Public Health Expenditure and Health System Performance in Nigeria: Econometric Investigation of Life Expectancy in Relation to Per Capital Income

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Abstract
This study offers an empirical assessment of the relationships between public health expenditure, life expectancy and per capital income in Nigeria. The data used in this empirical study secondary annual data spanning from the period of 1981 to 2020 and they are obtained from the World Bank Development Indicator. The data were analyzed using correlational statistics to determine if there is a significant statistical linear association between health system performance and public health expenditure. The Augmented Dickey Fuller unit root test was used to check for maximum order of integration of the variables used in this investigative study while the Autoregressive Distributed Lag (ARDL) Bounds test approach to cointegration was used to investigate if a long-run relationship exists among the macroeconomic variables From the examination it is clear that health system performance is positively and statistically significant with life expectancy. Therefore, for life expectancy to improve in Nigeria, it becomes vital for government authorities to boost her public health expenditure. Furthermore, it has been established in this research that there is also linear linkage between public health expenditure and per capita income in Nigeria indicating that if government can increase her public health expenditure in Nigeria, this will consistently enhance her per capita income.

Keywords: *Health system performance, life expectancy, per capita income and public health expenditure.*
JEL Classification: I12, C22, P44, H51

1.0 INTRODUCTION

According to United Nation report of 2020, between 2000 and 2020, public health expenditure increased astronomically in a sixty countries that experienced fast economic growth. On average, health financing per capita grew by 250 per cent and increased by 0ne per cent points as a share of gross domestic product. Across developing countries, the average health financing was only 50 United State Dollars per individual in 2020, vis-a-vis US$ 3,000 in high income countries. High income countries recorded about 78.99% of worldwide expenditure, but the low income countries accounted for twenty percent to twenty five of global health funding between 2000 and 2020.

In Nigeria, unfortunately, the funding of public health division has been very low and the sector is experiencing a number of fundamental problems, which contribute to the below average level of performance of the sector. Poor management of funds and human resources, limited coverage and inadequate number of workers are some of the important challenges. Nwaobi (2004) observed that the health system in Nigeria has remained under developed and the quality of life of the average citizen is critically below the international poverty level. This according to him is due attributable to the country's health system has not experienced the necessary operational changes that would guarantee maintainable growth and acceptable minimum standard of living.

Nigerian government should make intensive determinations towards boosting the health expenditure to achieve the WHO's recommendation that all countries should earmark at least thirteen per cent of their yearly budget to the health system for effective funding as this would bring anticipated health system deliverables. Nonetheless, despite increase in government health expenditure, much significant influence is yet to be felt in health system deliverables such as low life expectancy in Nigeria.

The failing health system as a result of inadequate health expenditure in emerging third world countries is a source of concern and the pervasiveness of extensive health problems, such as low life expectancy and mortality rate, are consequential to scarce health resources and infrastructure. Thus, the study shall attempt to answer the following questions: What is the influence of public health expenditure on life expectancy in Nigeria? What is the linear relationship between per capita income and life expectancy in Nigeria?

Therefore, the broad objective of this research is to examine the relationship between public health expenditure and health system performance in Nigeria (1981-2020). The specific objectives of this study are to examine the relationship between public health expenditure and life expectancy and to determine the relationship between per capita income and life expectancy in Nigeria. The hypotheses to verify are that, *H_{O1}: there is no significant relationship between public health expenditure and life expectancy in Nigeria and H_{O2}: there no significant correlation between per capital income and life expectancy in Nigeria with particular reference to the period of study.*

Justification of the Study

This quantitative research will guide government in area of fiscal allocations with a view to achieving significant influence of health care financing on the health sector key performance indicators. It will further help the stakeholders in knowing the magnitude of impact of healthcare financing on life expectancy in health sector and guide health sector policy formulation. Therefore, it becomes important to conduct a study to examine whether the resources allocated to healthcare have any contribution to improvement of life expectancy in the country. The concentration of this research is to determine linear association among public health expenditure, life expectancy and per capita income in Nigeria. In order to

copiously examine the relationships, the general overview of Nigeria's health profile from 1981-2020 (40 years) were discussed.

2.0 LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 Conceptual Review

2.1.1 Public Health Expenditure, Life Expectancy and Per Capita Income

Public health expenditure encompasses recurrent and capital expenditure from the government budget, donations from NGOs and global aid organizations and health insurance funds. Baldacci (2004) investigates the effect of health expenditures and discovered that public health expenditure within a period of time affects economic growth, life expectancy and labour productivity within that same period of time. He also focused on the labour productivity effects, where health funding will lead to an increase in per capita income. The major finding is that health has a positive and significant effect on economic development.

Gross domestic product per capita indicates the income level or indicator for a country's standard of living of a country. A country's capacity to spend on healthcare is influenced by its income level measured by Gross domestic product per capita. Prior empirical studies postulate that income is the major influencing factor of public health expenditure. The volume of government public health expenditure is relatively determined by its income level. Consequently, as the country's income level increases, fiscal allocation of the health system increases as well, life expectancy.

2.2 Theoretical review

2.2.1 Development Theory by Musgrave and Rostow

Musgrave and Rostow postulated that public expenditure growth is related to the trend of economic growth and development. The proponents suggested three phases as follows: The early development stage where huge public spending is required on infrastructure, education and health.

The rapid growth in which there are large increases in private saving and public investment falls proportionately. The increasing need in high income societies for skilled labour leads education to become increasingly an investment good for society as a whole. Increased population movements lead to huge demand in public expenditure. Such factors and others lead once again to an increase in public health expenditure in relation to gross domestic product.

2.2.2 Demand for Health Theory

Wagstaff (1986) demand for health theory considers public health spending as a response variable of the various inputs in the health sector production function. In that regard, health care is acknowledged as input in the production of the commodity that is low mortality rates in addition to higher lifespan, hence public health expenditure is included in the health production function. Filmer and Pritchett (1999) opined the economic growth oriented theory that examines the linear linkage between health input and health outcome.

Consequently, the government makes available health facilities and human resources to improve their health sector deliverables. Rajkurmar and Swaroop (2008) suggested the causal association among public spending, health sector performance and other health system.

The theoretical base of this study is adapted from Grossman (1972) who advanced a theoretical health production function, which is identified mathematically as follow:

$$IHO = f(VII) \quad (1)$$

Where individual health output is represented by IHO and VII is a vector of individual inputs to the health production function *f*. Grossman's theoretical health production function model was designed for analysis of health production at micro level.

2.3 Empirical Review

Deluna and Peralta (2014) empirically investigated the linear inter-relationships among public health expenditures, income and health outcomes in the Philippines. The outcomes depicted that infant mortality rate is inversely related to public health expenditure, per capita and GDP per capita. Also, the quantitative assessment of the relationship among health spending, health outcomes and per capita income in Canada, Day and Tousignant (2005) used the vector autoregression (VAR) model and the generalized impulse response function econometric technique and discovered weak statistically significant relationship between per capita health spending, health outcomes, and per capita GDP. Also in a cross-sectional data covering 117 countries for the year 1993, Zakir and Wunnava (1997) found that government expenditure on healthcare system is not strongly correlated to life expectancy.

Wagstaff (1986) found out that, according to the World Bank's Country Policy and Institutional Assessment (CPIA) index, good health policies and facilities are fundamental to effective and efficient health outcomes. Wagstaff pointed out that when the standards of facilities along with sound strategies progresses (as the CPIA index improve), the influence of public health expenditure and health system performance indicators are statistically significant correlated.

Jaba, Balana and Robu (2014) assessed the linear connection between the inputs and the outputs of health care systems and discovered that there is a significant statistical connection between health expenditures and life expectancy among different nations.

In their empirical study of the inter-relationships among life expectancy, public health spending and economic growth in Nigeria, Ogungbenle, Olawumi and Obasuyi (2013) found that there is no bi-directional causality between life expectancy and public health spending in Nigeria neither is a bi-directional causality between life expectancy and economic growth in Nigeria over the years. However, the study established that there is bi-directional causality between public health spending and economic growth in Nigeria.

3.0 DATA AND METHODS

The model uses Life expectancy (LEX) from the period of 1981 to 2020 as proxy for health system performance in Nigeria, which is the dependent variable. The LEX is measured by the life expectancy average age. A public health expenditure (PHE) explains the total amount allocated for health-related issues in the annual budget; amount is always allocated to the health sector. The Per capita income measures the average income earned per person in a given country, in a specified year. It is thus calculated by the country's total income by her total population. Changes in per capita income reflect economic growth and help provide an insight into the general well-being of citizens in a country.

The data to be used in this study should be a secondary annual data spanning from the period of 1981 to 2020 and they are sourced from the World Bank Development Indicator. The model of Maduka, Madichie and Ekesiobi (2016), the relationship between health expenditure, health outcomes and economic growth are adapted and are represented mathematically as follows:

$$LEXP = f(HEXP, RGDP) \quad \text{.....(2)}$$

The econometric representations of the above mathematical equations are as follow:

$$LEXP = \alpha_0 + \alpha_1 HEXP + \alpha_2 RGDP + \boldsymbol{\varepsilon}_1 \quad \text{.....(3)}$$

Where LEXP is life expectancy, HEXP is Health Expenditure and RGDP is Real Gross Domestic Product

To empirically find the linear association between public health expenditure and health system performance in Nigeria, health system performance is represented by life expectancy

(LEX) and other determinants of health system performance in this study, which include; public health expenditure (PHE) and per capita income (PCI). Hence, the equation (2) re-written as:

LEX=f(PHE,PCI).....……(4)

LEX = Life expectancy
PHE = Public health expenditure
PCI =Per capita income
Ui = Error Term

A PRIORI – EXPECTATION

In accordance with economic theory, an increase in public health expenditure is expected to produce a positive change and increase in health outcome (life expectancy); as well as an increase in per capita income to boost general health outcome in Nigeria. Hence, from the model, the a-priori expectation may be mathematically denoted as:

$\frac{dPHE}{dLEX} > 0$:connote that Public Health Expenditur(PHE) is expected to exert positive relationship with Life Expectancy (LEX).

$\frac{dPCI}{dLEX} > 0$: connote that Per Capita Income (PCI) is expected to exert positive relationship with Life Expectancy (LEX).

Data Analysis and Discussion of Findings

Descriptive statistics

The Jarque-Bera (JB) test statistic was used to determine whether the variables (control variables) follow the normal probability distribution. The descriptive statistics for the variables under consideration are therefore presented as follows:

The descriptive statistics

	LEX	PHE	PCI
Mean	47.96072	63.63128	1.820566
Median	46.12700	15.22000	2.025823
Maximum	53.95000	296.4400	22.18228
Minimum	45.33300	0.040000	-15.45037
Std. Dev.	2.734603	89.87203	7.687579
Skewness	0.921118	1.274920	0.382525
Kurtosis	2.306573	3.195522	4.086910
Jarque-Bera	6.296342	10.62736	2.870846
Probability	0.042931	0.004924	0.238015
Sum	1870.468	2481.620	71.00209
Sum Sq. Dev.	284.1660	306925.3	2245.757
Observations	40	40	40

Source: Author's computation from the Eviews result

From the result table, the descriptive statistics indicates that all the variables have a positive mean values with 40 observations. The standard deviation showed that the highest standard deviation is recorded by the PHE while the least standard deviation is recorded by LEX. The skewness statistics from the table revealed that four of the variables are positively skewed, while two variables are negatively skewed. The kurtosis coefficients showed that three of the variables are leptokurtic, suggesting that the distributions are high relative to normal distribution, two variables are mesokurtic, indicating not too flat topped, while one variable is platikurtic, suggesting a flat topped The probabilities of Jarque-Bera test of normality for the

variables indicates that the variables have values greater than 5% level of significance. This implies that the variables are normally distributed.

4.2 Correlation

Under the correlation test, we conduct the test to ascertain the degree of relationship that exists between the dependent variable and the independent variables. The relationships among the studied variables depicted in the model were tested using correlation matrix and the result presented below:

Correlation matrix

	LEX	PHE	PCI
LEX	1.000000	0.944772	0.094748
PHE	0.944772	1.000000	0.104309
PCI	0.094748	0.104309	1.000000

Source: Author's computation from the Eviews result

The correlation result shows that the variables have positive values. This result suggests the variables under consideration are positively related to the life expectancy in Nigeria.

4.3 Unit root /stationary test

Economic variables are generally non-stationary and they are a random process. Linear combination of non-stationary series in general is a non-stationary series and closely associated with economic theory. Because economic theory guarantees stagnation of combination of economic variables, in this study Dickey Fuller's generalized Test for assessment of stationary variables is used. In order to assess the time series properties of the data, unit root tests were conducted. As Engle and Granger (1987) argued, if individual time series data are non-stationary, their linear combinations could be stationary if the variables were integrated of the same order. The results of the Augmented Dickey Fuller (ADF) test obtained are as follow:

The Unit root test

Variable	Level difference	Probability	Order of integration	First difference	probability	Order of integration
LEX	-2.720950	0.0801		-3.502816	0.0133	**I(1)**
PHE	2.410115	0.9999		-7.102369	0.0000	**I(1)**
PCI	-3.556866	0.0115	**I(0)**			

Source: Author's computation from the Eviews result

From the table above the result shows that two of the variables are stationary at level, while the other variable is integrated of order one at 5% level of significance in ADF test procedure. Thus there is a need to conduct a bound test procedure since there is a mixed order of stationarity

4.4 Bound auto regressive distributed lag (ARDL) testing approach

Conducting the ARDL bounds test procedure, it is expected that the variables are I(0) or I(1), otherwise, the variable may be considered spurious. In the conduct of the ARDL test, we adopt the Augmented DickyFuller (ADF) test to determine the difference levels of the

variables under consideration. We therefore compute an F-statistics test procedure to test the long-run relationship in which the maximum lag length p is 2 in the Error Correction Mechanism (ECM). The results for the bounds for the F-test are therefore presented as follows:

The ARDL Bound test result for Life expectancy equation

ARDL Bounds Test		
Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	5.028471	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Source: Author's computation from the Eviews result

The Bound test result from the tables above indicates that the underling ARDL model can be established to determine the long-run slope-estimated coefficients and the short-run dynamic-estimated coefficients for the equation. The ARDL (1, 4) is selected based on Akaike information criterion (AIC).

The short run error correction coefficients

There is long-run equilibrium relationship among the variables in the regression model; however, it is the short-run that transmit to the long-run. Thus, Error Correction Mechanism (ECM) is therefore used to correct or eliminate the discrepancy that occurs in the short-run. The assumption of the ECM states that if two variables are cointegrated, then, there is error correction mechanism to revise instability in short term (Engle and Granger, 1987). ECM is used to see the speed of adjustments of the variables to deviations from their common stochastic trend. ECM rectified the deviations from the long run equilibrium by short-run adjustments. This shows us that changes in independent variables are a function of changes in explanatory variables and the lagged error term in cointegrated regression. The ECM result is therefore presented below:

The short run error correction model

ARDL Cointegrating And Long Run Form				
Dependent Variable: LOG(LEX)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(LEX(-1))	50.504621	12.402450	4.072149	0.0096
DLOG(PHE)	-0.004143	0.001602	-2.585217	0.0491
DLOG(PHE(-2))	0.007566	0.001843	4.106076	0.0093
DLOG(PHE(-3))	0.004881	0.001595	3.059807	0.0281
D(PCI, 2)	-0.000203	0.000130	-1.565868	0.1782
D(PCI(-1), 2)	-0.000715	0.000243	-2.946558	0.0320
D(PCI(-2), 2)	-0.001139	0.000185	-6.142110	0.0017
D(PCI(-3), 2)	-0.000357	0.000102	-3.487217	0.0175
ECM(-1)	-0.673539	0.476427	-3.512689	0.0171

R-squared	0.991478	Mean dependent var	0.003166
Adjusted R-squared	0.943757	S.D. dependent var	0.010398
S.E. of regression	0.002466	Akaike info criterion	-9.383503
Sum squared resid	3.04E-05	Schwarz criterion	-8.081607
Log likelihood	188.5195	Hannan-Quinn criter.	-8.939519
F-statistic	20.77628	Durbin-Watson stat	2.136076
Prob(F-statistic)	0.001553		

Source: Author's computation from the Eviews result

The equilibrium error-correction coefficient ECM (-1) is -0.595503. The coefficients have the expected negative signs and are statistically significant at 5% significant levels. The implication is that there is a long run impact running from independent variables to dependent variable. It also confirms that all the variables are cointegrated or have long run association. We can therefore state that 67 percent gaps between long run equilibrium values and the actual values of the dependent variable has been corrected. It can be also said that the speed of adjustment towards long run equilibrium is 67 percent annually. Its t-ratios are-3.512689 and the probability of the null hypothesis being true for zero is [0.0171], which is significant even when $\alpha = 0.05$. Thus, it can also be concluded that the adjustments is quite meaningful in the short-run ARDL relationship.

Statistically, the coefficient of determination R-squared is 0.991478 while the adjusted R-squared 0.943757. This implies that the independent variables explain the dependent variable to the tune 94%. The t-statistic of the variables under consideration show that lag values of six variables, exhibited values that is greater than positive two and less than the negative two. This shows that the variables under consideration are statistically significant. The F-statistic shows that the overall estimate of the regression has a good fit and is statistically significant. Also the Durbin Watson (DW) statistics DW = 2.136076, which is greater than the R^2 shows that the overall regression is statistically significance. Thus the result indicates no serial auto correlation among the variables under consideration.

The long run relationships equation

Long Run Coefficients results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(PHE)	-0.012609	0.004739	-2.660857	0.0448
PCI	0.001412	0.000380	3.720535	0.0137
C	6.440191	1.186237	5.429092	0.0029

Source: Author's computation from the Eviews result

From the results table above, the intercept is 6.440191. This indicates that if the independent variables are held constant, the value of the health outcome will be 6.440191. The long-run elasticity of the independent variables contributing to the health outcome growth shows that the coefficient of LOG (PHE) indicates a negative sign and is significant statistically. Thus a unit increase in the public expenditure health will decrease the life expectancy by -0.012609. The results conforms to the findings of Rajkumar and Swaroop (2008) while examining the effect of government expenditure on health status for 91 developing and developed nations show that in countries with weak governance, public health spending may have impact on life expectancy.

On the other hand, the coefficients of PCI and LOG(LEX) showed positive signs and are statistically significant respectively. The positive coefficient of the Per Capita Income conforms to the findings of Jaba, Balana and Robu (2014) that the mean for income levels represented by (GDP per capita) had a positive significant effect on life expectancy.

4.5 Diagnostic test

To ensure the goodness of fit of the model, diagnostic test are conducted. Diagnostic tests examine the model for serial correlation, functional form, non-normality and heteroscedasticity.

4.6 Serial correlation tests

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.026977	Prob. F(2,4)	0.4366
Obs*R-squared	11.87462	Prob. Chi-Square(2)	0.0026

Conclusion and Recommendation

Conclusion

The research study examined the linear inter-dependency among public health expenditure, per capital income and life expectancy in Nigeria. The study concluded that there exists significant relationship between the public health expenditure, per capital income and life expectancy in Nigeria during the period of study (1981 and 2020) in conformity with a priori expectations. It suggests that the public health expenditure in Nigeria has been able to achieve a desired result (increase in Life expectancy) and that the governmental health policies and spending on facilities in the heath sector have not been in vain. This result is also consistent with finding by Ogungbenle, Olawumi and Obasuyi (2013). This result in line with a priori expectation and research outcomes of Maduka, Madichie and Ekesiobi (2006), Jaba, Balana and Robu (2014). The result further support the findings of Ogungbenle, Olawumi and Obasuyi (2013), who found a bidirectional causal connection running from per capital income to life expectancy and vice versa.

Recommendations

Based on findings of the study, the following are therefore recommended with a view to enhancing public health expenditure in Nigeria:

More efforts should be gear towards effective and efficient health financing policies via mutual partnership among relevant health authorities at local and international level.

Ensure equitable and even distribution and allocation of health spending reduce impoverishment from health expenditure at local and rural level.

Augment fiscal in line with sustainable development goals while ensuring fiscal sustainability on achievement of key performance indicators in the health sector in accordance with international dictates.

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