models of growth consider capital (k) and effective labour (AL) as major determinant of growth which are exogenously determined. This model considers them to be endogenous and defined A which is considered as misery variable to be knowledge, what a simplifying assumption. According to Romer (2012) , the model was developed by Romer (1990), Grossman and Helpman (1991a), and Aghion and Howitt (1992). The model involves four variables: labor (*L*), capital (*K*), technology (*A*), and output (*Y*). The model is set in continuous time, it assumes large economy in which the benefit of specialisation has been exhausted. There are two sectors, a goods-producing sector where output is produced and research and development sector where new knowledge is generated . This study consider only the goods producing sector since it is the centre of discussion. The model assume largely the conventional production function. The conventional production function is the one in which labour and capital are combined to produce good in deterministic way. The production function is assumed to be in form of Cobb-Douglass power form, well behaved, twice differentiable and exhibit inada condition . The production function is specified as thus:

$$Y(t) = \{(1 - aK)^{\alpha})(K(t))^{\alpha}\}\{(A(t)^{1-\alpha}(1 - aL)^{1-\alpha})L(t)^{1-\alpha}\} \qquad 0< \alpha < 1 \qquad (1)$$

Where Y is output, L is labour , K is capital and A is knowledge.

The model assumed saving rate to be constant and exogenously determined without depreciation . Hence,

$$\dot{K} = sY(t) \qquad (2)$$

Divide equation (2) by L(t) to derive output per worker, capital stock per worker and normalise s to be 1, s is normalised to one in order to show that the larger component of income is spent on consumption in Nigeria. Equation (2) gives:

$$\frac{\dot{k(t)}}{L(t)} = \frac{Y(t)}{L(t)} \qquad (3)$$

This paper modifies equation (1) by including X (life expectancy) which stands to augment knowledge.

$Y(t) = \{(1 - aK)^{\alpha})(K(t))^{\alpha}\}\{(XA(t))^{\beta}(1 - aL)^{\beta})L(t)^{1-\alpha-\beta}\}$ $0< \alpha \ \& \ \beta < 1$ (4)

By substitution,

$Y(t) = \{(1 - aK)^{\alpha})(K(t))^{\alpha}\}\{(XA(t))^{\beta}(1 - aL)^{\beta})L(t)^{1-\alpha-\beta}\}$ (5)

Divide equation (4) by L(t) and Let $\{(1 - aK)^{\alpha})(1 - al(t))^{\beta}\}$ represent B_K

$$\frac{Y(t)}{L(t)} = \frac{B_k\{(K(t))^{\alpha}\}\{(XA(t))^{\beta}L(t)^{1-\alpha-\beta}\}}{L(t)} \quad (6)$$

Equation (5) implies output per worker.

Log equation (5) to derive steady state.

Let $y(t) = \frac{Y(t)}{L(t)}$

$\lin y(t) = \lin B_k + \alpha \lin K(t) + \beta \lin\{X(t) + A(t)\} - (\alpha+\beta) \lin L(t)$ (7)

Differentiate equation (6) with respect to time;

$g_y = \alpha g_k + \beta[x(t) + g_A] - (\alpha+\beta)n$ (8)

Equation (8) can intuitively mean that life expectancy rate is positively related to output per worker, likewise growth rate of knowledge and capital (direct effect). A closer scrutiny to equation (8) may show that the impact of population is negatively related to growth of output per capita (indirect effect).

3.1 Model Specification.

This work modifies endogenous growth model developed by Romer (1990), Grossman and Helpman (1991a), and Aghion and Howitt (1992) which has the major characteristics of this country. The paper performs the basic ordinary least squared (OLS) which may lead to other forms of tests depending on the behaviour of the data through pre-test analysis. The functional form of the model from equation (9) is as follows:

GDP = F(CF, LE,SE, POP) (9)

Where

GDP is the growth rate of gross domestic product per worker or income per worker, capital formation, life expectancy rate, school enrolment rate and POP is population growth rate. Below specifies equation (9) in ARDL form (Autoregressive Distributed lag).

$$\Delta GDP_t = a_0 + b_1 GDP_{t-i} + b_2 LE_{t-i} + b_3 SE_{t-i} + b_4 CF_{t-i} + b_5 POP_{t-i} + \sum_{i=1}^{p} b_6 \Delta GDP_{t-i} +$$

$$\sum_{i=0}^{p} b_7 \Delta LE_{t-i} + \sum_{i=0}^{p} b_8 \Delta SE_{t-i} + \sum_{i=0}^{p} b_9 \Delta CF_{t-i} + \sum_{i=0}^{p} b_{10} \Delta POP_{t-i} + \varepsilon_t \quad (10)$$

where ε_t is the error term or stochastic variable and a, b_1, b_2, b_3 to b_{10} are the parameters. The choice of year picked span from 1981 to 2014 (see Appendix 2) to observe both pre and post SAP periods. It should be noted that all data are in % and are sourced from WDI.

4.0 Empirical Results

Appendix 1 shows the paths the data portray as time persist. The life expectancy rate that is the born of contention, shows an increase from 2005 to 2010 and start declining after was. This affirms the WHO report in 2014 that there is no improvement in life expectancy rate in Nigeria. overall, the descriptive graphical analyses indicate that the series are not trending. This study further performs pre- test analysis to identify the order of integration using Augumented Dickey Fuller. The result shows that growth rate of gross domestic product per worker is integrated of order zero which implies constant mean, constant variance and constant covariance (stationary series). Capital formation and school enrolment rate also possess the same characteristic under this test. The rest of the variables are of order one which are significant at different levels. The below table tells the story. The analysis of unit root test prompted the use of Autoregressive distributed Lag model (ARDL) since the variables are not of the same order of integration.

Table 1: Augumented Dickey Fuller

VARIABLE	CRITICA VALUE			ADF CRITICAL VALUE	ORDER OF INTEGRATION
	1%	5%	10%		
GDP	-3.646342*	-2.954021**	-2.615817 ***	-4.734402	I(0)

LE	-3.670170	-2.963972**	-2.621007 ***	-2.983389	I(1)
CF	-3.646342*	-2.954021**	-2.615817***	-5.054021	I(0)
SE	-3.653730*	-2.957110**	-2.617434***	-5.882117	I(0)
POP	-3.661661*	-2.960411**	-2.619160***	-5.693788	I(1)

Significant at 1% ..... * 5% ..... ** 10% ..... ***

Table 2 explains the ARDL estimation in which the overall fit is significant at both 5% and 10% level of significant. The study is interested in long run relationship between the choices of variables as shown by equation (8). The a priori expectation in the long run is conformable with equation (8), the result shows a positive relationship between GDP and LE as a direct effect in the long run but shows a negative effective between GDP and POP as an indirect effect in the long run. This explains Ngangue and Kouty (2015) argument that improving health causes labour productivity and the lengthening of life expectancy translates into more long-term investment in education and in a greater accumulation of knowledge for a lot of individuals.. They argued further that improvement of health requires significant public funding care (and out of pocket in Nigeria) and the resulting increase in government levies may slowdowns economic activity.

Although the adjusted R-square is low using one lag but this gives the lowest of Akaike criterion and Schwarz criterion than using two lags. The Durbin- Watson is approximately 2 which imply that there is no autocorrelation in the model. The below table summarises it all.

Table 2: ARDL Estimation

Dependent Variable: D(GDP)
Method: Least Squares.

Variable	Coefficient	t-Statistic
C	65.10680	0.505828
D(GDP(-1))	0.236361	1.029332
D(LE(-1))	19.07067	1.450752
D(CF(-1))	-0.030164	-0.909845
D(SE(-1))	-1.200957	-1.340727
D(POP(-1))	-13.58765	-0.183989
GDP(-1)	-1.065266	-3.663198

LE(-1)	0.071762	0.021811
CF(-1)	0.057661	1.260164
SE(-1)	0.128353	0.111629
POP(-1)	-28.94948	-0.770514

R-squared	0.577691	Akaike criterion	7.007363
Adjusted R-squared	0.376592	Schwarz criterion	7.511210
F-statistic	2.872662	Durbin-Watson	1.885846
Prob(F-statistic)	0.019965		

This table explains the test of serial correlation using Breusch Greusch-Godfrey correlation LM Test. This work did not reject the null hypothesis (has no autocorrelation) since the rule of thumb is based on the observed R-squared. A stability test was performed to know if its stable and the result shows that the model is stable since the line is within the diverged two lines at 5% (see Appendix 3).

Table 3: Test for serial Correlation

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	3.159478	Prob. F(2,19)	0.0654
Obs*R-squared	7.986372	Prob. Chi-Square(2)	0.0184

The bound cointegration test explains the long run associative among the long run variables to ensure that the model converge to long run (see equation 8).The rule of thumb is for the pesaran critical upper bound to be greater than estimated value. However, the F-statistics of 5.2 is greater than the upper bound I(1) value at 5%. This is an indication that long run exist and the null hypothesis can be rejected as such the variables move together in the long run.

5. 0 Conclusion and Findings

The wealth of a nation rest solely on the health sector. Growth models have emphasized the important of human capital through health. However, health measured through life expectancy in Nigeria for both men and women is less than 55years. Empirical analysis shows that in the long run, the higher the life expectancy, the higher the output per capita. This implies the direct effect on longetivity of individual's life on output and indirect relationship is the effect of population on output per capita which establishes negative relationships between the two measured variables. The implication of this findings is that an economy that wants a rapid and sustainable growth should invest in inputs of the health sector to have better health outcomes.

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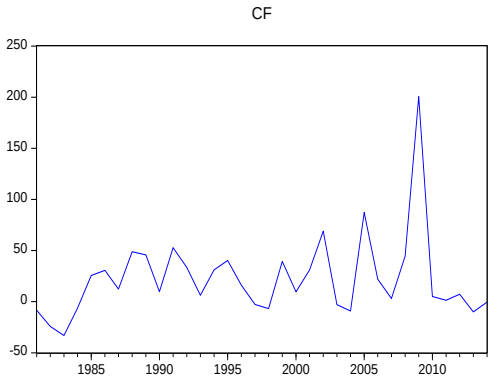
Appendix 1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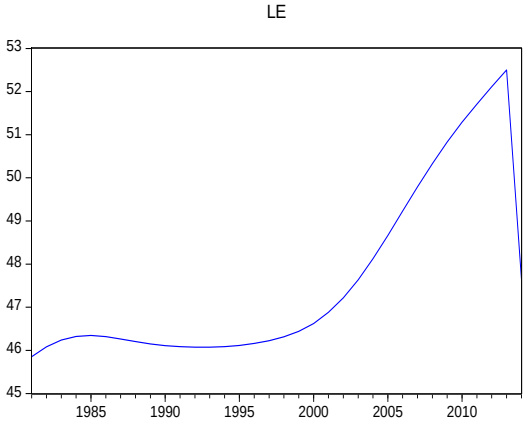
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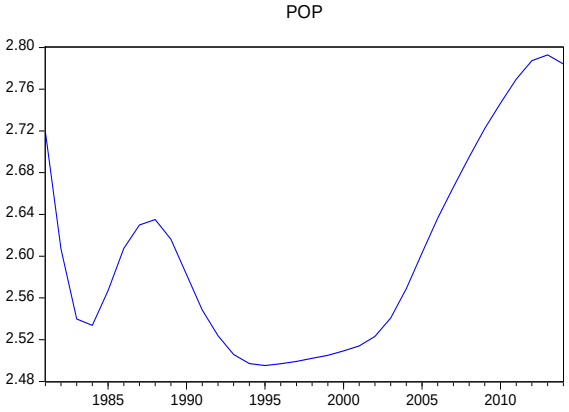
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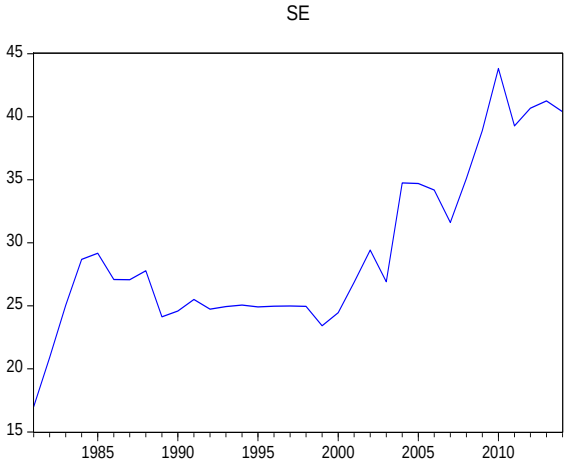
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Appendix 4: Stability Test