THE IMPACT OF PUBLIC HEALTH EXPENDITURE ON HEALTH INDICATORS IN NIGERIA

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ABSTRACT
This study investigates the relationship between public health expenditure and health indicators in Nigeria. The study utilized the Error Correction Mechanism (ECM) framework to capture the plausible short-run effects of public health expenditure on health indicators (proxy by life expectancy and under-5 mortality rate) in Nigeria from 1985 to 2019. The results revealed a long-run relationship between health indicators, health expenditure, gross domestic product (GDP) per capita, carbon dioxide emission, literacy level, and urban population. The results also indicate that GDP per capita and literacy level positively affect health indicators while urban population and carbon dioxide emissions impacted negatively on health indicators. Furthermore, the results revealed that the various speeds to adjustment are significant and low. The study concludes that expenditure on healthcare is vital for improving the quality of life in Nigeria and recommends that the government should increase health expenditure, control over-crowding in urban centers, reduce inequality, and promote the use of green energy.

Keywords: Public health expenditure, health indicators, Co-integration, error correction mechanism, Nigeria
JEL Classification: H51, I12, C32

1. INTRODUCTION

Life expectancy has vital implications for individuals and aggregate human behavior. It has crucial effects on fertility behavior, economic growth, human capital investment, intergeneration transfers, and incentives for pension benefits (Colie, 2017; Ji, 2018). Life expectancy is key to Less Developed Countries (LDC) that are earnestly striving to achieve socio-economic progress through investing significantly in social sectors like health, education, sanitation, environmental management and sustainability, and social safety nets. In Nigeria, variations in morbidity and mortality have been linked with a wide variety of measures of socioeconomic status like per capita GDP, fertility rate, adult illiteracy rate, health care expenditure, access to portable drinking water, urban inhabitants, unemployment rate, and the nominal exchange rate. Although, Nigeria is said to be highly non-egalitarian in income distribution (Sede, 2015). However, studies have shown that countries with more even income distribution tend to have low mortality rates (Wilkinson 1992; LeGrand 1993).

Nigeria's overall health performance was ranked 187th among the 191 member countries by the World Health Organization (WHO) in 2000. In 2001, the Head of States of African Countries gathered in Abuja and agreed to budget 15% annually to the health sector. According to Eguzozie (2017), Nigeria has hardly achieved a maximum of 5.95%; other African Nations like Rwanda, Botswana, Niger, Malawi, Zambia, and Burkina Faso have all spent 15% and above on the health sector. In October 2019 the National Bureau

of Statistics reported that about 40% of the Nigerian population are living below the poverty line; this implies that 40% of Nigerians cannot afford to expend $1.9 daily. With the concentration of health centers in urban areas, access to health services is quite difficult for citizens located in rural areas (Titus, 2015).

The Sustainable Development Goals were formed in 2015 after the elapse of the Millennium Development Goal (MDG). The third aim of the Sustainable Development Goal (SDG) seeks to promote good health and the wellbeing of all before 2030. This goal roots for a substantial decrease in maternal, neonatal, under-five mortality and advocates for a significant increase in public health financing (WHO, 2016). However, the non-prioritization of the health sector is evident in the government budgetary allocation. In 2019, total government spending on health was ₦456 billion (US$1.09 billion) or 0.6 percent of gross domestic product (GDP). While Nigeria's debased macro-fiscal condition partially accounts for the low degree of spending, during the economic boom, the investments in health have been consistently low over the past twenty years as compared to nations of similar status (World Bank, 2017).

The link between healthcare expenditure and health indicators cannot be over-underscored. Studies assessing the determinant of health indicators recognized the level of public spending, secondary school enrolment, per capita income, government expenditure, unemployment, breastfeeding, birth spacing, birth weight, antenatal care, early marriage, immunization, intake of syrup by children, literacy level and private spending on healthcare as the main determinants of life expectancy and under-5 child mortality (Tulisidhar 1989; Sede 2015; Banerjee 2018).
Based on data collected from the central bank of Nigeria (CBN) and the world development indicators (WDI), total health expenditure was ₦186 million in 1985 while life expectancy and under-5 mortality rate stood at 46.1 years and 206.9% respectively. In 1999, public health expenditure doubled from ₦11,863.8 to ₦24,026.8, which drove an increase in life expectancy by 0.4% while under-5 mortality dropped by 2.5%. In 2010, public health expenditure declined from ₦142,700 in the previous year to ₦134, 100 which brought about a 0.93% increase in life expectancy and a 2% decrease in under-5 mortality rate. In 2017, public health expenditure rose to ₦299,000 and further increased to ₦456040 in 2019. Life expectancy increased to 0.64% and the under-5 mortality rate declined to 2.3% in the same period.

Theoretically, an increase in spending on healthcare should improve the health status of members of society and hence a better quality of life. Therefore, it is against this background that this study sets out to ascertain the impact of public health expenditure on health indicators in Nigeria. Following the introduction, the rest of the paper is organized as follows: Section 2 presents a review of the related literature. Section 3 presents the theoretical framework and methodology. Section 4 discusses empirical results, while section 5 concludes with policy implications.

2. LITERATURE REVIEW

2.1 Theoretical Review

Wagner's (1917) public expenditure theory states that as an economy grows, so does the countries public expenditure while the concentration theory expands on Wagner's theory by noting that though the economy desires an expansion of social goods, they do not wish for an increase in taxes and therefore the government increase taxes (thereby increasing the government's revenue) in times of dire need to restore the economy back to its natural state. The Keynesian (1936) theory on the other hand, advocates for government interventions as opposed to the classical thinking, the public goods theory (1954) posits the need for the provision of social goods by the government, Grossman (1972) & Mosley-Chen (1984) attempt to link biological and socio-economic phenomena; providing a health production function.

2.2 Empirical Review

The empirical literature is divided into three; those with positive, negative and neutral findings. For instance, Olarinde, *et al.* (2013) examined the impact of government health expenditure and the quality of

institutions on health sector performance in Nigeria from 1970 to 2011 using the vector error correction model and found that public health expenditure exhibits a negative significant relationship with infant mortality and under-five mortality respectively in the short-run while in the long-run government expenditure is negatively signed, therefore an increase in government expenditure leads to better health outcomes. Similarly, Edeme & Emecheta (2014) examined the impact of public health expenditure on health outcome in Nigeria from 1981 to 2014. Using the OLS regression, their findings showed that an increase in public health expenditure leads to a decrease in infant mortality and an increase in life expectancy. In addition, urban population and HIV prevalence rate significantly affects health outcomes, while per capita income exhibits no effect on health outcomes in Nigeria. The findings suggest that public health expenditure remains a necessary component in improving health outcomes in Nigeria.

In the same vain, Maduka, *et al*. (2016) investigated the effect of health care expenditure on infant mortality and life expectancy for the period 1970 to 2013. Using the Johansen co-integration approach, they found that government health expenditure causes growth indirectly via infant mortality rate and life expectancy and that an increase in health expenditure leads to better health outcomes. This is also corroborated by Babalola, Ilori & Olalere (2017). They examined the relationship between public health expenditure and life expectancy in Nigeria from 1981 to 2014 using the ARDL model, found that there is a co-integration between public health expenditure, income, carbon emission and life expectancy; public health expenditure has a positive significant influence on life expectancy while carbon emissions affect health outcomes inversely. The study by Ajisafe & Ewubare (2018) analyzed the impact of government expenditure on health on health sector development in Nigeria from 1980 to 2017. Using OLS regression and ECM, their results showed that allocations to the health sector are effective in improving health outcomes in Nigeria. Per capita gross domestic product has a positive influence on health status in the long-run. In addition, Eboh, *et al.* (2018) assessed the impact of public health expenditure on health outcomes in Nigeria from 1994 to 2017. The result showed that budget allocations to health had a significant negative effect on infant mortality, though this was not to the desired extent. With health recurrent expenditure (HRE) having more impact on infant mortality than the health capital expenditure (HCE).

Also for Nigeria, Nwani, *et al.* (2018) assessed the relationship between public health expenditure and health outcomes from 1981 to 2017 using Autoregressive distributed lag method. The study found that public health expenditure is positively related to life expectancy in the short and long-run. Measuring health outcomes with infant mortality rate in Nigeria, David (2018) also found that an increase in government health expenditure poses little impact compared to private health expenditure. Elsewhere in Africa, Murunga, Mogeni & Kimolo (2019) examined the impact of government health expenditure on health outcomes for Kenya, covering the period 1984 to 2015. Using the Error Correction Model, their findings revealed that health expenditure influences health outcomes on average.

Contrarily, using the Ordinary Least Squared estimation technique, Oluwatoyin, *et al.* (2014) examined the impact of public health spending on health outcomes in Nigeria from 1980-2011; their findings revealed that government health spending impacted negatively on health outcomes proxy by life expectancy. Likewise, Adewumi, *et al*. (2018) analyzed the impact of government health expenditure on health outcomes in Nigeria from 1981-2017 and their

findings shows that government health expenditure impacts positively on neonatal mortality, child mortality and infant mortality rate in Nigeria, thereby leading to worse outcomes. Besides, studies like Rajkumar & Swaroop (2007), Yaqub, *et al.* (2010), Dickson, Eneji & Onabe (2013), and Ugwunta & Abada (2016) found that public health expenditure had a rather neutral and in some cases an insignificant impact on health indicators.

3. METHODOLOGY

3.1 Theoretical Framework

Grossman (1972) form the theoretical foundation of this study, Grossman's health production function can be specified as:

$H_t = f\ (Z_t)$ (1)

Where H is a measure of individual health output and a function of Z, which is also a function of Nutrient intake, income, consumption of public goods, education, time devoted to health, personal and community endowments.

Grossman's model was designed for the analysis of health production at the micro level. The interest here is to analyze the production system at the macro level, converting this from micro to macro analysis without losing the theoretical grounds; the subsets of Z are condensed into:

$H_t = f\ (HEXP_t, \Theta_t)$ (2)

Where H represents health indicators and is captured by life expectancy and under-5 mortality, HEXP is aggregate health expenditure and Θ represents controlling variables.

$LEXP_t = f\ (HEXP_t, GDP_t, CO_{2t}, LIT_t, URP_t)$ (3)

$U5_t = f\ (HEXP_t, GDP_t, CO_{2t}, LIT_t, URP_t)$ (4)

Where LEXP is the life expectancy, U5 is UNDER-5 mortality rate and μ represent the controlling variables (GDP per capita, carbon dioxide emission, literacy rate and urban population). The control variables used are adopted from Sede (2015) & Ilori, *et al.* (2017) whose studies showed that literacy rate, carbon-dioxide emission, urban population and GDP per capita significantly influences health indicators in Nigeria.

3.2 Model Estimation

3.2.1 Model Specification

Based on the functional forms presented in equation (3-4), the error correction model takes the form:

$$\Delta LNLEXP_t = \alpha_0 + \sum_{i=1}^{J} a_{1i}\,\Delta LNLEXP_{t-2} + \sum_{i=1}^{J} a_{2i}\,\Delta LNHEXP_{t-2} + \sum_{i=1}^{J} a_{3i}\,\Delta LNGDP_{t-2} + \sum_{i=1}^{J} a_{4i}\,\Delta LNCO_{2t-2} + \sum_{i=1}^{J} a_{5i}\,\Delta LNLIT_{t-2} + \sum_{i=1}^{J} a_{6i}\,\Delta LNURP_{t-2} + a_7\,ect_{t-1} + \varepsilon_{t1} \quad (5)$$

$$\Delta LNU5_t = \beta_0 + \sum_{i=1}^{J} \beta_{1i}\,\Delta LNU5_{t-2} + \sum_{i=1}^{J} \beta_{2i}\,\Delta LNHEXP_{t-2} + \sum_{i=1}^{J} \beta_{3i}\,\Delta LNGDP_{t-2} + \sum_{i=1}^{J} \beta_{4i}\,\Delta LNCO_{2t-2} + \sum_{i=1}^{J} \beta_{5i}\,\Delta LNLIT_{t-2} + \sum_{i=1}^{J} \beta_{6i}\,\Delta LNURP_{t-2} + \beta_7\,ect_{t-1} + \varepsilon_{t2} \quad (6)$$

Where:

$_t$ is the time period

f is function of
The controlling variables are;
GDP is GDP per capita
C_0 is carbon dioxide emission
LIT is literacy rate (primary school enrolment)
URP is urban population
α_0, β_0, ϑ_0, η_0, κ_0, τ_0 and p_0 are the intercepts
$\alpha_{1...}\alpha_6$, $\beta_{1...}\beta_6$, $\vartheta_{1...}\vartheta_6$, $\eta_{1...}\eta_6$, $\kappa_{1...}\kappa_6$ and $\tau_{1...}\tau_6$ are coefficients of the variables
ε_t is the white noise or stochastic disturbance term.

ECT is the error correction terms, which are the residuals of the long run regression at lagged one period. The coefficients of the error correction term (α_7, β_7, ϑ_7, η_7, κ_7 and τ_7) determine the speed of adjustment towards the long run equilibrium.

$-1 < \alpha_7 < 0$, $-1 < \beta_7 < 0$, $-1 < \vartheta_7 < 0$, $-1 < \eta_7 < 0$, $-1 < \kappa_7 < 0$, $-1 < \tau_7 < 0$

3.3 Sources of Data

Table 3.3.1: Description and Sources of Data

S/N	Variable	Description	Source
1.	LEXP	Life expectancy	World development indicators
2.	U5	Under-5 child mortality rate (per 1,000 live births)	World Development Indicators
3.	HEXP	Public health expenditure	Central Bank of Nigeria
4.	GDP	Gross domestic product (per capita)	World development indicators
5.	C02	Carbon dioxide emission (metric tons per capita)	World development indicators
6.	LIT	Primary school enrolment rate	World development indicators
7.	URP	Urban population (% of total population)	World development indicators

4. RESULTS AND DISCUSSION OF FINDINGS

4.1 Unit Root Test

Table 4.1.1: Unit Root Test Result

Augmented Dickey Fuller					
Variable		Test statistic	Critical value	Probability	Remark
LEXP	Intercept	-3.86	-3.71*	0.0070	I(1)
U5	Intercept	-2.69	-2.62***	0.0867	I(1)
HEXP	Trend and Intercept	-4.14	-3.57**	0.0145	I(1)
GDP	Trend and Intercept	-3.90	-3.55**	0.0233	I(1)
CO_2	None	-8.94	-2.63*	0.0000	I(1)
LIT	Trend and Intercept	-4.77	-4.26*	0.0028	I(1)
URP	Trend and Intercept	-3.84	-3.61**	0.0316	I(1)

Source: Author's Computation

The macroeconomic variables are tested for stationarity so as to obtain robust and non-spurious results. The main statistical tool for examining time series properties is the unit root test, it tests the null hypothesis of the presence of unit root as against the alternative hypothesis of the absence of unit root ($H_0=0$, $H_1\neq0$). The condition is that the null hypothesis will fail to be accepted and the alternative hypothesis will fail to be rejected should the computed t-statistic be greater than the test critical value in absolute terms or the

probability value be less than 0.1 or 0.05 or 0.01 at 01%, 5% and 1% level of significance respectively

This study employs the Augmented Dickey-Fuller (ADF) unit root test method to check the order of integration of the macroeconomic variables of the study and the results are presented in Table 4.1.1. The results show that all variables are stationary at first difference (I(1)). This result shows that the macroeconomic variables employed in this study are integrated of order one.

4.2 Co-Integration Results

Table 4.2.1: Lag Length Information Criterion

Equation	Criteria/Lag length	0	1	2
7	AIC	-14.8232	-29.3202	-33.05295*
	SIC	-14.5511	-27.4155	-29.51575*
	FPE	1.47E-14	7.74E-21	2.33e-22*
	HQ	-14.7316	-28.6793	-31.86279*
	LR	NA	433.6497	118.2918*
8	AIC	-11.7913	-27.5249	-29.92150*
	SIC	-11.6997	-26.884	-28.73134*
	FPE	3.05E-13	4.66E-20	5.34e-21*
	HQ	-11.6997	-26.884	-28.73134*
	LR	NA	465.7999	91.56936*

Source: Author's Computation

The Johansen co-integration method is adopted in testing if a long run equilibrium relationship exists between the variables. In adopting this method, we first determine the optimal lag length of the Vector Autoregressive (VAR) model using various criteria, and the test results of the lag length selection criteria are presented in Table 4.5.1. It is seen from the table 4.6.1 that for equations 5 and 6, the optimal lag length as 2 was suggested by all the five different information criteria considered; Akaike information criterion (AIC), Schwarz information criterion (SIC), Hannan-Quinn information criterion (HQ), Final Prediction Error (FPE) and sequential modified LR test statistic (LR).

Table 4.2.2: Test Results for Co-Integration between Pair Variables

Trace statistics						**Max-Eigen statistics**				
	H_0	H_1	Trace statistic	Critical value	No. of co-integration	H_0	H_1	Max-eigen statistic	Critical value	No. of co-integration
Equation 7	$R=0^*$	R=0	219.19	107.34	5	$R=0^*$	R=0	67.94	43.41	5
	$R\leq1^*$	R=1	151.24	79.34		$R\leq1^*$	R=1	55.06	37.16	
	$R\leq2^*$	R=2	96.177	55.24		$R\leq2^*$	R=3	37.72	30.81	
	$R\leq3^*$	R=3	58.45	35.01		$R\leq3^*$	R=3	34.8	24.25	
	$R\leq4^*$	R=4	23.56	18.39		$R\leq4^*$	R=4	22.80	17.14	
	$R\leq5$	R=5	0.761	3.84		$R\leq5$	R=5	0.761	3.84	
Equation 8	$R=0^*$	R=0	200.73	107.34	6	$R=0^*$	R=0	49.93	43.41	6
	$R\leq1^*$	R=1	150.79	79.34		$R\leq1^*$	R=1	48.37	37.16	
	$R\leq2^*$	R=2	102.41	55.24		$R\leq2^*$	R=2	40.66	30.81	
	$R\leq3^*$	R=3	61.74	35.01		$R\leq3^*$	R=3	34.57	2.43	
	$R\leq4^*$	R=4	2.72	1.84		$R\leq4^*$	R=4	18.06	17.14	
	$R\leq5^*$	R=5	9.10	3.84		$R\leq5^*$	R=5	9.10	3.84	

Source: Author's Computation

The Johansen co-integration test is applied to the variables using a lag length of 2 as suggested by all five criterions considered. The results are presented in Table 4.6.2, it shows a long-run equilibrium relationship exists between health expenditure and health indicators in Nigeria. The table reveals that for equation 5 the trace and Maximum eigenvalue tests indicate five co-integrating equations and six co-integrating equations for equation 6, suggesting that there is a long-run relationship between health indicators (life expectancy and under-5 child mortality rate), expenditure on health, GDP per capita, literacy level and carbon dioxide emission.

4.3 Error Correction Model

Given that the variables are co-integrated, an Error correction model is constructed by including in the model, the lagged terms of the variables and the error correction term generated. The error correction model shows the short run relationship between variables and its results are presented in the tables below:

Table 4.3.1: Parsimonious Regression Results for Equation 5
Dependent Variable: DLOGLEXP
Included observations: 32 after adjustments

Variable	Coefficient	T-Statistics	Prob
Constant	0.0014	4.1257	0.0004
d(loglexp(-1))	1.5807	19.9270	0.0000
d(loglexp(-2))	-0.6536	-9.1307	0.0000
d(loghexp)	0.0028	3.5816	0.0017
d(loghexp(-1))	-0.0024	-2.4182	0.0243
d(logc02)	-0.0006	-2.1262	0.0449
d(loglit)	-0.0615	-3.7655	0.0011
d(loglit(-1))	0.0520	2.4341	0.0235
ect(logurp(-2))	-0.0462	-3.7334	0.0012
ect(-1)	-0.0282	-2.7159	0.0126
R2	0.89		
Adj R2	0.87		
Durbin Watson	1.83		
F-statistic	1710.68		
Prob (F-statistic)	0.0000		

Source: Author's Computation

The parsimonious estimates for equation 5, reveals that public health expenditure has a positive impact on life expectancy while a change in one-period lagged value of total public health expenditure has a significant (0.024) but negative (-0.00243) effect on life expectancy in conformity with the findings of Boachie, *et al* (2018). Carbon dioxide emissions has a negative (-0.00657) impact on life expectancy as a priori expected which implies that an increase in carbon dioxide emission would lead to a decline in life expectancy, literacy level has a negative (-0.0615) impact on life expectancy while one-period lagged value literacy level of has a positive(0.0011) impact on life expectancy at 5% level of signif0icance(0.0235).Urban population has negative impact on life expectancy, from the result, an increase in urban population will lead to a decrease in life expectancy by -0.046. The error correction term is negative and significant (-0.0282) at five percent level of significance indicating a low speed of adjustment to equilibrium.

Table 4.3.2: Parsimonious Regression Results for Equation 6
Dependent Variable: DLOGU5
Included observations: 32 after adjustments

Variable	Coefficient	T-Statistic	Prob
Constant	-0.0006	-1.0740	0.2935
d(logu5(-1))	1.4434	11.006	0.0000
d(logu5(-2))	-0.4517	-3.1876	0.0040
d(loghexp)	-0.0010	-1.8622	0.0748
d(loghexp(-1))	0.0014	2.1206	0.0445
d(loggdp)	-0.0032	-1.7350	0.0946
d(loggdp(-1))	0.0061	3.2161	0.0037
ect(-1)	-0.0593	-2.8603	0.0086
R2	0.885		
Adj R2	0.881		
Durbin Watson	2.21		
F-statistic	237.51		
Prob (F-statistic)	0.0000		

Source: Author's Computation

From equation 6, public expenditure on health has a significant (0.078) and negative (-0.001074) as theoretically expected, implying that an increase in public health expenditure will bring about a decrease in under-5 child mortality rate by -0.001074 this is in line with the findings of Maduka, *et al.* (2016) and Olarinde, *et al* (2013), however, health expenditure lagged one period back derails from a priori expectations as it has a significant (0.0445) and positive (0.00143) impact on under-5 child mortality rate. The findings also reveal that gdp per capita has a statistically significant (0.0946) and negative effect on under-5 child mortality while it's lagged value has a positive (0.00617) and significant (0.0037) relationship with under-5 child mortality rate, another deviation from expectations. The coefficient of the lagged error correction terms is approximately -0.05 suggesting very low speed of adjustment towards equilibrium.

5. CONCLUSION AND POLICY RECOMMENDATIONS

The study uses life expectancy and under-5 child mortality rates as proxies for health indicators while public health expenditure is captured by Nigeria's recurrent and capital health expenditure for the period 1985 – 2019. The augmented Dickey Fuller unit root test reveals that all the data used in this research are integrated of order I(1) and hence the Johansen co-integration test was carried out to determine if a long run relation between the variables exists. The latter result reveals at least five co-integrating equations in all models examined, thus, the error correction model was regressed for both equations. The ECM reveals that there is a positive and significant relationship between total health expenditure and health indicators. The error correction terms (ect) lagged one-period are significant for all equations implying that there is a long-run relationship as earlier confirmed by the Johansen co-integration.

The regression result shows that public health expenditure has a positive and significant impact on life expectancy and under-5 child mortality rate, thus the following recommendations; the government at all tiers should invest and encourage the use of green energy in order to reduce the consumption of fossil fuels so as to reduce the harmful effect of carbon dioxide emission on the environment and on the health of the populace. Policy should be put in place to regulate the emission of harmful gases. The Federal and state governments should discourage high concentration in one area by providing equal opportunities in every part of the country, the Government should aim towards inclusive growth in order to prevent excessive migration from rural centers to urban areas. The local governments should provide opportunities to incentivize people against migrating to urban centers. The state government should supervise and ensure

that the educational system is qualitative and not just quantitative, both formal and informal education should be encouraged in order to build human capacity, the state government should provide free basic education in order to increase enrolment rates and reduce the levels of illiteracy, hence, creating a health conscious environment.

Furthermore, from the findings, gdp per capita has a significant impact on health indicators in current time period, therefore, the federal government should aim at reducing inequality by putting policies in place to bridge the gap between the rich and the poor, this would reduce monopoly power and bring about more equitable allocation of resources in the society which will lead to improvement in health outcomes hence a better quality of life.

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