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EFFECT OF HEALTH ON ECONOMIC GROWTH IN NIGERIA: AN APPLICATION OF THE ARDL MODEL

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ABSTRACT

The paper empirically investigates the effect of health on economic growth from 1970 to 2017, using Autoregressive Re-Distributed Lag (ARDL). Life expectancy at birth was used as a proxy for health and real capital GDP as a proxy for economic growth. The results suggest that infant mortality rate decreases economic growth in both the short and the long-run and both statistically significant at 1% level. While better health improves economic performance, it follows from the positive and significant relationship between health and economic growth in the short and long run. Accordingly, the health sector should be considered as a prime sector by policy makers in the decision to allocate resources for development as it is pivotal to other sectors' development.

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INTRODUCTION

To promote physical and mental health as well as general well-being and extension of life expectancy for Nigerians, we must achieve universal health coverage and ensure access to quality health care where no one must be left behind (WHO, 2016). Having good health and longevity are essential needs of every human being. Being healthy, meaning a complete state of physical, mental and social well-being including the absence of illnesses, is one of the goals valued most by human beings. Thus, the most common analysis related to health is an understanding of factors that determine good health for its intrinsic value. It is unquestionable that avoiding or alleviating illnesses, and developing and maintaining our physical and mental abilities are aspects of life that individuals and social levels consider essential for human welfare. To explain the relationship between health and economic growth, it is necessary to understand the concept of health in a broad sense. Health is not only the absence of illnesses, it is also the ability of people to develop their potentials during their entire lives. In that sense, health is an asset individuals possess, which has intrinsic value (being healthy is a very important source of well-being) as well as instrumental value. In instrumental terms, health impacts economic growth in several ways. For example, it reduces production losses caused by workers' illness; it increases the productivity of adult as a result of better nutrition; it lowers absenteeism rates and improves learning among school children. Health also allows for the use of natural resources that used to be totally or partially inaccessible due to illnesses. Finally, it permits the different use of financial resources that might normally be destined for the treatment of ill health. In sum, health affects economic growth directly through labour productivity and the economic burden of illnesses. Diseases have significantly reduced the productivity of labour in developing countries due to the loss of labour and know-how of productive adults (World Bank, 2016). In Nigeria, loss of labour due to illness is more frequent during the rainy season because of poor prevention programs and inefficient healthcare services. With a gross rate of mortality of 12.1 percent in 2017 and a life expectancy of 53.9 years in 2017, health issues remain quite disturbing in Nigeria, especially for rural populations. The country's epidemiological profile is characterized by the persistence of a high rate of morbidity due mainly to malaria, respiratory infections, malnutrition,

diarrhoea and HIV/AIDS (World Bank, 2018). These diseases negatively affect the productivity of rural households' agricultural labour. Though Nigeria's economic productivity is low by international standards, it had grown slowly but since the economic recession, it has been declining and a□ecting growth. The productivity gap between Nigeria and comparative countries reflects both its lower relative stocks of physical and human capital and the ine□ciency with which inputs (capital and labour) are transformed into outputs. The endogenous growth theory emphasizes the 'idea gap' between developed and developing countries (Majumdar, 2005), which has made the former to grow at a higher rate than later. The vulnerability of Nigeria's economy to volatile oil prices has also inhibited sustained productivity gains: labour has repeatedly shifted from agriculture to services when oil prices were high, then shifted back when oil prices were low, thereby limiting the economic transformation that is needed to produce more and better-paid jobs. Also, health indirectly impacts economic growth since aspects such as child health affect the future income of people through the impact. This indirect impact is easier to understand if it is observed on a family level. When a family is healthy, both the mother and the father can hold a job, earn money which allows them to feed, protect and send their children to school. Healthy and well-nourished children will perform better in school and better performance in school will positively impact their future income. If parents ensure that their children have high probabilities of reaching adulthood, in general, they will have fewer children and they will be able to invest more in health and education for each of them. Also, the loss of health affects the poor to a greater extent since the main, and some times, the only asset they have is their body. When they become ill they have fewer alternative solutions and suffer greater consequences. Health capital has been put out of sight in most of the works of literature compared to other human capital such as education, labour-training and production. Sustained growth depends on considerable levels of human capital, stocks of human capital increases as a result of higher levels of health, the better quality of education and new training and learning procedures. Education and health are considered important indicators of a country's economic growth and development. But, the labour force with lower levels of education and poor health status drives the economic growth negatively in the long run (Fogel, 2004). After considering all the various health indicator proxies, this research used life expectancy as the principal basis and considers infant mortality rates to establish whether they have a significant impact on economic growth. Also, the study explored the relationship between health and economic growth for Nigeria using auto-regression distributed lag (ARDL) over a forty-seven years' time span (1970-2017).

Nigeria's Health Sector: Health services are provided by the private and public sectors. In the private sector, there is non-governmental organizations, private- for-profit providers, community-based organizations, religious and traditional care-givers. The government assumes the responsibility of health service provision in the public sector. The provision of health services in public sectors are at three levels namely the Primary, Secondary and Tertiary. At the primary level, services are at the doorstep of communities where preventive, curative; primitive and pre-referral cares are provided. Medical personnel that provide such services are nurses, community health officers, community health extension workers (CHEWs) and environmental health officers. At the secondary level, there are general hospitals to provide medical, laboratory and specialized health services, namely, surgery, obstetrics, paediatrics, gynaecology and so on. Major health workers that are at the secondary level include doctors, nurses, midwives, laboratory scientists and pharmacists. The tertiary level of health service provision is the highest health care in the country with such facilities as specialist and teaching hospitals, and federal medical centres. They are equipped with high technology for special health services and serve as resource centres for knowledge generation. It is not surprising that Nigeria ranked very low in the global Human Capital Development Index (HDI) as it reflects the low level of investment in education and health over the years. HDI is a measure of the need to allocate funds to certain sectors of the economy such that the country could compete with the developing/developed countries to ensure sustainability. Nigeria ranked 157th (with 0.532 HDI) out of the 189 countries assessed globally and 24th out of the 53 countries. The inefficiencies inherent in Nigeria's healthcare system are reflected in the nation's health statistics, both maternal and infant mortality are among the highest in the world.

Literature Review: The relationship between health and economic growth has received attention in literatures. Adeniyi and Abiodun (2011) analysed the effects of health expenditure on the Nigerian economic growth, using data on life expectancy at birth, fertility rate, capital and recurrent expenditures between 1985 and 2009. He argued that if funds are judiciously expended in the health sector, its effects on economic growth will be direct and substantial. Thus the need to improve the quality and type of health provided. Odior (2011) using an integrated sequential dynamic computable general equilibrium (CGE) model, examined the potential impact of an increase in government expenditure on health in Nigeria. His result shows that the re-allocation of government expenditure to the health sector is significant in explaining economic growth in Nigeria. Thus,the need for government to invest in health services. Riman and Akpan (2010) investigated the causal direction and long-run relationship between government health expenditure, poverty and health status, in Nigeria. They employed the Granger causality test and Vector Error Correction Model (VECM) which established a strong causal bi-directional relationship running between life expectancy and poverty in Nigeria. Their study also reported the existence of a long-run relationship between poverty and health status. However, they found a non- significant long-run relationship between health status and government health expenditure and concluded that policies that would improve health status should be such as would promote adult literacy level, reduce poverty and income disparity since, increasing budgetary allocation to funding health sector alone without reducing poverty level, would not be sufficient to improve the health status of the country. Bello (2005) determined the relationship between deaths from malaria and public health and non-health expenditure in Nigeria, the impact of malaria deaths on the economy and how much more public expenditure is required to reduce deaths from malaria. Using the Filmer and Pritchet (1999) and the gross output transfer models. His study revealed that there is a negative relationship between deaths from malaria, public health expenditure, per capita income and non-public health expenditure, but positive relationship death from malaria and political instability. His study further found that an average of 5.86% of the GDP was lost to malaria deaths annually, between 1975 and 2001.

Therefore, there is a need to increase public spending on the health sector. Odubunmi et al (2012) examined the relationship between health care expenditure and economic growth in Nigeria for the period 1970-2009. They employed the multivariate

cointegration technique proposed by Johansen and found the existence of at least one cointegrating vector describing a long-run relationship among economic growth, foreign aids, health expenditure, total saving and population. The cointegrating equation, however, shows some deviations in terms of the signs of the coefficients of foreign aids and health expenditure which they attributed to some diversification of foreign aids to other uses or inadequate allocation to health services. Yaqub et al (2013) while investigating the impact of public health spending on infant and under-5 mortalities as well as life expectancy using the two-stage-least squares in addition to the ordinary least squares techniques, because of the possibility of reverse causality, revealed that public health expenditure has a negative effect on under-5 mortalities when governance indicators are included but with a reversed sign without the governance indicators. They argued that as the level of corruption goes down and there is an improvement in health status since infant and under-5 mortalities decline and life expectancy rises. Thus, simply increasing public expenditure on health is less likely to lead to an improvement in health status unless the corruption issue is addressed.

Empirical Evidence on the Relationship between Health and Economic Growth: Perhaps, few attempts were made to econometrically quantify health's impact on the level and growth of GDP before works which aimed to identify the determinants of long-run economic growth, including longevity Barro, (1996); Barro & Lee, (1994) and Barro & Sala-i-Martin, (1995). In this vein, several studies Bloom, Canning, and Sevilla, (2004), Lorentzen, McMillan and Wacziarg, (2008), Zhang and Zhang, (2005) identified longevity's positive impact on various measures of GDP and GDP growth, although some studies Bhargava et al., (2001) revealed a hump-shaped relationship. Zhang and Zhang (2005) show that an increase in schooling and a decline in fertility accompany life expectancy's positive impact on economic growth, with all effects being subject to decreasing returns. The theory underpinning Aghion et al. (2011) and Bloom, Canning and Fink (2014) assume decreasing returns to health investments at the macro level. This is consistent with the findings of Bhargava et al. (2001) that an initially positive relationship between adult survival rates and GDP growth reverses into a negative one at high levels of longevity. Indeed, the intuitive expectation is that within countries with high standards of living, large and technically well-equipped health-care systems, and widespread access to (public) health care, further longevity improvements can only be achieved at a resource cost that is so high as to stifle economic performance. Further, declining mortality in these countries disproportionately benefits the older part of the population beyond their retirement age such that the positive economic effects are bound to be lower. Yet, other results from the empirical literature seemingly contradict this theory. Controlling for initial health, Hansen (2014) finds no significant effect of the change or level of longevity on GDP per capita for US states. Again, Hansen and Lönstrup (2015) show that when implementing a three-point panel (with international data from 1900, 1940, and 1980) and controlling for initial health and country fixed effects, increased longevity appears to have a negative influence on GDP per capita. The relationship between health and economic growth is further nuanced by distinguishing the influence of specific diseases on GDP per capita from that of aggregate measures of health (such as life expectancy). Indeed, evidence exists that even within developed economies, progress against particular sources of mortality or morbidity may foster better economic performance. In estimating, the parameters of dynamic panel data models using the generalized method of moments (GMM) and employing lagged levels and lagged differences as instruments for current cardiovascular mortality at working age, Suhrcke and Urban (2010) find a negative causal effect of cardiovascular diseases on subsequent economic growth in high-income countries for 1960–2000. Hyclak, Skeels, and Taylor (2016) confirmed this same relationship in a subsequent period, 2000–2012. They also show that across the Organisation for Economic Co-operation and Development (OECD) countries studied, the correlation between cardiovascular mortality and income per capita arises because of Eastern European countries. Again, this aligns with the concept of decreasing returns to health improvements: gains from the cardiac revolution have been mostly exhausted within Western countries and only accrue to countries lagging in terms of health and income. China and India, for example, are in favourable economic and demographic positions to reap macroeconomic benefits from health improvements. Bloom, et al. (2014) asserted that over 18 years, five categories of noncommunicable diseases showed that restricted access to innovative pharmaceutical pain relief would lead to a reduction in US labour supply. While these studies indicate significant positive macroeconomic effects of health and health care within specific disease domains, they also suggest that considerable amounts of health-care spending may not be conducive to economic growth. This may be a consequence of less effective treatments (Chandra & Skinner, 2012), inefficiencies in the health-care system (Cutler & Ly, 2011), or the fact that health-care spending is targeted at groups with little potential for productivity gains (for example retired adults). These will combine to reduce labour supply and capital accumulation in China and India and is enough to result in $27.6 trillion of lost output.

Data and model description: The main focus of this research is to examine whether health is a reflection of human capital accumulation and how it would affect economic growth in Nigeria. Thus, we consider the effects of health human capital accumulation on growth as well as those of the education. There is dearth of information on empirical study considering the role health investment played in supporting economic growth in Nigeria. Therefore, the authors followed the studies analyzing the health effect on economic growth in other regions for possible selection of health capital proxy variables. Sen (1998) argued that although life expectancy (LE) and mortality rate (MOT) as proxy variables for health are criticized as crude by Knowles and Owen (1995), they have been strongly defended in the macroeconomic context of developing countries. Therefore, both variables were employed as proxies for health capital. Just as other empirical papers analyzing the relationship between health and economic growth, we have also employed the following variables in the growth equation: Real GDP per capita (RGDP), Gross fixed capital (FCF), and the summation of population growth rate, technological progress and depreciation rate ($n+ g+ \delta$) which sometimes is referred to as ''workforce growth (PGRW).'' The variables n, g, and δ stand for population growth, technological progress, and depreciation rate, respectively. For the sum of depreciation rate and technological progress ($n+ g +\delta$), we follow Mankiw et al. (1992).The data sources for HE is from the National Bureau of Statistics (NBS). The data sources for LE and MOT, RGDP, FCF, and n are the World Bank's World Development Indicators collected from its Statistical Yearbooks.

The Autoregressive Distributed Lag (ARDL) Model: This study is using the ARDL model due to the following benefits over other cointegration models. First, the autoregressive distributed lag model is superior in consideration regardless of sample size,

which can be either small or finite and consist of 30 to 80 observations (Ghatak and Siddiki2001). Second, this approach is more suitable when variables integrate in a different order, as when some variables are I(0), and some variables are I(1). Third, modelling ARDL with the appropriate lags is correct for both serial correlation and the indigeneity problem (Pesaran et al. 2001). Fourth, the ARDL model, simultaneously, can estimate long run and short run cointegration relations and provide unbiased estimation for the study (Pesaran et al. 2001). A simplified ARDL model for these variables X, Y, and Z can be express as:

$$\Delta yt=\square_1+\gamma_1 y_{t-1}+\gamma_2 xt_{-1}+\gamma_3 z_{t-1}+\theta_1\sum_{j=1}^{n}\Delta yt-1+\theta_2\sum_{j=1}^{n}\Delta xt-1+\theta_3\sum_{j=1}^{n}\Delta zt-1+\varepsilon_{1t} \quad (1)$$

where, $\gamma_1,\gamma_2,\gamma_3$are long-run coefficients whose sum is equivalent to the error correction term at VECM model and$\theta_1,\theta_2,\theta_3$ are short-run coefficients. The generalized ADRL model for assessing the effect of health on economic growth in Nigeria is as follows;

$$\sum_{i=1}^{p}\varphi_1\Delta InRGDP_{t-i}\sum_{i=0}^{p}\varphi_2\Delta InPGRW_{t-i}+\sum_{i=0}^{p}\varphi_3\Delta InFCF_{t-i}+\sum_{i=0}^{p}\varphi_4\Delta InMOT_{t-i}+\sum_{i=0}^{p}\varphi_5 InHE_{t-i}+\sum_{i=0}^{p}\varphi_6 InLE_{t-i}+\beta_1 InRGDP_{t-1}+\beta_2 InPGRW_{t-1}+\beta_3 InFCF_{t-1}+\beta_4 InMOT_{t-1}+\beta_5 InHE_{t-1}+\beta_6 InLE_{t-1}+u_t \quad (2)$$

Δindicates differencing of variables, while ε_t is the error term (white noise), and $(_{t-1})$ is for the lagged period, $\varphi_1$to $\varphi_7$is the short-run coefficient. For decision-making criteria about (H_0orH_1), Pesaran et al. (2001) proposed the following procedure;

- If Fs> upper bound of critical value, confirm the existence of cointegration.
- If Fs< lower bound of critical value, conform variables are not cointegrated.
- If Fs≤ upper bound and ≥ lower bound of critical value then the conclusive decision may not reach about variables cointegration.

Once, the long-run association is established, the next two steps need to be executed to estimate long-run and short-run coefficients of the proposed ARDL models. The long-run ARDL equilibrium model is as follows
Therefore, the ARDL model specification of equation (2) is expressed as unrestricted error correction model (UECM) to test for cointegration between the variables under study:

$$\sum_{i=1}^{p}\varphi_1\Delta InRGDP_{t-i}\sum_{i=0}^{p}\varphi_2\Delta InPGRW_{t-i}+\sum_{i=0}^{p}\varphi_3\Delta InFCF_{t-i}+\sum_{i=0}^{p}\varphi_4\Delta InMOT_{t-i}+\sum_{i=0}^{p}\varphi_5 InHE_{t-i}+\sum_{i=0}^{p}\varphi_6 InLE_{t-i}+\beta_1 InRGDP_{t-1}+\beta_2 InPGRW_{t-1}+\beta_3 InFCF_{t-1}+\beta_4 InMOT_{t-1}+\beta_5 InHE_{t-1}+\beta_6 InLE_{t-1}u_t \quad (3)$$

Once cointegration is established, the long-run relationship is estimated using the conditional ARDL model specified as:

$$InGDP_t=\varphi_0=\beta_1 InRGDP_{t-1}+\beta_2 InPGRW_{t-1}+\beta_3 InFCF_{t-1}+\beta_4 InMOT_{t-1}+\beta_5 InHE_{t-1}+\beta_5 InLE_{t-1}+u_t$$
On the a priori, we expect; $\beta_1>0$, $\beta_2>0$, $\beta_3>0$, $\beta_4<0$, $\beta_5>0$, $\beta_6>0$. (4)

The lags length of the ARDL model are to be estimated using the Akaike Information Criterion (AIC).

$$\sum_{i=1}^{p}\varphi_1\Delta InRGDP_{t-i}\sum_{i=0}^{p}\varphi_2\Delta InPGRW_{t-i}+\sum_{i=0}^{p}\varphi_3\Delta InFCF_{t-i}+\sum_{i=0}^{p}\varphi_4\Delta InMOT+\sum_{i=0}^{p}\varphi_5 InHE_{t-i}+\sum_{i=0}^{p}\varphi_6 InLE_{t-i}\ \sum_{i=0}^{p}\ \delta ecm_{t-1}+u_t \quad (5)$$

Where: RGDP = Economic growth is given by real GDP per capita; $PDRW$ =Population growth;FCF = Gross fixed capital;HE = Health expenditure; LE= Life expectancy; MOT =Mortality rate.

φ_0 = Constant term
u_t = White noise
$\varphi_1-\varphi_5$ = Short-run elasticities (coefficients of the first-differenced explanatory variables)
$\beta_1-\beta_5$ =Long-run elasticities (coefficients of the explanatory variables).

On the a priori, we expect; $\delta_1>0$, $\delta_2>0$, $\delta_3>0$, $\delta_4<0$, $\delta_5>0$, $\delta_6>0$. This implies that total public expenditures on health, life expectancy, labour force and gross physical capital formation should have a positive relationship with the real gross domestic product. This means that an increase in any of the variables should increase or impact positively on the level of the income in the economy. For infant mortality, an inverse relationship exists between it and the gross domestic product, indicating that a fall in infant mortality should increase the level of GDP while a rise in infant mortality should reduce the GDP level in the country.

RESULTS AND DISCUSSION

Data Analysis and Interpretation

Table 1. Descriptive Statistics of Variables

	Mean	Median	Maxim	Minim	Std. Dev.
RGDP	7.84397	8.77097	112.025	-47.446	26.9723
FCF	17.3107	14.6326	62.6371	-18.702	18.0001
GRW	2.59188	2.63237	2.99404	1.89546	0.26526
LE	0.5855	0.82076	1.14947	-0.1272	0.4572
MOT	-1.6541	-1.6646	0.40420	-3.2885	1.20380
HE	28.4415	19.9005	161.800	-45.215	44.3037

Descriptive statistics are shown in Table (1) gives the minimum, maximum, mean and standard deviation of the annual growth rate of the study variables. The growth rate and the values used in this analysis are consistent with the growth accounting formula. Real

GDP per capita grew annually by an average of 7.84percent for the period 1971- 2017 with the best performance in the periods 1972-1975, 2002-2008, and 2011-2014, and the recession of the periods 1983, 1986,1993, and 2015-2016, respectively.

The growth rate of employment averaged 2.5 for study with strong growth in the years 1994-1995 with about 2.99 percent The poorest employment growth happened in the 1999 year of 1.89 percent. Real gross fixed capital formation grew annually by an average of about 17.3 percent over the period with the strongest growth in the years 1995 of 62 percent and 2006 and 2013 years with 39.77 and 17 percent for each. The poorest performance in the years 1984 of -18.7 percent and 2007 of percents, respectively. The life expectancy rate grew 0.58 percent for study with the highest growth of 1.14 percent in 2006 and with the lowest of -0.12 in 1998. Mortality rate grew annually by an average of -1.65percent for the period 1971- 2017, with the strongest growth in the years 1986. The poorest performance was in the years 1986 of -3.28 percent.

Unit Root Test: In econometric analysis variable order of integration is important for having internal inconsistency among the research variables. To ascertain the order of the integration, we perform the Augmented Dickey-Fuller test proposed by Phillips and Perron (1988). A stationary test with a null hypothesis non-stationary against the presence of stationary in the dataset under three different assumptions. Furthermore, the KPSS test is applied to investigate evidence of a structural break in the time series data. The results of the stationary test are presented in Table 3. The stationary test shows the mixed order of integration of variables (Table 3a&3b). Among all the variables, RGDP, FCF, HE , LE and MOT are stationary at the first difference I(1) and the remaining variable conform to stationary at the level 1(0) but there is no variable integrated after the second difference I(2). A mixed order of integration allows performing ARDL bound testing, initially proposed by Pesaran and Shin (1998) and after that further development conducted by Pesaran et al. (2001) to capture long-run cointegration among variables.

Table 2. Results from the Unit Root Test

Series	*ADF*	Critical value @ 5%	KPSS	Critical value @5%	Order of Integration
Δ(LRGDP)	-6.2509	-2.9266	0.1119	0.4630	1(1)
Δ (LFCF)	-4.2089	-2.9266	0.1081	0.4630	1(1)
Δ(LHE)	-7.3722	-2.9266	0.1572	0.4630	1(1)
Δ(LLE)	-4.0341	-2.9369	0.1952	0.4630	1(1)
Δ(LMOT)	-5.3607	-2.9297	0.1288	0.4630	1(1)
Δ(PGRW)	-2.9615	-2.9369	0.0824	0.4630	1(0)

Sources: Authors' compilation from Eviews 9 output.

ARDL Bounds Testing for Cointegration: Four ARDL Bound tests are performed based on proxy indicators assigned for the independent variable and their calculated F-statistics, is presented in Table 4. The bound test for cointegration involves a comparison between critical values and F-statistics. To make a conclusive decision regarding the long association among the research variables of each model, we consider a critical value of 1% the level of significance, which is consistent with both Pesaran et al. (2001) and Narayan (2004). If the calculated F-statistics are higher than the upper bound of the critical value than variables are cointegrated. On the other hand, if the calculated F-statistics are lower than the lower bound of the critical value, it implies no cointegration. However, if the calculated F-statistics lies within the lower bound and the upper bound levels, the results are not inclusive. The study findings revealed the existence of a long-run cointegration for all tested models. Therefore, one can conclude that health development and economic growth move together in the long-run. These study findings are supported by empirical studies conducted by Boubakari and Jin (2010); Co ̧skun et al. (2017); and Pradhan et al. (2014a, 2015). Furthermore, the finding of the long-run association between health and economic growth is also in line with Ajide (2015); Qamruzzaman and Wei (2017); and Bara and Mudzingiri (2016).

Table 3a. Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.931794	314.0102	95.75366	0.0000
At most 1 *	0.778765	193.1752	69.81889	0.0000
At most 2 *	0.681659	125.2913	47.85613	0.0000
At most 3 *	0.632255	73.78281	29.79707	0.0000
At most 4 *	0.390114	28.76634	15.49471	0.0003
At most 5 *	0.134778	6.514603	3.841466	0.0107

Trace test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 3b. Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.931794	120.8350	40.07757	0.0000
At most 1 *	0.778765	67.88391	33.87687	0.0000
At most 2 *	0.681659	51.50849	27.58434	0.0000
At most 3 *	0.632255	45.01647	21.13162	0.0000
At most 4 *	0.390114	22.25174	14.26460	0.0022
At most 5 *	0.134778	6.514603	3.841466	0.0107

Max-eigenvalue test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 4. ARDL Bounds Test

ARDL Bounds Test		
Test Statistic	Value	k
F-statistic	6.476168	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Results from ARDL Cointegration test

There is ample evidence to suggest that there exists a long-run relationship between economic growth and the variables presented in table (3). The results from the bounds test approach to cointegration are presented in Table (4) above: Once the establishment of the cointegrating relationship between economic growth and the independent variables is made, the next step is to estimate the long-run coefficients in the ARDL model with a lag length based on SBIC. The long-run estimates from the ARDL specification are presented in Table 5.

Table 5. Long-run estimates based on ARDL

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PGRW	1.365394	0.494919	2.758827	0.0051
LFCF	2.431014	0.361375	6.727117	0.0000
LHE	0.750023	0.336358	2.229838	0.0354
LLE	1 .103638	0.260583	4.235172	0.0003
MOT	-1.422579	0.441403	-3.222822	0.0036
C	-21.147099	5.238354	-4.036973	0.0005
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PGRW)	5.492233	3.114374	1.763511	0.0905
D(PGRW(-1))	4.597176	1.279197	3.511767	0.0018
D(LFCF)	1.054569	0.358284	2.943394	0.0071
D(LHE)	0.300479	0.101256	2.967518	0.0067
D(LLE(-1))	6.836279	3.169409	2.156961	0.0412
D(MOT)	-5.587609	1.570465	-3.557926	0.0016
D(MOT(-1))	-4.910988	1.594202	-3.080109	0.0051
CointEq(-1)	-0.692255	0.165105	-4.192821	0.0003

Regression Summary Statistics

R-squared	0.998647	Mean dependent var	14.12353
Adjusted R-squared	0.987576	S.D. dependent var	2.930510
S.E. of regression	0.144291	Akaike info criterion	-0.731013
Sum squared resid	0.499678	Schwarz criterion	0.079982
Log likelihood	36.08229	Hannan-Quinn criter.	-0.430257
F-statistic	932.2545	Durbin-Watson stat	2.024029
Prob(F-statistic)	0.000000		

All the five independent variables presented in the model were statistically significant in influencing long-term growth in Nigeria within the study period. The coefficient of health, measured by life expectancy at birth, was 1.1036 and statistically significant at 1% level while that of health expenditure was 0.7500 and statistically different from zero at 5% level. The stock of physical capital and mortality rate were also statistically significant at 1% level with elasticities of 2.4310 and -1.4226 respectively. While the elasticity coefficients of growth of labour (1.3654) were statistically significant at 5% level. The next step in our econometric analysis is to model the short-run dynamics to capture the speed of adjustment towards equilibrium following any shock in the system. The results of the error correction model (ECM) are presented in Table 6. In the short-run, the coefficient of health was 6.8363 and statistically significant at 5% level. The coefficient of gross fixed capital was positive; it was statistically significant in influencing economic growth. While the statistical significance of the elasticity coefficient of capital was a change in the short-run, its positive elasticity dropped from 2.4310 to 1.0546. Again, both the elasticity coefficient and significance of health expenditure and mortality rate dropped. Precisely, the elasticity coefficient of health expenditure and the mortality rate was 0.3005 and -5.5877 statistically significant at 5% unlike its 1% level significance in the long run. The negative signs of the elasticity coefficients of mortality rate did not alter in the short run, their significance levels and magnitudes changed. The elasticity coefficient of population growth was 5.4922 and statistically at 10% level while the elasticity coefficient of one year lagged were 4.5972 with 1% level significance. The coefficient of ECM was - 0.6923 and statistically significant at 1% level. The summary statistics of the estimates show that the coefficient of determination that measures the goodness-of-fit of the estimated model shows that the model has the predictive capability as high as 99% for the model. R^2 adjusted 98.76% of the variations in economic growth of the short-run are explained by the variables presented in the model. This suggests that the model is a good fit. The *F*-statistic value of 932.54 for the model is indicative of the overall statistical significance of the models at the 1% level as shown by the *p*-value.

Discussion of the long run and short-run results: This study has estimated the effect of health on economic growth in Nigeria while controlling for the effects of life expectancy proxy for health, physical capital accumulation, mortality rate, population growth, and health expenditure. We find that the long-term economic growth achieved in Nigeria within the study period has been significantly influenced by improvement in health, physical capital accumulation, mortality rate, population growth, and health expenditure. First, we find that better health improves the economic performance of the country. This follows from the positive and significant relationship between health and economic growth both in the short and long run. However, the growth effect of health was greater than health expenditure in both short and long terms as shown by their magnitudes. The results suggest that increasing life expectancy by a year boosts the productivity of workers and that increases economic growth by 1.10% in the long-term. Our long run results could be due to the effectiveness and high level of productivity among health workers. Another possible reason for the long-term positive effect of health emanates from the sustained labour that healthy people provide, thus enhancing productivity. The savings of such healthy people also made available more funds for productive ventures, which has increased the performance of the Nigerian economy. These points have been emphasised by Bloom and Canning (2003) and the findings of Dauda (2010) support this result. Nigeria's economy is labour-intensive based and this might have accounted for this nature of the result. Again, in the short term, the growth effect of health is positive. More specifically, improvement in health, i.e., an extra year of life expectancy, boosts economic growth by 6.83%. The short-run results, perhaps, is due to the low level of absenteeism resulting from improved health. While these findings on the positive effect of health on economic growth deviate from those reported by Acemoglu and Johnson (2007) and the short-run results from Akram et al. (2008), they corroborate with that of Bloom et al. (2001, 2004) who find, from cross-national data, that improvement in health raises output by 4%. Similar findings have also been reported by Arthur (2013), and Aghion et al. (2010). Further, accumulation of physical capital was a significant contributor to economic growth, both in the short-run and long run. Specifically, our findings of the positive elasticity coefficient of physical capital accumulation suggest that long-term economic growth rises by 2.43% following a 1% increase in physical capital accumulation. This elasticity confirms the assumption of decreasing returns to scale in neoclassical growth theory. Thus, percentage growth in output is lower than percentage growth in input, in this case, capital stock. The implication is that capital accumulation has been one of the driving forces of economic growth in Nigeria. While these findings agree with those reported by Bloom et al. (2001, 2004), Knowles and Owen (1997) and Barro (1999), the findings from Sub-Saharan Africa data reported by Arthur (2013) suggest otherwise. Similarly, Adu et al. (2013), and Ajide (2015), have found that investment or capital formation has been an important driver of economic growth in Nigeria. Thus, the accumulation of physical capital is a strong determinant of economic growth in Nigeria.

The results suggest that infant mortality rate, decrease the economic growth in both the long-run and the short-run and both statistically significant at 1 % level. This agrees with theoretical a priori of negative relationship and following the finding of Akram et al. (2008). An increase in infant mortality rate reduces the level of economic growth since such infants would not live to the age of adulthood to contribute to productivity within the economy and it will reduce the income available for investment that brings about growth. The study also finds that health expenditures have a positive and significant impact on economic growth in the short-run and long run. The R^2 adjusted suggests that 81.68% of the short-run variations in economic growth are explained by the variables presented in the model. The highly significant coefficient of ECM was -0.6923 which implies that 69.23% of the disequilibrium in the previous year's growth is corrected in the current year. Thus, the speed of adjustment, following a shock in any of the independent variables, towards equilibrium was 69.23%. This seems to suggest that the speed of adjustment towards equilibrium was moving faster. The Durbin-Watson statistic of 2.02 falls within the acceptable range of no autocorrelation, which implies that there is no autocorrelation in the model.

Conclusion and Recommendations

Health is often regarded as an important factor in individuals' labour supply decision, not only because health is a form of human capital, valued by both employers and employees (Becker, 1964; Grossman, 1972), but also because individuals' preferences between work and leisure may change following a health shock. Economists have increasingly recognized that good health across the whole population significantly contributes to labour and human capital to achieve economic growth. Through higher participation and productivity, good health contributes to economic performance and is positive for individual wellbeing (Hsiao and Heller, 2007). The study has tried to address the issue of health as an important factor in determining the growth of the Nigerian economy. Time-series properties of the data employed in the study were tested namely: the unit root test and cointegration analysis and autoregression distribution lag (ARDL) of analysis. The results show that a positive and significant long-run relationship exists between real GDP and life expectancy both in the short and the long run. The study also finds that labor force participation rate have an encouraging and significant impact on the economic growth in the short run, but this result evaporates in the long-run. The results suggest that infant mortality rate, decrease the economic growth in the long-run and in the short-run and both statistically significant at 1 % level The study also finds that health expenditures have a positive and significant impact on economic growth in the short-run and long run.

The conclusion from this analysis is that the long-run relationships and the statistical significance of health variables show that health is an important component for the growth of the Nigerian economy. Also the signs of their coefficients are an indication that the government still has to show more commitment to the issue of health in the economy. These findings have some policy implications. First, there is the need to increase health investments to improve health conditions. This stems from the fact that improvement in health does not only enhance welfare but also, output. Thus, as Nigeria aspires to achieve higher income status there is the need to raise investment in health to raise the vitality and strength of the population to propel Nigeria's growth. In addition to public health programmes, construction of new health facilities, training of healthcare personnel, and improved medical

supplies in hospitals will help achieve this goal. Again, the policy should aim at promoting immunization programmes to reduce infant and under-five mortality. Overall, Nigeria's healthcare system should be strengthened to respond to the health needs of the population. These measures will help improve the life expectancy of the population. Also, policymakers should improve the capital stock of the country to fasten the pace of growth and development. Thus, investment in efficient and effective infrastructure such as road networks, telecommunications and railway lines are necessary to fasten Nigeria's growth and development. Public-Private Partnerships can be introduced in such sectors as transportation and manufacturing to boost the stock of physical capital.

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