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An Empirical Analysis of Public Health Expenditure on Life Expectancy: Evidence from Nigeria

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Authors' contributions

This study was carried out in collaboration between all authors. Author IIA conceptualized and designed the study and as well analyzed the data. He also did the interpretation of the results and wrote the first draft of manuscript. While other authors OSS and BMA managed the literature searches, did critical review and comments on the manuscript. Author IIA read and approved the final manuscript.

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ABSTRACT

This paper examines an empirical evidence of the specific impact of public health expenditure on life expectancy in Nigeria using time series data spanning between 1981 and 2014. The study made use of the recent bounds testing co-integration approach developed within the framework of the Autoregressive Distributed Lag (ARDL) procedure to determine the long-run relationship between public spending on health and life expectancy in Nigeria. Empirical findings suggest that a long run relationship between life expectancy, public health expenditure, primary school enrollment exist in Nigeria. The results showed that Primary School Enrolment (PHEXP) and Carbon-dioxide Emission (CAREM) significantly and directly influenced the rate of life expectancy in Nigeria. On the other hand, Primary School Enrolment (PSEN) was found to be insignificant in both short and long runs contrary to economic theory. It was also revealed that environmental factors such as carbon dioxide emissions which was used in this study affects individuals' health. Therefore, based

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on the findings of this study, it recommends that government should introduce programmes that will enable people to be aware of the effect of carbon-dioxide emissions on individual's health and should advise people and industries the appropriate measure to be taken and as well to separate residential and industrial areas, to avoid any hazard caused by carbon-dioxide emissions. Also, the government should increase and restructure the public expenditure allocation to the health sector.

Keywords: ARDL; life expectancy; public health expenditure; Nigeria.

1. INTRODUCTION

Health is a very important aspect of an individual's wellbeing and since individuals make a nation, therefore, healthcare could be regarded as one of the necessary conditions to achieving a sustainable long-term economic development. Health can be defined to mean general physical condition i.e. condition of the body or mind especially in terms of the presence or absence of illness, injuries or impairments [1]. The issue of health is a very sensitive one because it deals with not just humans but with human body. Without a good health condition it is almost impossible to carry out any economic activity and if at all there is any it will certainly not be efficient and so we really have to take this subject seriously [2]. It has been established in the literature that improvement in health care is an important prerequisite for enhancing Human Capital Development (HCD) in any every economy [3].

In another perspective, the issue of health is one of the most critical development facing our world today, because it permits us to fully develop our capacities and if this asset erodes or it is not developed completely, it can cause physical and emotional weakening, causing obstacles in the lives of people. The previous connection can be seen as the relationship between income and health. Life cycle models have explained how one's health status can determine future income, wealth and consumption [4]. Nowadays, it is possible to say that every person could expect to live a long and healthy life. We could say its economic value is huge and health gains had the economic consequences of widespread economic growth and an escape of ill-health traps in poverty [5]. But also, health problems could be reflected as reductions and obstacles for economic progress. [6] have studied the impact of AIDS on African economic development, stating the disease is prevalent among young workers, affecting productivity and domestic savings rates.

According to [7] they opined that improved health status of a nation creates outward shift in labour supply curve/increase productivity of labour with a resultant increase in productivity of investment in other forms of human capital. Thus, the level of government expenditure on health determines the ultimate level of human capital development which eventually leads to better, more skilful, efficient and productive investment in other sectors of the economy [8].

In a theoretical basis, [9] have developed models that include health capital as a significant variable for economic growth. Nevertheless, life expectancy is the most used variable to represent it. This variable is defined by the United Nations as the average number of life years since birth according to the expected rate of mortality by age. [10] also assets that analysts prefer to focus on a survival time indicator, such as life expectancy, because it emphasizes the duration of health status and places implicit importance on a person's well-being. However, under the classification of the European Commission of Public Health, there are four determinants of health: genetics, lifestyles, environment and socioeconomics, compared to the life expectancy which is the best variable for health capital.

[11] reveals that life expectancy does not reflect the productivity of the labor force accurately and capital formation. Thus, innovation need the labor force to be active and healthy during most of its working life. [12] asserts that death and health factors are not be related. Therefore, it is unsure whether life expectancy completely measures the impact of health on economic growth. On this note, there are several studies on life expectancy in Nigeria, but fail to account for the inability of the government of any country to channeled funds to appropriate sector of the economy such as health sector that will lead to a better health status of an individual and economic development in Nigeria. Also, most of these studies are carried out at the micro-level using single point survey rather than multiple points survey. Therefore, the ability to generate a health production function from a point survey has been questioned. Furthermore, most of these studies have neglected the extent and

magnitude of the impact of public health expenditure on life expectancy within and outside Nigeria. Hence findings from these studies have been inconclusive, contradictory and unreliable. Thus, there has been general absence of consensus on the relationship. Hence, the lack of consistent findings in the literature, and possibly specification problems in the early works, lends justification to the analysis that we pursue in this study. Therefore, the objectives of this study are to: (i) examine the relationship between public health expenditure and life expectancy in Nigeria; and (ii) assess the relationship between environmental factors and life expectancy in Nigeria. The study made use of the recent bounds testing co-integration approach developed within the framework of the Autoregressive Distributed Lag (ARDL) econometric procedure for the analysis of the data. Thus, the study sets out to test the following two hypotheses which are stated in their null forms viz; (i) H0: there is no significant relationship between public health expenditure and life expectancy in Nigeria; and (ii) H0: there is no significant relationship between environmental factors and life expectancy in Nigeria. The remaining part of the study is structured as follows: next is the literature and theoretical reviews, followed by Research methods in section 3, analysis and discussion of results are in section 4. conclusion and recommendations are in section 5.

2. REVIEW OF RELATED LITERATURE

2.1 Conceptual Clarifications

Public health expenditure consists of recurrent and capital spending from government(central and local) budgets, external borrowings and grants(including donations from international agencies and non-government organizations) and social(or compulsory) health insurance funds. While general government expenditure on health comprises the direct outlays earmarked for the enhancement of the health status of the population and/or the distribution of medical care goods and services among population by the following financing agents: central/federal/ state/provincial/regional, and local/municipal authorities; extra budgetary agencies, social security schemes and parastatals. All can be financed through domestic funds or through external resources.

Life expectancy is the most common indicator of health conditions in a country, and Nigeria's life expectancy was estimated as just 47.9 years in 2003, from 45.8 years in 1999 but fell to 47 years in 2011. This level is one of the lowest in the world, below those of Ghana put at 54.4 years and Cameroon put at 48 years in 2011. Contributing to Nigeria's low life expectancy are high rates of HIV/AIDS infection, although these are lower than the catastrophic levels found in some other African countries. The 2003 HIV/AIDS infection rate which was 5.4 percent remained almost unchanged from the previous survey year.

2.2 Theoretical Issues

2.2.1 Keynesian theory of public expenditure

Keynes (2009) advocated government intervention in the management of the macro economy (of Great Britain) in the midst of great economic depression of the Great Britain, Europe and across the world in the 1930s. The First World War (World War 1) took place from 1914 to 1918; and the second World War (World War 2) took place from 1939 to 1944. The prevailing economic theory before Keynes revolution was the classical or orthodox postulation that the market system has the ability to automatically adjust the economy to a point of equilibrium at any stage of the economy, hence there is no basis for government intervention.

Keynes, therefore advocated government intervention in driving the economy. This requires that government should make huge public spending in the areas that the private sector is deficient and also in activities that need huge capital outlay for the interest of the general public called public good. Indeed, there are several areas that the market system fails, such as inability to efficiently allocate resources to the citizenry, inability to produce the output and services that need huge capital outlay -like public goods, production of harmful goods for the consumption of the citizenry and residents in the country due to profit motive without taking cognizance of the health of the people and the nation. Keynes advocated government intervention to curb these problems. This, therefore, call for public spending to enhance good health outcomes and economic development of a country. This study examines the extent to which Nigeria's government has achieved this intervention with particular reference to its expenditure towards meeting required funding of the power sector. Keynes propositions is related to Nigeria in that they supported the reasons for government health spending on health outcomes and political activities.

Similarly, the theory of public expenditure development posits that the role of public spending evolves in the course of development since the budgetary function must adapt to the changing needs of the economy [13]. The varying needs of the economy relate to both the allocation and distribution perspectives of public expenditure. The allocation perspective deals with the rising share of the public sector in the economy. That is there exists a statistical direct relationship between the growth in public sector size, the growth and development of an economy. This is Wagner's law of the ever-increasing scale of state activity [14]. They assert that, in growing economies, the share of public expenditure in the normal income increases. In order to justify this generalization, public expenditure was divided into two categories: namely, those for security (both internal and External) and those for welfare. As the level of development increases, the share of the public sector in national income has been increasing [15]. Public health facilities in Nigeria are primarily financed by the public through tax revenue. However, the health sector is principally financed by the government [13]. According to the [16], Out of pocket expenditure as percentage of private expenditure on health for Nigeria is 95.3% compared to 66.4% in Ghana, 29.6% in South Africa and 25.1% in the united states of America. This data shows the nascent state of the health insurance scheme in Nigeria as Patients bear the full and direct brunt of their medical expenses without any significant assistance from the company or institution they work for (if not enrolled in the National Health Insurance Scheme).

2.3 Empirical Literature

An empirical studies is ample with works on the relationship between public health expenditure and health outcomes. The several endogenous growth models link public spending with the economy's long-term growth. [9] among others have examined the relationship between public spending and economic growth. Specifically, some researchers have investigated the link between sectoral public expenditure such as public health care expenditure and health outcomes.

Among such studies are [17] used data covering 72 countries from 1961 to 1995, in order to investigate the determinants of public health outcomes in a macroeconomic perspective, taking into cognisance households' choices concerning education, health related expenditure and saving. They found evidence for a dual role of education as a determinant of health outcomes. [17] on the other hand, using panel data set of 207 Indonesian districts over a 4-year period from 2001 to 2004, concluded that district-level public health spending is largely driven by central government transfers. Most of the studies on Nigeria examined the impact of health expenditure or health status on economic growth.

[18] in their own work found that public spending and health outcome are tenuously related. According to them doubling public spending from 3 to 6 percent of GDP would improve child mortality by only 9 to 13 percent. Surveying the literature on the link between public expenditure and outcome Pritchett (1996), notes that all of the negative or ambivalent findings on the effect of public spending on outcomes could potentially be a reflection of differences in the efficacy of spending which could arise due to a variety of reasons including corruption and patronage. Besides, it is also noted that the link between public spending and outcomes could be broken is the displacement of private sector effort by public spending. This argument is eloquently made in [18] while commenting on the weak links that several studies have found between public spending on health and health status. Although in most of the studies where public spending is found to have low or negligible impact, it is argued that public provision could lead to a "crowding out" of private sector provision, they have failed to question the efficacy of public spending.

In a study conducted by Day, Pearce, and Dorling, life expectancy was compared to a range of health system indicators within and between clusters of countries,12 clusters of countries were identified with average life expectancy of each cluster ranging from 81.5 years (cluster 1) to 37.7 years (cluster 12). Unsurprisingly, the three highest ranked clusters were dominated by Western European countries, US, UK, Canada, Australia and Japan, while the four lowest ranked clusters were constructed by different combinations of African countries. On a per capita income basis, worldwide health spending was concentrated within the three highest life expectancy clusters; in other words, health spending was concentrated in the developed world. Health system indicators for workforce, hospital beds, access to medicines and vaccinations clearly corresponded with life expectancy of each cluster. The study concluded that there are considerable inequalities in life expectancy and healthcare, which was evident when comparing clusters grouped by their health outcomes.

The relationship between expenditure and healthcare quality can be tested for in several ways. In another study, the relationship between avoidable mortality and healthcare spending in 14 western countries was examined. Using changes in national health expenditures as an input measure, or independent variable, they measured the changes in avoidable mortality, which they defined as a situation in which “timely and effective health care could prevent mortality even after the condition had developed.” What the study found is that there is a negative relationship between healthcare spending and avoidable mortality, even after factors such as unemployment, education, and time varying determinants were controlled for In general, countries with an above average increase in health spending experienced an above average decline in avoidable mortality. However the study also noted that although there is certainly a negative relationship between the two factors, there are some limits regarding how to interpret the findings. For example, increased spending may have created other welfare gains that were not accounted for in the study. This may have had an additional effect on mortality, and thus, the precise efficiency of the healthcare system is not given by the study. In short, even after accounting for confounding factors, the study concluded there is a negative relationship between health care spending and avoidable mortality. There is little room to extrapolate further based on these findings alone, however, the study does indicate several other areas that could be researched further [19]. Overall, the findings in the literature suggest that there will not be a positive relationship between healthcare expenditure and life expectancy. Although this literature exists, our paper is unique in that it examines 181 developed and developing nations and examines, though not exclusively, the relationship between just health expenditure life expectancy. We seek to further literature on the effectiveness of government spending on healthcare to see if it is the most efficient way of improving healthcare.

[20] revealed in their work that, the poor bear a disproportionately higher burden of illness, injury and disease than the rich. The poor suffer ill-health due to a variety of causes, poor nutrition for instance, which reduces the ability to work and weaken their resistance to disease. Illness reduces the income earning ability of the poor and further increases dependency. [21] examining theoretically the interaction between growth inequality and poverty also showed that both growth and changes in inequality contributes to changes in poverty. Hence, healthy people are strong enough to work, earn good income and afford better nutrition. When poor people get sick, they are often unable to afford treatment from clinics or hospital. Even when they can afford such treatment, they tend to sell off productive assets, or rely on borrowing. These tend to decrease their long-run earning capacity and the capacity to take advantage of any trickle-down labour market advantage usually offered by growing economies. Many factors combine together to affect the health of individuals and communities. Whether people are healthy or not, is determined by their circumstances and environment. To a large extent, factors such as where we live, the state of our environment, genetics, the income level, education level, and the relationships with friends and family all have considerable impacts on health, whereas the more commonly considered factors such as access and use of health care services often have less of an impact [22]. The determinants of health according to the World Health Organization [5] include: the social and economic environment, the physical environment, and the person’s individual characteristics and behaviors.

[23], also examined the determinants of health expenditure in Italian regions, applying the model selection procedure and panel methodologies to identify the determinants of health expenditure at the state level. Empirical results suggest that the real Gross State Product, the unemployment rate, the number of beds in community hospitals, the urbanization degree, and the percentage of the population with at least the junior high school degree had a direct impact on the real health care outlay. The results further suggest that income elasticity is below the unity (0.83-0.88 according to the static panel estimates, 0.43-0.48 for the dynamic methods), implying that health expenditure is a necessity rather than a luxury good at the state level.

[23] investigates the nexus between health care households' expenditure and GSP for Italian regions during 1980-2009, using time series and panel econometric techniques. Empirical results showed the presence of a long-run relationship in fifteen regions. As regards, the causality analysis, health-led growth hypothesis is supported in three regions, while the reverse causation appears in five cases. The neutrality hypothesis seems to be confirmed in ten regions. The results indicates that a bi-directional causality flow (feedback hypothesis) has been found for two regions. Panel analysis also shows that, if our sample is divided into three more homogeneous macro-regions (North, Centre and South), a long-run relationship between health expenditure and aggregate income has been found in two areas. Furthermore, the income elasticity is below the unity, implying that health expenditure is not a luxury good.

2.4 Gaps Identified in the Reviewed Empirical Literature

Most of the empirical studies conducted especially in developed and developing countries including Nigeria, on public health expenditure and health outcomes failed to appropriately account for the impact of public health expenditure on life time earnings of an individual using life expectancy health indicator, and the effect caused by manufacturing industries emissions on individual health status. In addition, bound testing ARDL procedure has not been adopted to investigate the theme in Nigeria. Hence, this study will bridge the gap in the empirical literature by investigating the specific impact of public health expenditure on life expectancy in Nigeria.

3. METHODOLOGY

3.1 Theoretical Framework

The theoretical base of this study is adopted from [15] which was later reviewed by [15]; and [24] who developed a theoretical health production function given as:

$$H = f(X) \quad \text{(i)}$$

Where: H is a measure of individual health output and X is a vector of individual inputs to the health production function. Therefore, the elements of the vector includes: nutrient intake, income, consumption of public goods, education, time devoted to health related procedures, initial individual endowments like genetic makeup, and community endowments such as the environment. Grossman's theoretical health production function model was designed for analysis of health production at micro level. The interest here is however, to analyze the production system at macro level. To switch from micro to macro analysis, without losing the theoretical ground. The elements of the vector X were represented by explanatory variables and regrouped into sub-sectoral vectors of economic, social and environmental factors as:

$$H = f(Y, S, V) \quad \text{(ii)}$$

Where: Y is a vector of economic variables, S is a vector of social variables and V is a vector of environmental factors as presented in the next sub section model specification.

3.2 Model Specification

Premised on theoretical exposition and following the extant literature in the work of [15]; and [24] health production function model was adopted. Their work which had earlier been reviewed in the empirical studies examined the impact of public health expenditure on life expectancy and made use of basic form of the relationship between the variables drawn from theoretical framework as:

$$LFEXP = f(PHEXP, PSEN, DER, POPGR,) \quad \text{(iii)}$$

Where: (LFEXP) = Life expectancy at birth; (PHEXP)= Public Health Expenditure (PSEN) =Primary school enrolment; (DER)= Death rate and; (POPGR)= Population growth rate. This study however, modified their work by employing two (2) additional independent variables: Life expectancy at birth; Public Health Expenditure; Per Capita Income and Carbon-dioxide emission. Thus, the new model is of the general form:

$$LFEXP = f(PHEXP, CAREM, PCIN) \quad \text{(iv)}$$

Equation (iv) functional form above may be rewritten more specifically as:

$$LFEXP_t = \alpha_0 + \alpha_1 PHEXP_t + \alpha_2 CAREM_t + PCIN_t + \omega_t \quad \text{(v)}$$

Where:

α_0 = Constant intercept
$LFEXP_t$ = Life Expectancy at birth
$PHEXP_t$ = Public Health Expenditure
$PCIN_t$ = Per Capita Income
$CAREM_t$ = Carbon-dioxide Emission
ω_t = Stochastic Error term
α_1; α_2 and α_3 = are parameters to be estimated

Equation (v) cannot be estimated directly using the Ordinary Least Squares (OLS) technique of estimation since it is non-linear. Therefore, it would be necessary to transform it into linear form that allows the use of the OLS technique. In doing this, the double log-transformation rule is applied on the equation. The essence of this is that it provides estimated parameters that can be interpreted directly as elasticities, that is, the sensitivity of a change in the life expectancy following a change in the variables included in the model. Thus, taking the natural logarithm of both sides of equation (iv) and still assuming linearity among the variables gives:

$$InLFEXP_t = \alpha_0 + \alpha_1 InPHEXP_t + \alpha_2 InCAREM_t + \alpha_3 PCIN_t + \omega_t \quad \text{(vi)}$$

Base on equation (vi) the parameter must satisfy the following sign restrictions:

$\alpha_0 \neq 0$; $\alpha_1 > 0$; $\alpha_2 > 0$; $\alpha_3 > 0$

3.3 Sources of Data

The study relies on secondary data which involves variables consisting of the annually data of the Nigerian economy for the period between 1981 and 2014. The data are sourced from [25] various issue and [26] various issues for life expectancy at birth, Income per Capita(INPC) and Carbon-dioxide Emission (CAREM) data.

3.4 Estimation Techniques and ARDL Modelling Approach

The study employed an Autoregressive Distributed Lag (ARDL) bounds test co-integration procedure developed by [27] examine the impact of public health expenditure on health outcome. The choice of this modeling approach is based on the following considerations. First, unlike most of the multivariate co-integration procedures like [28], which are valid for large samples, the bounds test procedure is robust and suitable for small sample study [27]. Given that our sample size is limited with a total of 34 observations only, this approach would be appropriate. Secondly, the bounds test does not impose a restrictive assumption that all the variables under consideration/study must be integrated of the same order. Also, it is unnecessary that the order of integration of the underlying regressors be ascertained prior to testing the existence of a level relationship between the variables [27]. However, to ensure that the variables are not integrated of higher orders like I(2), it may be useful to test for unit root. Thirdly, it estimates the short and long-run components of the model simultaneously, removing problems of omitted variables and autocorrelation. Furthermore, the bounds test procedure is possible even when the explanatory variables are endogenous [27] the Autoregressive Distributed Lag (ARDL) representation of equation(v) above may be expressed as follows:

$$\Delta InLFEXP_t = \alpha_0 + \sum_{i=1}^{h} \alpha_1 InLFEXP_{t-1} + \sum_{i=0}^{h} \alpha_2 InPHEXP_{t-1} + \sum_{i=0}^{h} \alpha_3 InLPCIN_{t-1} + \sum_{i=1}^{h} \alpha_4 InLCAREM_{t-1} + \delta_1 LFEXP_{t-1} + \delta_2 PHEXP_{t-1} + \delta_3 PCIN_{t-1} + \delta_4 CAREM_{t-1} + \omega_t \quad \text{(vii)}$$

Where, the variables and notational representation are as earlier defined the symbol Δ represents the first difference operator, α_0 is the intercept, ω_t is the white noise error term and parameters: α_i: i= 1, 2, 3, 4 are the short run dynamic coefficients, while the parameters δ_i : i= 1, 2, 3, 4 are the long run multipliers of the underlying ARDL model.

The first step in the ARDL bounds test approach is to estimate equation (iv) by OLS in order to test for the existence of a long-run relationship among the variables by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables being investigated. The F-test is actually a test of the null hypothesis that there is no co-integration (long-run) relationship between life expectancy(a proxy for health outcomes) and its determinants as expressed in our model, i.e H_o: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$. This hypothesis is against the alternative, H_1: $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq 0$ i.e there is a long run relationship between life expectancy and its determinants.

The existence of a long run relationship is confirmed once the null hypothesis is successfully rejected. To do this, two sets of critical values as provided by [29] are used. One set assumes that all variables are I(0) and the other assumes that they are all I(1). If the computed F-statistic is less than the lower bound critical value, then we do not reject the null hypothesis of no co-integration relationship. Conversely, if the computed F-statistic is greater than the upper bounds critical value, then we reject the null hypothesis and conclude that there exists a co-integration relationship between the variables under study. However, if the computed F-statistic falls within the lower and upper bounds critical values, then the result is inconclusive. The approximate critical values for the F-test are obtained from [29]

Once the co-integration relationship is established, the next step is to estimate the conditional ARDL long-run model for LFEXP. This involves selecting the order of the ARDL model using Akaike Information Criterion (AIC). The final step is to obtain the short-run dynamic parameters by estimating an error correction model associated with the long-run estimates. This is specified as follows:

$$\Delta InLFEXP_t = \alpha_0 + \sum_{i=1}^{h} \alpha_1 InLFEXP_{t-1} + \sum_{i=0}^{h} \alpha_2 InPHEXP_{t-1} + \sum_{i=0}^{h} \alpha_3 InLPCIN_{t-1} + \sum_{i=1}^{h} \alpha_4 InLCAREM_{t-1} + \delta_1 LFEXP_{t-1} + \delta_2 PHEXP_{t-1} + \delta_3 PCIN_{t-1} + \delta_4 CAREM_{t-1} + \theta ECM + \omega_t \quad \text{(viii)}$$

Where: ϴ is the speed of adjustment parameter, ECM is the error correction term that is derived from the estimated equilibrium relationship of equation(vii) and the variables and notational representation are as earlier defined. Hence, the study used the stability test proposed by (Brown et al, 2008) known as cumulative sum of recursive residual (CUSUM) and cumulative sum of square recursive residual (CUSUMsq). If the plots of CUSUM and CUSUMsq statistics lie within the critical bound of 5% level of significance, the null hypothesis that all the coefficients in the model are stable cannot be rejected.

4. DISCUSSION OF RESULTS

Based on the fact that bounds test is based on the probability that the variables are either integrated of order zero or one , the investigation of the unit roots properties using the ARDL techniques still becomes paramount to ensure none of the variables is integrated of order two. Therefore, the time series properties of the variables used in the model were investigated to confirm their order of integration to avoid spurious regression, using Augmented Dickey Fuller(ADF) test. The result showed that all the variables in the model were both integrated at level for PHEXP and PCIN while, LFEXP and CAREM became stationary at first differences respectively as shown in Table 1.

The results of ADF unit root test implies that the condition for cointegration using Johannsen method was met by the series. The major objective of this study is to analyse both the long and short runs dynamics relationship between the dependent and explanatory variables of interest using ARDL procedure and as well a maximum lag of two was considered appropriate based on the majority of the criteria including AIC and HQ as evidenced from table of the appendix. However, a co-integration test was carried out using the bound test developed by [27], the result are next presented in Tables 2 and 3.

In view of the above analysis, the ARDL bound test result shows that a long-run relationship exist among the series employed in the study. This is based on the value of computed Wald (F-statistic) as shown in Table 3, which is higher than the upper bound of the critical values of Pesaran as well as Narayan and Narayan at the 5% level of significance. The results of the test for optimum lag for the model is presented in Table 4.

Table 1. Result of stationarity test on variables using ADF

Variables	@level ADF	1st Diff. ADF	C.V 5%	C.V 1%	Order of integrt.	Remark
LFEXP	-2.954021	-5.299852	-2.957110	-3.653730	1(1)	Stationary
PHEXP	7.557597	-	-2.954021	-3.646342	1(0)	Stationary
PCIN	-7.087371	-	-2.954021	-3.646342	1(0)	Stationary
CAREM	-2.215892	-6.183138	-2.957110	-3.653730	1(1)	Stationary

Source: Author's computation from ADF output on E-views 7.1 2015

Table 2. Bounds test results for co-integration

Computed Wald Test (F-statistic): 14.45**
K = 4

Critical value		Lower bound value I(0)	Upper bound value I(1)
Pesaran	1%	4.35	5.89
	5%	3.12	4.78
	10%	2.86	4.06
Narayan	1%	4.76	6.67
	5%	3.35	4.77
	10%	2.75	3.99

Sources: (i) Pesaran et al. (2001), Table CI (iii), Case 111: Unrestricted intercept and no trend. K is the number of regressors in the ARDL model. Narayan and Narayan (2005), Case III,
; ** and * denotes significance at 1%, 5% and 10% respectively.*
(ii) Authors' Computations using E-views 7.1

Table 3. Wald bound test

Test statistic	Value	Df	Probabilty
F-statistic	14.45366	(4,8)	0.0010
Chi-square	57.81465	4	0.0000

Null Hypothesis: C(1)=0, C(2)=0, C(3)=0, C(4)=0
Null Hypothesis Summary:

Normalized restriction (= 0)	Value	Std. err.
C(1)	2.049342	0.425892
C(2)	-0.045282	0.008926
C(3)	2.34E-06	3.44E-07
C(4)	1.40E-06	3.31E-06

Source: Author's regression output

Table 4. Lag order selection criteria

Endogenous variables: LFEXP PHEXP CAREM PCIN
Exogenous variables: C
Date: 03/09/16 Time: 00:39
Sample: 1981 2014:
Included obs: 29

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1462.701	NA	1.00e+39	101.1518	101.3404	101.2108
1	-1346.013	193.1381	9.77e+35	94.20781	95.15077*	94.50313
2	-1320.450	35.25973*	5.42e+35*	93.54827*	95.24560	94.07985*

** indicates lag order selected by the criterion*
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion
Source: Author's regression output

As evidenced in Table 4, it can be seen that Akaike information criteria (AIC), Hannan-Quinn (HQ) and others selected optimum lag of two (2). Consequently, for this study, the highest lag employed in the ARDL procedure is 2. Thus, we can proceed to obtaining long run coefficients. The long run coefficients are presented in Table 5.

4.1 Long Run Estimates

A careful look at the long run result in Table 5 shows that the coefficients of PHEXP, PCIN, CAREM and there lagged values all have their expected sign and significant as suggested by economic theories, expect lag-two value of CAREM that carries statistical indirect relationship. PHEXP proxy for human capital indicates a positive and significant relationship with life expectancy. While lag value of PHEXP reveals a positive impact and statistically significant on the level of life expectancy-health outcomes in line with our a priori expectation. This indicates that a 1% increase in the level of public health expenditure in the country will result in 1.02E-09% increase in the level of life expectancy. The carbon-dioxide emission used to proxy environmental factors has a negative and statistically insignificant relationship on life expectancy for its lag one value contrary to theoretical expectation, while lag two value shows a positive and significant relationship on the life expectancy as indicated by the values of t-ratio and probability credence to our a-priori expectation. Therefore, a unit increase in the carbon-dioxide emission lag one value, will reduce life expectancy by only 0.286034 while lag two value of CAREM assumes positive impact and significant at 10% significance level on life expectancy due to the fact that residential and industrial areas has been separated to avert incessant hazard caused by carbon-dioxide emissions on life time earnings of an individual. This indicates that a unit increase in the CAREM will increase the life expectancy by 0.226805. The income and its lagged value of an individual indicates a positive and statistically significant relationship with life expectancy in Nigeria. Also, a 1% increase in the PCIN of an individual will give rise life expectancy (health outcomes) by 3.21E-10%. This shows that people will have enough funds to take care themselves, if there is a measure put in place by the government to increase the income of an individual as evident by [17].

Meanwhile, the R-squared of approximately 0.59 indicates 59% of the variation in life expectancy was explained by the variables in the model. This result shows that the model has a good fit.

The overall goodness of the model as shown by the adjusted coefficient of determination (R^{-2}) is 0.46662, which shows that about 47 percent of the variation experienced in life expectancy by Nigerian for the period being investigated is explained by the independent variables.

The Durbin-Watson statistic value shows that the model is free of serial autocorrelation model as its value fall within the acceptance region. The F-statistic shows that the null hypothesis of insignificance of the joint explanatory variables is rejected at the highest level of significance.

In order to see the short run dynamics, the estimates of the error correction model is presented in Table 6.

4.2 Short Run Estimates

The short-term dynamics of the model has been examined by estimating an error correction model (ECM) in equation (viii). Therefore, in the short-run the deviations from the long-run equilibrium can occur because of the shocks in any of the variables in the model.

Table 5. Long run coefficients from ARDL estimation-dependent variable: LFEXP

Variable	Coefficient	Std. error	t-Statistic	Prob.
C	-0.439302	0.265614	-1.653906	0.0000
D(PHEXP)	1.78E-09	6.89E-10	-2.580117	0.0075
PCIN	3.21E-10	7.91E-11	-4.060353	0.0006
D(PHEXP(-1))	1.02E-09	5.59E-10	-1.824082	0.0024
D(PCIN(-1))	1.34E-10	6.46E-11	2.077414	0.0002
D(CAREM(-1))	-0.286034	0.118390	-2.416031	0.0049
D(CAREM(-2))	0.226805	0.125617	1.805523	0.0054
R-squared	0.585149	Mean dependent var		0.428571
Adjusted R-squared	0.466620	S.D. dependent var		1.168366
S.E. of regression	0.853292	Akaike info criterion		2.732887
Sum squared resid	15.29024	Schwarz criterion		3.065938
Log likelihood	-31.26042	Hannan-Quinn criter.		2.834704
F-statistic	4.936755	Durbin-Watson stat		2.444178
Prob(F-statistic)	0.002705			

Source: Author's regression output

Table 6 shows that the estimated lagged error correction term (ECM-1) is negative and statistically significant at 1% level. This result indicates the existence of co-integration among the variables: public health expenditure, income, carbon-dioxide emission and life expectancy. Therefore, the long-run equilibrium is achievable. The absolute value of the coefficient of error term (0.5681) implies that about 57% of the disequilibrium in the level of life expectancy is adjusted towards equilibrium annually. For instance, if the rate of health exceeds its long run relationship with the other variables in the model, while the life expectancy will adjust downwards at a rate of 57% per year in Nigeria.

Empirical evidence shows that carbon-dioxide emission lag two value is inversely related but statistically significant to life expectancy in Nigeria for the period 1981-2014. This result is in consistent with Neo-Classical theory as well as previous empirical studies (Filmer & Pritchett, 2009). This provides an indication that if adequate measures are put in place against CAREM, this will increase the level of life expectancy in Nigeria. While only public health expenditure, per capita income and their lagged values had the expected sign (positive) and statistically significant at 1% level each. This indicates that PHEXP, PCIN and their lagged values influencing life expectancy in Nigeria to the tune of 139%, 310%, 120% and 146% respectively.

The coefficient of determination R^2 indicates that 75 per cent of the total variation in life expectancy is jointly explained by public health expenditure, income, carbon-dioxide emission in Nigeria.

4.3 Post Estimation Analyses

The robustness of the model has been definite by several diagnostic tests such as serial correlation test, heteroskedasticity test, Ramsey RESET specification test, and Jacque-Bera normality test. All the tests indicates that the model has a satisfactory econometric propreties, with a correct functional form and as well the model's residuals are serially uncorrelated, normally distributed and homoskedastic. Hence, the results reported are valid for reliable interpretation and policy making. The results of the residual analysis can be confirmed as shown in Table 7 and Fig. 1/Table 8 in the appendix.

The Jarque-Bera test result of normality is contained in Fig. 1/Table 8. The result revealed that, the residuals of the data are normally distributed. The null hypothesis of normality of the residuals of the data is accepted at 16.57 per cent confidence level as indicated by the probability value of 0.165724 and Jarque-Bera value of 3.594859 which is greater than zero.

Table 6. Error correction representation for ARDL model- dependent variable: D(LFEXP)

Variable	Coefficient	Std. error	t-statistic	Prob.
C	0.558317	0.193237	-2.889279	0.0000
D(PHEXP)	1.39E-09	5.32E-10	-2.608657	0.0000
PCIN	3.10E-10	6.04E-11	-5.136962	0.0000
D(PHEXP(-1))	1.20E-09	4.32E-10	-2.784093	0.0008
D(PCIN(-1))	1.46E-10	4.93E-11	2.955786	0.0073
D(CAREM(-1))	-0.354056	0.090150	-3.927407	0.0007
ECM(-1)	-0.568195	0.129244	-4.396310	0.0002
R-squared	0.745771	Mean dependent var	0.413793	
Adjusted R-squared	0.676436	S.D. dependent var	1.150070	
S.E. of regression	0.654190	Akaike info criterion	2.195668	
Sum squared resid	9.415222	Schwarz criterion	2.525705	
Log likelihood	-24.83718	Hannan-Quinncriter.	2.299031	
F-statistic	10.75605	Durbin-Watson stat	2.181308	
Prob(F-statistic)	0.000013			

Source: Author's regression output

4.4 Stability Tests-plot of CUSUM and CUSUMSQ

The model stability test is necessary for prediction and econometric inference. We test for the stability of estimated parameters by using the cumulative sum of recursive residual (CUSUM) and the cumulative sum of square recursive residual (CUSUMsq) tests. Neither CUSUM nor CUSUMsq tests provided any evidence of instability in the estimated at 5% significance level for conventional specification. Therefore, both the tests are within the 5% critical bound, this implies that all the coefficients in the short run model are stable and robust for prediction.

The graphical presentation of these tests are presented in Figs. 2 and 3 as shown in appendix.

4.5 The Profile (Trend) of Financial Commitments of Government

4.5.1 Expenditure to the health sector in Nigeria

The financial commitments of government to the health sector are both the recurrent and capital expenditure on health. The capital expenditure of government decrease from ₦7.3million in 1970 to ₦4.88 million in 1972 before it rose again to ₦126.75 in 1994. It dropped sharply to ₦79.2 million in 1982. From 1982 to 1987, capital expenditure on health declined from ₦72.9m in 1982 to an all time low of ₦17.2m in 1987. This development is occasioned by the fact government was more preoccupied in the business of paying workers salaries with less attention being paid to capital expenditure. In 1988 there was a significant rise to ₦297.96m. By 1991, the statistic dropped to ₦137.3m but plummeted to ₦33.72m in 1992. The figure rose steadily from ₦586.2 million in 1993 to ₦17,717.42m, ₦33,396.97m and ₦34,647.9m in 2003, 2005 and 2007 respectively the capital expenditure on health stood at ₦64,922.9m in 2008 and ₦79,321.09m in 2011.

The recurrent expenditure on health also follows a similar trend. It rose gradually from ₦12.48m in 1970 to ₦59.47m in 1977 but fell to ₦40.48m in the successive year. The pattern of health expenditure at this period is a reflection of both the product of the disposition of government policy towards health issue and the determination of the Federal Government to improve the health care system with the wind fall of oil revenue. Recurrent expenditure nosedived into ₦15.32m in 1979 before it rose to ₦52.79m, ₦84.46m ₦82.79 million in 1979, 1987 and 1983 respectively. From 1984 to 1986, recurrent expenditure rose from ₦101.55m to ₦134.12m when the recurrent expenditure as a percentage of total expenditure stood at 77.4 percent. The value of recurrent health expenditure reduced significantly in 1987 to ₦41.31m before it rose steadily from ₦422.80 in 1988 to ₦24,522.27m in 2001. This figure rose again from ₦40,621.42 in 2002 to ₦44,55 1.63, ₦58,686.56 and ₦72,290.07 in 2005, 2006 and 2007 respectively. Recurrent expenditure on health stood at ₦18,200.0 million in 2008 and ₦21,542.9m in 2011.

4.6 Trend Analysis

Figures below represent an illustrated analysis of the series in the model in a bid to properly capture some of the objectives of the study. The trend analysis revealed that Figs. 4 and 5 shows a downward trends in Life Expectancy (LFEXP) and Public Health Expenditure (PHEXP) between 1985 and 2010. However, an upward trend occurs after 2000 while, Figs. 6 and 7 show no trend in Per Capita Income (PCIN) and

Table 7. Diagnostic test of the ARDL model

S/N	TEST	F-statistic	P-value
i	Serial Correlation Test: B-G Serial Correlation LM Test	2.542636	0.0973
ii	Heteroskedasticity Test: ARCH LM Test	5.184642	0.0554
iii	Heteroskedasticity Test: Harvey	4.689948	0.0086
iv	Ramesy RESET Test:	11.50722	0.0612

Source: Author's regression output

Carbon-dioxide Emission (CAREM) during the period under consideration (1981-2014) as diagrammatically depicted below:

5. CONCLUSION AND POLICY RECOMMENDATIONS

The contribution of the life expectancy (health outcomes) to economic progress of any economy has been well-established in the development literature. The study examined empirically the impact of public health spending on health outcomes in Nigeria using time series data spanning between 1981 and 2014. This study made use of the recent bounds testing co-integration approach developed within the framework of the Autoregressive Distributed Lag (ARDL)econometric procedure to determine the long-run relationship between public spending on health and its outcomes in Nigeria. Using the ADF unit root test, the stationarity of the variables were confirmed, followed by the selection of optimal lag and then test for existence of co-integration. Empirical findings suggest that a long run relationship between health outcome (life expectancy), and public health expenditure, carbon-dioxide emissions at lagged two exit in Nigeria. The results showed that PHEXP and CAREM at lagged two significantly and positively influenced the rate of life expectancy in Nigeria. This was as a result of proper channel of funds to health sector in the country. Thus, reflect the efficiency of health outcomes proxied by life expectancy in the study. On the other hand, CAREM at lagged one appeared to be insignificant in both short and long runs contrary to economic theory.

Furthermore, the result of the estimated lagged error correction term (ECM-1) is negative and statistically significant at 1% level. This indicates the existence of co-integration among the variables: public health expenditure, income, carbon-dioxide emission and life expectancy. Therefore, the long-run equilibrium is achievable. The absolute value of the coefficient of error term (0.5681) implies that about 57% of the disequilibrium in the level of life expectancy is adjusted towards equilibrium annually.

In addition, empirical evidence also showed that carbon-dioxide emission at lag two is inversely related but statistically significant to life expectancy in Nigeria within the study period. This result is conformity with Neo-Classical theory as well as previous empirical studies of [17]. This also indicates that if adequate measures are put in place against CAREM, this will increase the level of life expectancy in Nigeria.

Different diagnostic tests were carried out on the short and long run models, the result shows both models passed all the tests. Confirming the stability of the model, CUSUM and CUSUMQ provided evidence in support of the stability of the model.

Flowing naturally from this, are the policy recommendations which include:

(i) Government of Nigeria (FGN) should increase and restructure the public expenditure allocation to health sector in order to provide more health facilities and also, adequate management of funds and development of health services should be greatly pursued.
(ii) Lastly, government should introduce programmes that will give awareness concerning the effect of carbon dioxide emissions on individual's health and should also advise people and industries the appropriate measure to be taken to separate residential and industrial areas, to avoid any hazard effect from carbon dioxide emissions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDICES

Appendix-1

Dependent Variable: LFEXP
Method: Least Squares
Date: 02/12/17 Time: 23:26
Sample: 1981 2014
Included observations: 33

Variable	Coefficient	Std. error	t-statistic	Prob.
PHEXP	5.14E-10	1.06E-10	4.838498	0.0000
CAREM	0.204378	0.066444	3.075957	0.0045
PCIN	-2.12E-10	8.45E-11	-2.507769	0.0180
C	42.17150	0.970792	43.44028	0.0000
R-squared	0.949410	Mean dependent var		48.57576
Adjusted R-squared	0.944177	S.D. dependent var		4.205876
S.E. of regression	0.993719	Akaike info criterion		2.938488
Sum squared resid	28.63685	Schwarz criterion		3.119883
Log likelihood	-44.48505	Hannan-Quinn criter.		2.999522
F-statistic	181.4130	Durbin-Watson stat		1.289155
Prob(F-statistic)	0.000000			

Appendix-2

Unrestricted cointegration rank test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical value	Prob.**
None *	0.860688	86.25021	47.85613	0.0000
At most 1	0.413557	29.09003	29.79707	0.0602
At most 2	0.366347	13.61330	15.49471	0.0942
At most 3	0.013083	0.381921	3.841466	0.5366

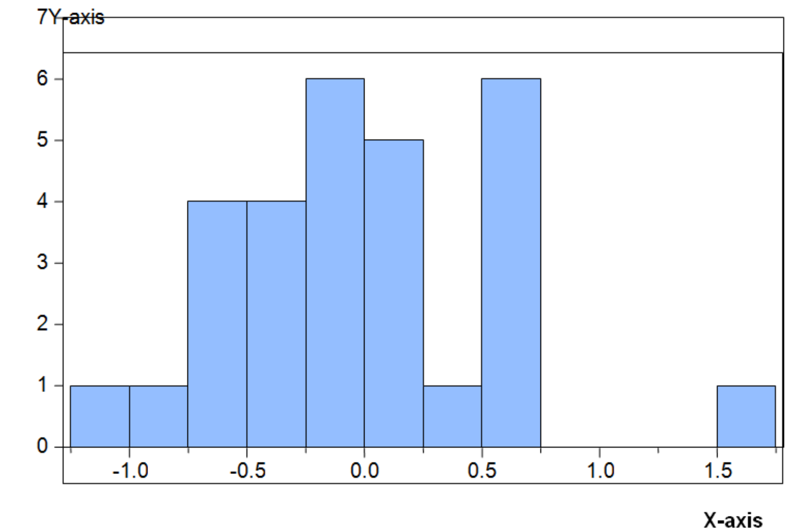
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level*
***MacKinnon-Haug-Michelis (1999) p-values*

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical value	Prob.**
None *	0.860688	57.16018	27.58434	0.0000
At most 1	0.413557	15.47673	21.13162	0.2569
At most 2	0.366347	13.23138	14.26460	0.0723
At most 3	0.013083	0.381921	3.841466	0.5366

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level*
***MacKinnon-Haug-Michelis (1999) p-values*

Normality



Series: Residuals	
Sample 1983 2014	
Observations 29	
Mean	-2.26e-16
Median	-0.040639
Maximum	1.729436
Minimum	-1.042100
Std. Dev.	0.579878
Skewness	0.719643
Kurtosis	3.950532
Jarque-Bera	3.594859
Probability	0.165724

Fig. 1/Table 8. Normality test
Source: Author's regression output

Appendix-3

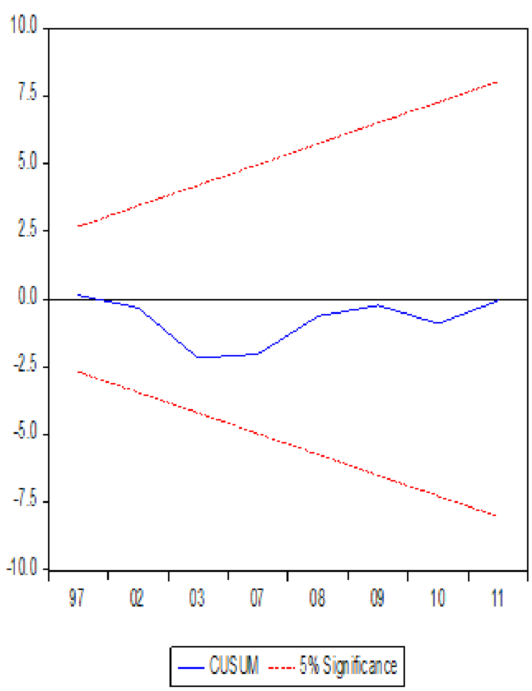


Fig. 2. CUSUM residual

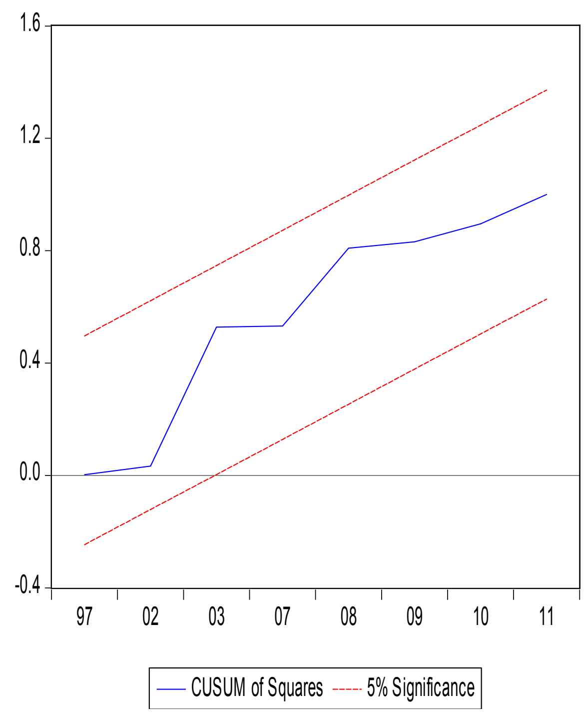


Fig. 3. CUSUMsq residual

Appendix-4

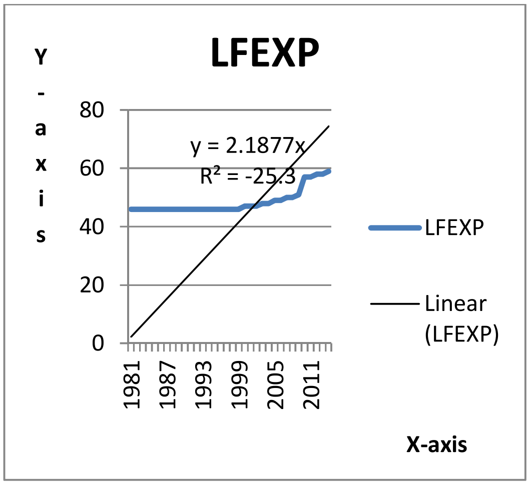


Fig. 4. Life expectancy

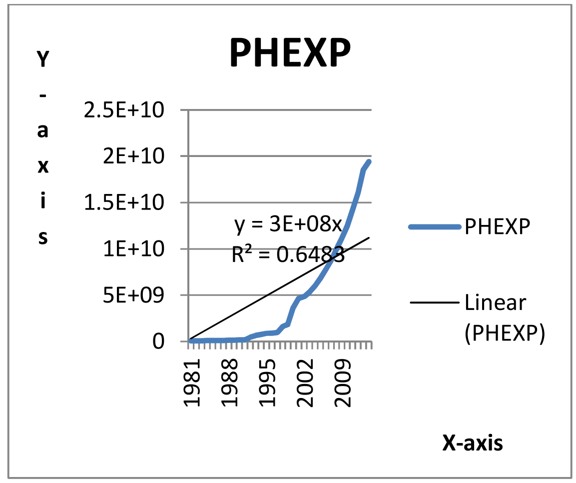


Fig. 5. Public health expenditure

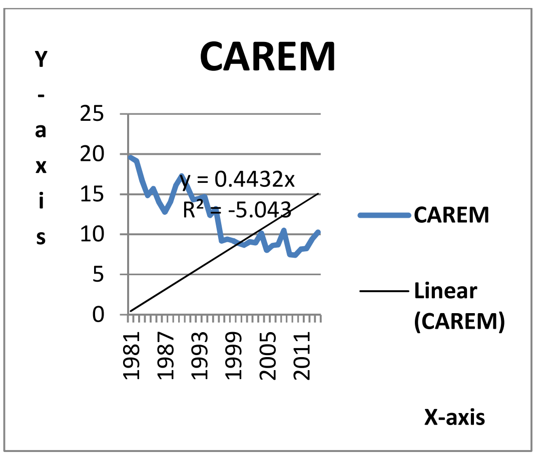


Fig. 6. Carbon-dioxide emission

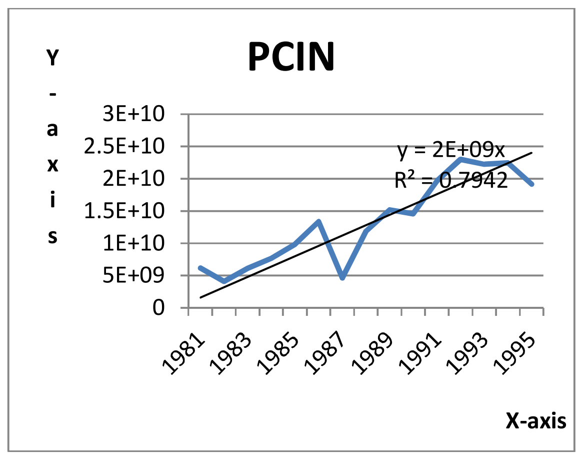


Fig. 7. Per capita income

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