Effect of Health Capital Expenditure on Economic Growth in Nigeria

Sakiru Oladele AKINBODE[1] and Sheriffdeen Adewale TELLA[2]

[1]Department of Economics, Federal University of Agriculture, Abeokuta, Nigeria

[2]Department of Economics, Olabisi Onabanjo University, Ago-Iwoye, Ogun State, Nigeria

Abstract

Huge public funds have been expended on health and other human capital variables over time with little knowledge of the impact on economic growth in Nigeria. Building on the endogenous growth model, this study assessed the impact of health capital expenditure on economic growth in Nigeria. Data was sourced from the Central Bank of Nigeria's (CBN) statistical bulletin, the National Bureau of Statistics (NBS) and the World Development Indicators (WDI) spanning 1981 to 2018. Based on the results of Augmented Dickey Fuller (ADF) tests, which revealed different orders of integration of the study series, the Autoregressive Distributed Lag model (ARDL) procedure was adopted in estimating the stated model equation. The bounds test suggested the presence of a long-run relationship among the study variables. The short-run model revealed that lagged GDP growth rate ($P<0.0$), health capital expenditure – CAP ($P<0.01$), lagged health capital expenditure and gross fixed – CAP(-1) ($P<0.05$) – capital formation-K ($P<0.1$), significantly affected economic growth with a significant negative trend and speed of adjustment of 37.6 percent. In the long run, health capital expenditure ($P<0.05$), gross fixed capital formation ($P<0.05$), education expenditure ($P<0.05$) alongside a positive trend significantly affected economic growth. The study concluded that capital expenditure in the health sector as well as education spending and capital formation were important for economic growth. Furthermore, labour was not a limiting factor in the Nigerian growth process, obviously due to abundant availability of labour and a high unemployment rate. Furthermore, the proposition of health-led growth hypothesis and the endogenous growth models were confirmed. Therefore, more funds should be expended on capital projects in the health and education sectors in order to enhance growth.

Keywords: economic growth, endogenous growth, health expenditure

JEL codes: E01, H51

Introduction

The World Health Organization (WHO) defined human health in a broad sense in the 1948 constitution of the organization as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." Health is both a direct utility good and a derived demand good (i.e., an input required for other processes). Everybody in the society aspires to attain an excellent state of health as it brings joy. As an input, health is required to engage in production and to engage in other economic activities in order to earn an income. Hence, health is a major component of human capital. Therefore, governments at all levels in every society always allocate a part of their resources to healthcare.

Healthier workers would certainly be able to work for longer times and are likely to be more productive than unhealthy ones, and therefore should be able to earn higher income *ceteris paribus*. Illness and disease reduce the working lives of people, and by implication reduce their life-time earnings. Health is a major component of an individual's wellbeing, and since individuals make a nation, healthcare could conveniently be regarded as one of the important conditions for achieving sustainable long-term economic growth and development.

The contribution of health expenditure to the process of economic development has its basis in the health-led growth hypothesis (Mushkin, 1962). The hypothesis views health as capital, therefore, any investment made on health has the tendency to lead to increased productivity of labour, increased income earning, and improved wellbeing of the people. In the opinion of Bloom and Canning (2000), the tendency and the encouragement to develop new skills and knowledge by healthy labour is higher as they hope to enjoy long-term benefits. Contrastingly, when the labour force consists mainly of unhealthy workers, low productivity becomes a prominent feature and this may be a major reason for the differences in development existing in the different regions of the globe (Cole and Neumayer, 2006). According to WHO (2005), about 50 percent of the differences in economic growth between developing and developed nations are due to differences in the incidence of ill-health, as well as life expectancy.

Meanwhile, in Nigeria, governments budget and indeed spend money (both capital and recurrent) on healthcare every year. For instance, in 1980, the Nigerian government spent a total of one hundred and thirty million naira (₦130 million) on capital projects in the health sector with a GDP value of ₦51.73 billion naira and a yearly economic growth rate of 4.2 percent. The government capital expenditure on health rose to ₦1.73 billion in 1995 with a GDP value of about ₦2 trillion and a yearly growth rate of -0.1 percent, which clearly indicated a shrink in the economy. In 2015, health capital expenditure was ₦48.87 billion while GDP was ₦69 trillion with a yearly economic growth rate of 2.7 percent. Meanwhile, figures on the main and intermediate indicators of health have not been encouraging. For instance, the number of doctors per 1000 people in Nigeria was 0.19 in 1989. This rose marginally to 0.281 in 2005 and 0.395 in 2010 (World Development Indicators, 2018). In the same vein, the number of nurses per 1000 people was 1.6 as at 2010. Furthermore, the number of hospital beds per 1000 people was 1.2 in year 2000 and 0.5 in 2004, and the declining trend has continued. Life expectancy is a major indicator of the state of healthcare in any country. Nigeria's life expectancy was 46.11 years in 1990. This also rose marginally to 48.66 years in 2005 and 53 years in 2016. These figures are below those of the majority of poorer African countries and far below the world averages. For instance, life expectancy is presently about 60 years in Benin

Republic, 57.7 years in the Democratic Republic of Congo and 61 years in South Africa (World Bank-WDI, 2018).

Capital expenditure on health is ordinarily supposed to improve the economy in two major ways. Aside health capital expenditure contributing to better health outcome and translating into improvement in the economy through improved labour productivity, health capital expenditure may raise aggregate demand, as well as provide jobs for construction workers for hospital buildings, equipment suppliers, computer programmers for automations and so on, thereby contributing to economic growth.

Given the important position of good health in achieving economic growth and the fact that Nigerian governments have been spending some portion of government expenditure on healthcare, it is imperative to conduct a study aimed at determining whether or not health capital expenditure has any significant effect on economic growth in the country. This is important as most previous studies have obtained diverse results as envisaged in the rudiments of the health-led growth hypothesis, contrary to the optimistic view of the endogenous growth model. One of the novelties of the present study is the separation of health expenditure into capital and recurrent. In addition, this study utilized up-to-date currently available data and its finding is expected to be of importance to health policy makers and other stakeholders in the Nigerian health sector. The remaining part of this paper is organized as follows: the theoretical framework and the empirical review of previous related papers; the methodology; results and the discussions; the summary and conclusion based on the findings of the research work.

Review of Empirical Literature

Some earlier studies aimed at identifying factors driving economic growth have emphasized the importance of human capital investment on growth. Examples are Barro and Sala-i-Martin, 1995; Barro and Lee, 1994; and Barro, 1991. The nature of the relationship existing between expenditure and public health and the growth of the economy have been extensively researched by scholars in both developed and developing countries of the world. However, there have been divergences in their conclusions. Hashmati (2001) adopted the Robert Solow growth model in assessing the nature of the relationship between health expenditure and economic growth among OECD countries using data from 1970 to 1992, and concluded that a direct (positive) relationship actually exists between expenditure on health and economic growth. Contrastingly, Kar and Taban (2003) carried out a similar study in Turkey and reported a negative (inverse) relationship. Mayer, Mora, Cermeno, Barona and Duryeau (2001) examined the effect of health expenditure on economic growth in the Latin American and Caribbean regions. The study reported a positive relationship, emphasizing that health expenditure plays a major role in economic growth.

Bakare and Sanmi (2011) assessed the effect of healthcare expenditure on economic growth in Nigeria relying on data from 1970 to 2008 and reported that the relationship existing between health expenditure and economic growth in the country was positive and significant. Ogundipe and Lawal (2011) attempted to assess the role health expenditure plays in the Nigerian economic growth process. The study found a negative relationship between the two. The finding obviously ran contrary to that of Bakare and Sanmi (2011) carried out around the same time in Nigeria. The difference in their findings may be due to differences in approach, scope of study and the presence of different control variables in their models. Odubunmi, Saka and Oke (2012) also attempted to establish the nature of the relationship between healthcare expenditure and economic growth in Nigeria using data from 1970 to 2009, which were analysed within the framework of the Johansen cointegration procedure, and reported the existence of a negative relationship. Oni (2014) examined the relationship between health expenditure and economic growth using data from 1970 to 2010 analyzed using multiple OLS regression and reported a positive relationship.

Mandiefe and Tieguhong (2015) assessed the impact of public health investments on economic growth in Cameroon using data from 1988 to 2013 and employing the vector error correction model (VECM) estimation technique. The results of the estimation carried out in the study showed that investments made in public health in Cameroon only affected economic growth in the long run. Atilgan, Kilic and Ertugrul (2016) empirically tested the validity and applicability of the health-led growth hypothesis in Turkey using data from 1975 to 2013. The ARDL model results showed that a percent increase in per-capita health expenditure led to 0.43 percent increase in per capita GDP. Bedir (2016) studied the relationship between healthcare expenditure and economic growth in developing countries using the Toda-Yamamoto causality test procedure and reported that for a number of emerging economies, increases in income level stimulate expenditure incurred on healthcare. Aboubacar and Xu (2017) probed into the nature of the relationship between healthcare expenditure and the growth of economies in sub-Saharan Africa from 1995 to 2014. The result of the system GMM revealed the existence of a positive and statistically significant effect of health expenditure on economic growth in the region. The divergence in the findings and conclusion of the previous studies calls for further research into the nature of the relationship existing between health expenditure and economic growth in Nigeria.

Theoretical Framework

The health-led growth hypothesis was originally proposed by Mushkin (1962), and the framework mainly comprises four items: (1) growth hypothesis where the direction of causality is from health expenditure to economic growth, that is, health expenditure directly affects economic growth, (2) growth detriment hypothesis where the direction of influence is from economic growth to health expenditure, that is, improvement in economic growth spurs increased spending on health, (3) feedback hypothesis in which bi-directional causality exists, with economic growth affecting health expenditure and vice versa, and (4) neutrality hypothesis where it is posited that no causality exists. It is generally understood that a more healthy population leads to an increase in total factor productivity, and healthy people can work productively for a longer time, earn more money, and have better ability to learn, thereby raising the human capital efficiency in the economy (Schultz, 1999). The health-led growth hypothesis is well related to the endogenous growth theory developed by Romer (1986, 1990) and Lucas (1988), and to other studies such as Barro (1991) as well as Barro and Lee (1994), which equally established the important roles of human capital (especially health and education) and accumulation and/or investment in the process of economic growth.

According to Piabuo and Tieguhong (2017), the channel by which economic growth is affected by investment in public health is contained in the endogenous growth models. These models emphasized the role of human capital in achieving economic growth. Economic growth is explained by the neoclassical growth models on the basis of population growth and savings. Solow (1956) stated that nations with high levels of savings are likely to have higher per capita GDP *ceteris paribus.* Rate of savings and population growth are the main factors affecting/determining per capita income in various countries in the Solow model (Hashimati, 2001).

According to Ssozi and Asongu (2015), the theoretical basis of Barro is still very important in the literature of empirical human capital in Africa. The augmented Solow model by Mankiw, Romer and Weil (1992) also further emphasizes the importance of human capital in achieving economic growth. The endogenous models do not take human capital as a constant, instead, they are based on the ability of human capital to influence economic growth in both the short and long-run.

The endogenous growth theory does not only criticize the neoclassical theory, it actually extends the neoclassical model by including endogenous technical progress in growth models. The endogenous models were developed by Arrow, Romer and Lucas, among other authors.

Arrow's model is stated thus:

$$Y_i = A(K)F(K_i, L_i) \quad (1)$$

where:

Y_i = output of firm i

K_i = capital stock

Li = firms' labour stock

K = aggregate capital stock

A = technology factor

It was shown that provided that labour stock is held constant, growth will certainly stop, as little is socially invested and produced. Consequently, Arrow did not claim that his model could lead to sustainable endogenous growth.

The Romer (1986) model is a variant of the Arrow model, and is referred to as *learning by investment*. Here, it is assumed that knowledge creation is a side effect of investment. It considers knowledge to be an input in the production function, which is of the form:

$$Y = A(R)\ F(R_i, K_i, L_i) \tag{2}$$

where:

Y = aggregate output

A = public stock of knowledge which emanates from research and development R

R_i = results from investment on research and development by firm i

K_i and L_i = stock of capital and labour of firm i respectively

The Lucas model developed further by Uzawa emphasized the endogenous growth model based on investment in human capital. It has been asserted that it is investment in human capital instead of physical capital that certainly will have spillover impacts, which raise technology level. Therefore, the output of firm i takes the form:

$$Yi = A(Ki).(Hi).H^e \tag{3}$$

where:

A = the technical coefficient

Ki and Hi = physical and human capital inputs used by firms to manufacture output Yi

H = variable for average level of human capital in the economy

e = parameter representing strength of the external effects of human capital to each firm

Romer (1990) came up with a model of endogenous technical change which identified a research sector specializing in the production of ideas. The sector invokes human capital along with the existing stock of knowledge to produce a new idea or knowledge. Romer believed that ideas are more important than natural resources. The Romer model is presented below:

$$\Delta A = F(K_A.\ H_A.A) \quad (4)$$

where:

- ΔA = increase in technology
- K_A = quantity of capital invested in producing the new design
- H_A = quantity of human capital (labour) employed in the process of producing the new technology
- A = existing technology of designs
- F = production function for technology

In summary, the endogenous growth model, technological progress, which increases productivity and accelerates the pace of growth, can be determined within the model through the formation of human capital. Spending on health and education helps promote efficiency, knowledge and inventions, all of which contribute to the economic growth of a country.

Lucas (1988) states that:

$$y = AK^{a}\,(uh)^{1-a}\,(ha\,)^{\gamma} \quad (5)$$

where:

- y = output
- K = physical capital
- u = the fraction of time devoted to productive activities (and the rest to accumulation of knowledge)
- h = the human capital input
- ha = the average human capital in the economy

Spending on education and healthcare proceed as human capital inputs and ultimately contribute to output growth through either direct accumulation (*uh*) or the existing stock of knowledge (*ha*), which leads to innovation and spills over into the rest of the economy. In addition, if $\gamma>0$, then the production function involves increasing returns to scale, where productivity growth is endogenized in human capital inputs.

Methodology

The model

In a bid to formulate a model, the present study adapted the endogenous growth model, specified in a labour augmented fashion as:

$$Y_t = AL_t^{\alpha} K_t^{\beta} H_t^{\gamma} \text{..................................}(6)$$

where:

Y = output

A = level of total factor productivity

L = labour

K = physical capita

H = human capital, consists of health (HE) and education (ED) with coefficients γ_1 and γ_2 respectively

α, β and γ = factors' contribution to output

Therefore, taking the log of equation (6) we have:

$$\text{In}Y = \text{Log}A + \alpha\text{Log}Lt + \beta\text{Log}K + \gamma_1\text{Log}HE + \gamma_2\text{Log}ED + e \qquad (7)$$

In the model estimated, the health component was proxied by expenditure on health, which was further broken into capital health expenditure and recurrent health expenditure. Therefore, the estimated model is stated implicitly thus:

$$Y = f(AL, K, CAP, REC, ED) \qquad (8)$$

With the aim of assessing the effect of health expenditure on economic growth, equation (8) can be stated in a more explicit fashion as:

$$Y_t = \beta_0 + \beta_1\text{Log}LF_t + \beta_2\text{Log}CAP_t + \beta_3\text{Log}REC_t + \beta_4\text{Log}ED_t +$$
$$\beta_5\text{Log}K_t + e_t \qquad (9)$$

where:

Y_t = Gross domestic product per capita growth rate in year *t*

CAP = Total capital health expenditure (in billion naira)

REC = Total recurrent health expenditure (in billion naira)

K = Gross fixed capital formation (in billion naira)

ED = Total education expenditure (in billion naira)

LF = Labour force

Apriori expectations: $\beta_{1} - \beta_{5} > 0$

Data and sources

Data for the present study spanned the period 1981 to 2018 due to data availability and completeness. Table 1 summarizes the data sources and descriptions.

Table 1: Data description and sources

Data Description	Proxy	Sources
Gross Domestic Product per capita growth rate (Y)	Growth rate of GDP per capita	World Development Indicators (WDI)
Capital Health Expenditure (CAP)	Amount of money spent by all governments on capital items in the health sector	CBN Statistical Bulletins
Recurrent Health Expenditure (REC)	Amount of money spent by all governments on recurrent items in the health sector	CBN Statistical Bulletins
Education Expenditure (ED)	Total amount of money spent by all governments on education	CBN Statistical Bulletins
Labour Force (LF)	This comprises people aged 15 and older who are currently employed and people who are unemployed but seeking work as well as first-time job-seekers.	National Bureau of Statistics
Gross Fixed Capital Formation (K)	Investment in fixed items such as machinery, buildings, railways, roads, etc.	WDI

Source: Author's compilation, 2019.

Data analyses

(a) Pre-estimation

(i) *Descriptive statistics:* A descriptive analysis of all the study variables was carried out. This included mean, median, maximum, range, standard deviation, skewness, normality test, etc.

(ii) *Unit root test:* This test was used to examine the stationarity of the series. A stationary series implies a series is predictable and hence stable over time. Thus, to enhance policy effectiveness, the unit root test was carried out on each of the variables employed in this research work. The Augmented Dickey Fuller test was adopted in respect of this.

(iii) *Co-integration test:* Having assessed the stationarity order of the series (either at level or differenced), the study proceeded to a co-integration test, which implies testing for long-run relationships between the variables. The choice of technique of test for co-integration was based on the result obtained from the unit root test. Since the series were integrated of different orders, that is, I(0) and I(1), the auto-regressive distributed lag bounds co-integration test (bounds testing approach) was employed.

(b) Estimation

The results of the unit root test which was used to assess the stationarity of the variables were the main determinant of the estimation technique. Since series were integrated of different orders i.e., I(0) and I(1), the autoregresive distributed model (ARDL) stated below was estimated.

$$\Delta Y_t = \alpha + \mu\text{TREND} + \sum_{m=1}^{M} \theta_m \Delta Y_{t-m} + \sum_{j=0}^{J} \vartheta_j \Delta CAP_{t-j} + \sum_{r=0}^{R} \theta_r \Delta REC_{t-r} + \sum_{p=0}^{k3} \varphi_p \Delta K_{t-p} + \sum_{q=0}^{Q} \delta_q \Delta LF_{t-q} + \sum_{n=0}^{n} \pi \Delta ED_{t-n} + \beta_1 CAP_{t-1} + \beta_2 REC_{t-1} + \beta_3 K_{t-1} + \beta_4 LF_{t-1} + \beta_5 ED_{t-1} + \varepsilon_{it}$$

(c) Post-Estimation Analysis

Here, having estimated the coefficient of the variables, the study proceeded to post-estimation tests to establish the validity of the above stated models, in order to ensure that their underlying assumptions were not violated and to guarantee the authenticity of the estimation technique adopted. Relevant tests performed under this section included the test for linearity using the Ramsey RESET test, test for normality with Jarque-Bera test, heteroskedasticity using the Breusch-Pagan-Godfrey test and test for serial correlation using the Breusch-Godfrey Test. All the analyses were carried out using the econometric software E-Views 10 version.

Results and Discussion

Descriptive statistics

Table 2 shows the descriptive statistics of the study variables. The average growth rate of per capita GDP for the years covered by the study was 0.54 percent. The skewness statistic value revealed that all the study variables skewed to the right except per capita GDP growth rate and labour force, implying that the long tails of their distribution lay to the right, suggesting that the majority of the figures in such series had low values, while a few had high scores, although, the skewness was not very pronounced. The kurtosis test which revealed the level of peakedness of each of the series showed that the GDP growth rate was leptokurtic in nature i.e., highly peaked, while capital and recurrent expenditures on health were mesokurtic, that is, moderately peaked. Capital formation (K), labour force (LF) and education expenditure (ED) were platykurtic in distribution, i.e., relatively flat peaked. The Jarque-Bera test combines the properties of kurtosis and skewness to test for normality. The Jarque-Bera test of normality (assessed through the *P*-value) revealed that only capital formation and labour force were normally distributed while others were not.

Table 2: Descriptive statistics

	Y	K	LF	CAP	REC	EDU
Mean	0.544901	4911560.	41164211	20.37605	67.78391	123.4152
Median	1.553724	2907435.	40844990	6.845000	15.92843	55.93662
Maximum	12.45747	10571700	58403811	97.20000	297.7600	405.2340
Minimum	-15.45037	1798580.	24018370	0.070000	0.041315	0.348904
Std. Dev.	5.394160	3158482.	10558044	24.45008	95.27044	149.0588
Skewness	-0.877883	0.706287	-0.011036	1.054963	1.263384	0.896132
Kurtosis	4.604779	1.822107	1.694265	3.504292	3.108535	2.220287
Jarque-Bera	8.958545	5.356097	2.700266	7.451328	10.12754	6.048594
Probability	0.011342	0.068697	0.259206	0.024097	0.006322	0.048592
Observations	38	38	38	38	38	38

Source: Author's computation, 2019.

Graphic illustration of study variables

Figure 1 represents the graphic illustration of the study variables. It can be observed that per capita GDP growth rate kept increasing with noticeable fluctuations from 1981 to 1990 before falling to about negative 5 percent in 1994, possibly due to the prevailing political instability at that time, which resulted in multiple protests and notably, strikes in the petroleum sector. The growth rate has been very unstable over time.

Capital expenditure on health was very low in Nigeria up till 1995 when it started rising. Capital expenditure on health reached an all-time high in 2009 but fell afterwards. Recurrent expenditure on health was similarly low before it started increasing in 1995, reaching an all-time high in 2011. A similar trend was observed for education expenditure. Gross fixed capital formation (GFCF), which is an indication of investment in the economy, fell between the early and mid-1980s and remained very low until 2005 when it began to experience upward movement. Labour force has continued to increase over time in Nigeria, possibly due to the rising population, except for a minor fall experienced in 2011 after which it continued its upward trend.

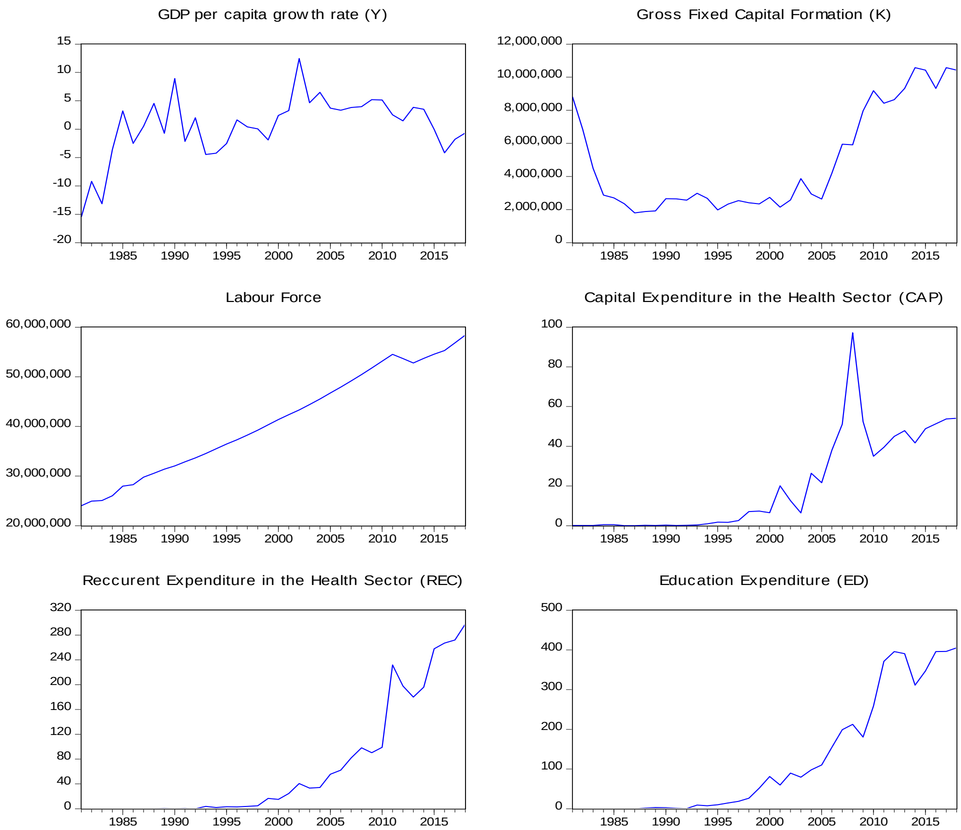

Figure 1: Graphic illustration of study variables.

Correlation among study variables

It is germane to estimate the level of correlation existing between variables to be used in a regression analysis. This allows for the avoidance of multicollinearity in the model to be estimated. According to Iyoha (2004), a correlation coefficient of more than 0.95 between two variables implied that two such variables should not coexist in a model to avoid a basic econometric problem. Table 3 reveals that none of the variables had correlation coefficient beyond the threshold suggested by Iyoha, hence, they could be included in the estimated model without posing any potential danger.

Table 3: Results of correlation analyses

	Y	K	LF	CAP	REC	EDU
Y	1					
K	-0.1289	1				
LF	0.4499	0.6622	1			
CAP	0.2845	0.7068	0.6481	1		
REC	0.1099	0.8579	0.5446	0.5813	1	
EDU	0.2047	0.5863	0.7015	0.8412	0.699	1

Source: Author's computation, 2019.

Test of stationarity of study variables

Table 4 shows the results of the unit root test in order to determine the stationarity or otherwise of the study variables. The results indicate that GDP per capita growth rate (Y) was stationary at level, i.e. I(0), while all other variables (labour force, capital formation, health capital expenditure, health recurrent expenditure and education expenditure) were stationary at first difference, i.e. I(1). Arising from the fact that the study variables, especially the main variables of the study, i.e. GDP, CAPH and REH, were integrated of different orders, the ARDL model built to accommodate variables which are integrated of different orders was adopted for the present study.

Table 4: Results of the augmented Dickey-Fuller (ADF) unit root test

Variables	**At Level**			**First Difference**			**I(d)**
	No intercept, no trend	With intercept	With intercept &trend	No intercept, no trend	With intercept	With intercept &trend	
GDP	-2.86***	-4.13***	-3.39*				I(0)
LogK	1.18	-0.88	-2.21	-3.22***	-3.35**	-2.83	I(1)
LogLF	4.22	-3.02**	-1.09	-0.85	-5.12***	3.31*	I(1)
LogCAP	-0.18	-1.00	-2.12	-6.17***	-6.53***	-5.87**	I(1)
LogREC	-0.89	-1.44	-0.02	-0.81	-9.99**	-5.40**	I(1)
LogED	0.73	-0.97	-2.61	-6.87***	-7.52***	-4.80**	I(1)

*Significant at 10%, **Significant at 5% and ***significant at 1%

Source: Author's computation, 2019.

Test of long-run cointegration

The ARDL bounds test results reported in Table 5 show that the F-statistic of the model was above the upper critical bound at 1 percent implying the presence of long-run relationships between economic growth rate, health capital and recurrent expenditures, education expenditure, GFCF and labour force. Therefore, both the short-run and the long-run versions of the model were estimated.

Table 5: ARDL bound test results

Significant levels		1%	2.5%	5%	10%	F-statistic
Critical Value Bounds	Upper Bound I(1)	5.32	4.16	3.51	3.41	9.67
	Lower Bound I(0)	3.24	2.92	2.67	2.31	

Source: Author's computation, 2019.

Short-run relationships

The short run model results (table 6) reveal that lagged per capita GDP growth rate ($P<0.1$), gross fixed capital formation – K ($P<0.1$), health capital expenditure – CAP ($P<0.05$) and lagged CAP ($P<0.05$) all had significant effects on economic growth in the short run. The coefficient of lagged growth rate value of 0.2555 implies that a one percent increase in the previous year's growth rate increased the present year's growth by 0.2555 percent *ceteris paribus*. This is plausible in the sense that if more capital goods were produced in the previous year which resulted in increased per capita income growth, utilization of such capital goods is likely to increase the subsequent year's growth rate. The positive and significant value implies that the Nigerian economy is not close to convergence, rather, there is still potential for expansion in the economy. An increase in the previous year's growth will raise consumption and aggregate demand, thereby significantly improving the economy in the present year.

In line with *a priori* expectation, capital expenditure on health positively affected growth. An increase in health capital expenditure by 1 percent increased per capita GDP growth rate by about 0.28 percent in the short run. The expenditure, which was mostly on hospital buildings construction, equipment acquisition etc. is expected to provide immediate employment for both skilled and unskilled labour, thereby raising income and aggregate demand, which will improve growth in the short run. These are in line with the views of the health-led growth hypothesis and the endogenous growth models proposed by Lucas, Romer, etc. The findings reported here also corroborate that of Oni (2014) who reported a positive relationship between health expenditure and economic growth in Nigeria. They also agree with that of Atilgan et al. (2016) in Turkey. However, they are contrary to the findings of Ebong et al. (2016), who reported a negative impact of health expenditure on economic growth in Nigeria. Differences in time, scope and methodology might be responsible for the disparity. Meanwhile, the lag of health capital expenditure returned a negative and significant coefficient, which may be taken cautiously as a form of convergence in health capital spending. As more expenditure is incurred on capital items, more resources (money) are required in the subsequent years to maintain such infrastructure and defray depreciation failure which can result in lower output from such physical items. On the other hand, the negative coefficient may be due to the lag which exists in some instances between capital item installation and utilization of such infrastructure. The period of idleness is likely to impact negatively on growth. The recurrent expenditure in the health sector, which accounts for payment of salaries and allowances among others, though positive was not significant. Salaries and allowances are expected to raise consumption and aggregate demand.

A capital accumulation coefficient value of 0.3093 implies that a percent increase in capital formation resulted in about 0.31 percent increase in GDP growth rate. The positive and significant coefficient of capital corroborates theories of economic growth, especially the neoclassical and new growth theories. The significance of capital is in line with the result of Mankiw, Romer and Weil (1992). Similar results were also reported by Abbas (2001) for Pakistan and Sri Lanka. Machinery and equipment are needed for massive production and service delivery, which improve the economy. It is worthy of note that labour force was not significant, although, positive. This actually describes the prevailing situation in Nigeria as the country's unemployment rate as at the second quarter of 2020 was 27.1 percent, while underemployment rate was as high as 28.6 percent. All these pooled together suggest that labour is not a limiting factor in the process of economic growth in the country. Meanwhile, if this labour were employed they it would contribute positively to growth. This therefore suggests under-utilization of the available labour force in the country.

The trend coefficient value of -0.25 which was significant at 1 percent risk level implies a yearly decrease of 0.25 percent in per capita income growth rate in the short run. Finally, the error correction variable (CointEq(-1)) coefficient value of -0.376 fulfilled the three conditions for the existence of long-run cointegration. These include being negative, being less than one and being significant. It implies that about 37.6 percent of the total disequilibrium in the system due to an external shock in the previous year was corrected in the present year. Therefore, it will take the system about 2.7 years to return to the long-run equilibrium path in the case of any external shock. The speed of adjustment recorded in the present study is close to those recorded by Ebong et al. (2016) and Oni (2014) in similar studies.

Table 6: Error correction model (short-run model)

Variable	Coefficient	t-Statistic	Prob.
D(Y(-1))	0.2555*	1.9118	0.0931
D(LogK)	0.3093*	1.7562	0.0913
D(logK(-1))	-0.7404	-1.3780	0.1804
D(LogLF)	0.1017	0.5484	0.5882
D(LogCAP)	0.2842***	2.4848	0.0200
D(LogCAP(-1))	-0.0391**	-2.4812	0.0371
D(LogREC)	-0.6696	0.2903	0.7740
D(LogED)	-0.0465	-1.5244	0.1879
D(@TREND())	-0.250***	-2.5915	0.00323
CointEq(-1)	-0.3763**	-2.4191	0.0318

*Significant at 10%, **Significant at 5% and ***significant at 1%

Source: Author's computation, 2019.

Long-run relationships

In the long run, capital expenditure on health – CAP (*P<0.05*), gross fixed capital formation – K (*P<0.05*) and education expenditure – ED (P<0.05) significantly affected economic growth (Table 7). The capital expenditure on health's positive and significant value means that expenditure such as building hospitals, installation of expensive diagnostic machines and so on in the health sector affected the growth of the economy positively in the long run in agreement with the endogenous growth model and by extension, the health-led growth hypothesis. Projects like this last for a longer period of time and are expected to serve the people, thereby improving their health status, contributing to the economy and the ability of the people to earn more income. It is generally acknowledged that healthy people are better positioned to contribute to the overall economic activities of a society compared with an unhealthy populace; and healthy children are better able to learn at school and grow faster.

Gross fixed capital formation (K) includes expenses and investment in machinery and related items, which aid production of goods and services, hence, its significance in the long run was in line with theory and *a priori* expectation. Most known theories of economic growth acknowledge the importance of capital in the growth process. The result corroborates that of Johansson (2015) in a study assessing the relationship between human capital and economic growth in sub-Saharan Africa. The relationship between the human capital variables and economic growth is not direct and immediate, therefore the positive and significant coefficient of education spending in the long run is expected despite being insignificant in the short run. The sustainable positive effect of human capital investment is naturally expected in the long run. For instance, the process of educating an individual and his subsequent contribution to growth through effective service delivery and innovation take some time to come to fruition.

Table 7: The long-run (static) model result

Variable	Coefficient	t-Statistic	Prob.
LogK	0.3727***	2.6182	0.0234
LogLF	0.023	0.7423	0.6410
LogCAP	0.1702**	2.0418	0.0472
LogREC	0.0826	0.3531	0.6914
LogED	0.2556**	2.1386	0.0281
C	15.6153	1.5775	0.2077
@TREND	0.5036**	2.5117	0.0493

*Significant at 10%, **Significant at 5% and ***significant at 1%

Source: Author's computation, 2019.

Post-estimation diagnosis

Relevant tests were carried out to diagnose the estimated model. The results as reported in table 8 reveal that the estimated model satisfied all the assumptions of the classical ordinary least squares (OLS) linear regression model. Therefore, the parameter estimates from the computations can be described as efficient, reliable, consistent and highly suitable for predictions and forecasting. The test result revealed that the error series of the model had constant variance, as the null hypothesis of homoscedasticity could not be rejected at 5% significance level in a Breusch-Pagan-Godfery test. The error series generated from the estimated model also satisfied the normality assumption as the Jarque-Berra test showed that the null hypothesis of the series being normally distributed could not be rejected at 5% significance level. Breusch-Godfrey LM test was adopted to determine if there was serial correlation in the model estimated. The null hypothesis was that there was no autocorrelation and this could not be rejected at 5% level of significance. The Ramsey Regression Specification Error Test (Ramsey RESET) was adopted to assess the linearity of the model with the null hypothesis that the model was linear. This is needed to determine if the model was well specified. The null hypothesis could not also be rejected at 5% level of significance, hence, the linearity of the model was confirmed.

Table 8: Post-estimation diagnosis results

Econometric Problem	Test Procedure	Statistics (Prob)	Conclusion
Linearity	Ramsey RESET	0.0307 (0.8625)	Model was linear
Heteroscedasticity	Breusch-Pagan-Godfery	1.1840 (0.3481)	No heteroscedasticity
Autocorrelation	Breusch-Godfery LM	0.0732 (0.8690)	No autocorrelation
Normality	Jaque-Berra	2.1934 (0.3340)	Residuals were normally distributed

Source: Author's computation, 2019.

Conclusion

The study assessed the effect of health expenditure on economic growth within the framework of the modified endogenous growth model. Data on per capita GDP growth rate, capital and recurrent health expenditure, education expenditure, gross fixed capital formation and labour force from 1981-2018 were obtained from the CBN statistical bulletins, the NBS database and the WDI website of the World Bank. The Augmented Dickey-Fuller (ADF) test was used to assess the stationarity or otherwise of the series. It was found that the GDP per capita growth rate series had no unit root problem. This means they were stationary at level while others only became stationary after they were differenced once, that is, they were I(1) series. Therefore, the ARDL model which is built to handle such combinations was adopted in the subsequent analyses. The ARDL bounds test suggested the presence of long-run cointegration among the study series. Estimation results revealed that lagged GDP growth rate, health capital expenditure and capital formation significantly affected economic growth in the short-run with a speed of adjustment of about 37 percent. In the long run, capital health expenditure, gross fixed capital formation, education expenditure and time trend significantly affected economic growth. The significance of health capital expenditure confirmed the relevance of the endogenous growth model and the health-led growth hypothesis. The first component of the health-led growth hypothesis, which is the "*growth hypothesis*" where the direction of causality is from health expenditures to economic growth, is the most applicable and the one confirmed by this study. The results of this study emphasized the need to spend a larger proportion of public health expenditure on capital projects in the health sector as this guarantees economic growth both in the short and long run.

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