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Public Expenditure on Health, Technology and Health Outcomes in Nigeria

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Abstract

This study investigated the relationship between public expenditure on health, technology and health outcomes in Nigeria from 1989 to 2022. The study employed the Autoregressive Distributed Lag (ARDL) model. On infant mortality, the long-run and short run results show that, both public expenditure on health and technology haves a negative and statistically significant impact on infant mortality rate at 5% level of significant. Technology reported a positive but statistically insignificant effect on infant mortality rate in the short run. On life expectancy rate, the long-run results shows that public expenditure on health has a negative and statistically significant impact on life expectancy rate at 5% level of significance, while technology has a positive and statistically significant effect on life expectancy rate in the long-run. Similarly, the short-run results revealed a negative and statistically significant relationship between public expenditure on health and life expectancy rate at 5% level of significance. The relationship between technology and life expectancy rate in the short-run shows a positive and statistically insignificant impact whereas governance indicated a negative and statistically insignificant effect on life expectancy rate in Nigeria. The study recommends that, the government should invest in sophisticated technological equipment such as telemedicine in the health sector in line with global best practices to reduce medical tourism abroad thereby reducing the pressure on the Naira, and the public servants should be charged on transparency and accountability of public funds.

Keywords: Public expenditure on Health, Technology, Infant mortality, Life Expectancy
JEL Classification: H51, Q56, I10

Contribution to/Originality Knowledge

1.0 Introduction

Public spending is a common public financial strategy used by governments to control and stabilize the economy and can be a critical tool for economic growth (Mathew et al., 2019). Public expenditure on health on the other hand, is the expenditure incurred by the government on the provision of health goods which plays important role in the health and wellbeing of the population (Ijoko, Magaji & Gombe, 2022). To achieve the Sustainable Development Goal (SDG) 3 (Health for All), and the 2001 Abuja declaration by nations on health funding, increasing health care spending has become paramount in every nation's development agenda (Oladosu et al., 2022). This is because the level of human capital formation, which determines better, more skilful, efficient labour force of a nation to a large extent, depends on government

expenditure (Osemwengie & Okeke, 2023). A country's level of welfare and the amount of effort put into productive work are determined by their level of health stock (Jack, 1999).

Most growth theories viewed stock of human capital as a crucial variable of production, hence improvement in this area through public expenditure can support both economic growth and development. Health related issues of nations workforce can have a negative impact on productivity which calls for attention of governments around the world (Waziri et al., 2016). Poor health and short life expectancy accounts for about 50% of the widening gap in economic growth between the developing and developed countries because the less developed countries like Nigeria have poor health expenditure per capita. For example, in 2020 health expenditure per capita for Nigeria was $70. This is a decrease of an average of 4.75% when compared with $106 in 2014 (Knoema, 2024).

Available data on Nigeria's health profile revealed average life expectancy rate of 52.3 years for male and 53.1 years for female as against the global average of 68.9 years for men and 73.9 years for female in 2024 (world Bank, 2024). This is unacceptably low when compared with the steady growth of public expenditure on health from 0.13 billion in 2000 to 99.90 billion in 2010 and 231.80 billion in 2011. It also reached 257.72 billion in 2015 and 202.36 billion in 2016. Though, data shows a decline in infant mortality rate from 124 per 1000 live birth in 1989 to 112 in 1999, 86 in 2009 and 71 in 2021 respectively. The percentage annual budget average of 6% is still far below the 15% recommended by the World Health Organization (WHO) during the 2001 Abuja declaration (Ijoko, 2023 & Ahonkhai et al., 2023).

The use of computer as a technological tool has become a common thing in most profession. While there is no doubt that health information technology is an important tool for improving healthcare quality and safety it comes with its own challenges (Alotaibi & Federico 2017). In this 21st Century, computer usage as a tool at places of work, academic, health institutions and homes has become a common thing. According to global estimates, over 100 million people spend hours on computer screen (Akinbinu & Mashalla, 2014). Several studies have shown a relationship between computer usage and visual impairment in children and adults. For example, Hales et al. (1999) shows that about 22% computer users have health related problems such as neck pain, back pain, shoulder problems and sight problems which can reduce life expectancy rate. Sitting for long periods on computer reduces blood circulation to the other parts of the body. Better Health, 1999 linked child hood obesity to periods of playing electronic games by children.

Most empirical and theoretical literatures have acknowledged public expenditure as an important factor influencing health outcomes both in Nigeria and other countries, but to the best of knowledge there is yet to be a study that has looked at the relationship between public expenditure, health and technology jointly and their impact on health outcomes, and this is the focus of this study. Considering the crucial role of technology in all human endeavours, it has become necessary to include it in the analysis of the impact of public expenditure on health outcome variables such as infant mortality rate and life expectancy to see if it has any significant impact on them.

The aim of this study is to examine the impact of public expenditure on health and technology on health outcomes in Nigeria with a focus on infant mortality and life expectancy rate. This paper is structured into five parts including the introduction. The next section is the empirical literature, followed by the methodology, presentation and discussion of results and conclusion and recommendations.

2.0 Theoretical Framework

The Grossman health production function serves as the foundation for this investigation. According to Fayissa and Gutema (2005), the Grossman Model includes social, economic, and environmental elements as inputs of health production system. By separating the behavioural input demand function from the biological health production function, Grossman (1972) made a significant addition to the literature on health economics and made it possible for scholars to incorporate socio-economic inputs like government spending and income. According to Grossman (1972), the majority of behaviours that affect one's health, such as seeking medical attention, are valued for that reason. The health production function in this study is used to describe the desire for health, where health is "produced" into a state of health.

The theoretical formulation can be expressed as follows:

$$H=F(x) \quad (1)$$

H = Health output

x = Vector of individual inputs to the health production function,

F = The elements of the vector of inputs include nutrient intake, income, consumption of public goods, education, time devoted to health-related procedures, initial health stock and the environment.

2.1 Empirical Review

The relationship between government expenditure and health outcomes in Nigeria has been a subject of interest due to the importance of healthcare in promoting economic growth and public welfare. A number of literatures have examined the relationship between public health expenditure and health outcomes. For instance, Using the ARDL technique, Bankole, Ajayi, and Oladapo (2021) examined the relationship between health spending and life expectancy in Nigeria from 1986 to 2016. They found that overall health spending significantly improves life expectancy over the long run. In the Long-run, life expectancy increased by 0.28% and short-run life expectancy increased by 0.13% for every 1% rise in overall health spending in the country. The report suggested that the Nigerian government improve its health care spending. Brenner et al. (2016) in a systematic review of the Effects of health information technology on patient outcomes using a quality range from 1 to 9. The study employs Descriptive and comparative analysis involving the use of health IT in a clinical setting and measured effects on patient safety outcomes. It was discovered that 36% of the reviewed studies found benefit of health IT on direct patient safety outcomes for the primary outcome measured, 62% found that either had non-significant or mixed findings, and 1% shows that health IT had a detrimental

effect. The study concluded that most of the reviewed studies demonstrated a positive benefit of health IT on direct patient safety

Alotaibi and Federico (2017) analyzed the impact of different health information technologies on improving patient safety outcomes. The study concludes that health information technology improves patient's safety by reducing medication errors, reducing adverse drug reactions, and improving compliance to practice guidelines. The study recommended that Healthcare organizations should be selective in the type of technology to invest in, as literature shows that some technologies have limited evidence in improving patient health outcomes.

Similarly, Mathew et al. (2019) also discovered a significant positive relationship between public expenditure on health and health outcome in Nigeria. Edeme et al. (2019) found that increase in public expenditure on health decreases infant mortality but has a negative correlation with economic growth.

In an attempt to show the empirical evidence of the impact of public expenditure on health on infant mortality rate in Nigeria using Fully Modified Ordinary Least Squares (FMOLS), Mathew (2020) found that public expenditure on health have positive impact on infant mortality rate.

In a recent study, Awoyemi et al. (2023) assessed the relationship between government health expenditure and health outcomes in Nigeria during the period 1995 – 2018 using the Autoregressive Distributed Lag (ARDL) estimation technique. Their findings revealed health expenditure significantly reduces mortality rate and increases life expectancy rate in Nigeria during the observed period. Gbagidi et al. (2021) used the Vector Autoregressive Model (VAR) to examine the nexus between public health expenditure, health outcomes, and economic growth in Nigeria from 1987 to 2018. The impulse response function of the VAR revealed that all the variables responded to their shocks as well as shocks from other variables.

Using under-5 mortality per 1000 birth and Life expectancy as proxies for health outcomes, Orji et al. (2021) examined the impact of public health expenditure on health outcomes in Nigeria from 1985–2019. Findings from their analysis showed that health expenditure by the government has a significant impact on the under-5 mortality rate and life expectancy. Immunization against measles also has a significant impact on the under-5 mortality rate.

Ebhotemhen and Hezekiah (2021) used the ARDL model and Error Correction Mechanism to examine the impact of public health expenditure on Nigeria's health sector performance from 1981 to 2020. Their findings revealed a significant long-run equilibrium relationship between life expectancy and the explanatory variables in the study. In addition, Oladosu et al. (2022) carried out a cross-country analysis by investigating the impact of public health expenditure on health outcomes in Nigeria and Ghana. Health outcomes were captured by infant mortality, maternal mortality, malaria mortality, and HIV/AIDS mortality. Using the linear regression analysis, the study found a low public health expenditure in both countries. Also, an insignificant negative impact of health expenditure was found in Ghana while a significant positive impact was found in Nigeria.

Employing time series data from 1986 to 2020, Musa (2022) investigated the impact of health expenditure on health status in Nigeria. The study employed the Co-integration and Error Correction Model for the analysis and found that public expenditure on health negatively impact infant mortality rate in Nigeria. Employing the Ordinary Least Squares (OLS) method, Nwanosike et al. (2022) examined the impact of public healthcare spending on health outcomes in Nigeria using life expectancy and infant mortality rate as proxies for health outcomes. They found private health expenditure as the major factor affecting health outcomes in Nigeria. Findings also revealed a negative relationship between public expenditure and infant mortality and life expectancy in Nigeria due to constrained healthcare financing.

In a bid to examine the relationship between government health expenditure and health outcomes in Nigeria, Umaru et al. (2022) used the Vector Autoregressive Model on time series data from 1981 to 2020. Their findings revealed that Government health expenditure has a negative relationship with infant mortality in Nigeria. Udochukwu et al. (2023) employed the fully modified ordinary least squares technique to examine health expenditure and life expectancy in Nigeria from 1990 to 2022. They found that government recurrent expenditure for the period under review impacts positively on life expectancy rates of Nigerians.

Osemwengie et al. (2023) used the Error Correction Model (ECM) to analyze public health spending, environmental pollution, and health outcomes using the infant mortality rate as a proxy. The findings demonstrated that gas flaring and carbon (IV) oxide had no discernible impact on the infant mortality rate since they were not statistically significant at the 5% level. The infant mortality rate was positively impacted by public health expenditures because of unethical behavior in the health system. The study suggests that healthcare spending by government be responsible and efficient.

This study is an improvement on the previous studies aside contributing to the literature of health economics because there is yet to be study that combined government expenditure on health, technology and health outcomes. Considering technology in literature of health economics has become imperative because of its relative importance in all field of human endeavour.

3.0 Methodology

The health production function was adapted from the work of Osemwengie et al. (2023) and Ijoko et al. (2023) for this study to show the relationship between Public Expenditure on Health, Technology, Government and health outcomes (Infant Mortality Rate and Life Expectancy Rate).

The production function shows the transformation of factor input of a production process to outputs as follows:

$$Q = (X1, 2, X3\ldots, Xn) \text{ ----------} \quad (2.2)$$

Where:

Q = Quantity of outputs and

X1, X2, X3…… Xn = Quantities of factor inputs such as labour, capital, and raw material.

This function was modified to relate health outcomes with inputs such as public expenditure, governance and technology in line with the work of (Ijoko et al., 2023)

Ln (HS) = β1 Ln $(GDPi/Ni)$ + β2 Ln $(Hi/GDPi)$ + β3 (Xi) + εI ……. (1)

Equation (1) is the natural log specification of the health outcomes used in the previous study.

3.1 Model Specification

In other to achieve the objective of the study, a multiple regression model was specified. The Model was built on the Grossman model of health demand, which believes that health is a durable capital goods that can be produced using socio-economic variables such as public health expenditure, technology and governance.

The modified model is specified in the functional form below as:

HO = *f (PEH)*-------- ----------(2)

Where;

HO = Health Outcome

F = function

PEH = Public Expenditure on Health

Since the two dependent variables of interest are infant mortality rate and life expectancy rate, the model can be rewritten in the following manner:

IMR = *f (PEH)*---------- ----------(3)

LER = *f (PEH)*---------- ----------(4)

Where;

IMR = Infant Mortality Rate

LER = Life Expectancy Rate

With the inclusion of technology and governance as a control variable, the equations can be presented in an econometric form as below:

$IMR_t = \alpha_0 + \alpha_1 PEH_t + \alpha_2 TEC_t + \alpha_3 Go_t + \varepsilon_t$ ----------(5)

$LER_t = \alpha_0 + \beta_1 PEH_t + \beta_2 TEC_t + \alpha_3 Go_t + \varepsilon_t.$ ----------(6)

Where; IMR is infant mortality rate, LER is life expectancy rate, TEC is technology, Go is governance; α_0 is constant; $\alpha_1, \alpha_2, \alpha_3, \beta_1, \beta_2$ *and* β_3 are the coefficients of long-run elasticities associated with the explanatory variables; *t* is the period spanning 33years; while ε is the error term. Data on mobile cellular subscriptions (per 100 people) is used as the proxy of technology in this study. Using government effectiveness as a proxy for governance, we can assess the quality of public services, the civil service and its independence from political pressures, the effectiveness of policies formulated and implemented, and the credibility of the commitment of the government to these policies as a whole.

All variables except *Go* are logged because they are expressed in values ranging from 0 to 1000 while *Go* is an index. The purpose of this is to present elasticity coefficients of the variables while interpreting result from the analysis.

The new models can be presented as below:

$$LnIMR_t = \alpha_0 + \alpha_1 LnPEH_t + \alpha_2 LnTEC_t + \alpha_3 Go_t + \varepsilon_t \quad \text{----------(7)}$$

$$LnLER_t = \alpha_0 + \beta_1 LnPEH_t + \beta_2 LnTEC_t + \alpha_3 Go_t + \varepsilon_t \quad \text{----------(8)}$$

3.2 Sources of Data

The study used time series data on an annual basis gotten from the CBN Statistical Bulletin, the National Bureau of Statistics (NBS) and the World Bank Development Indicators (WDI) respectively.

Table 3.1: Variable definition and Sources

Variables	Source
Infant Mortality Rate (IMR)	WDI
Life Expectancy Rate (LER)	WDI
Public Expenditure on Health (PEH)	CBN
Technology (TEC)	NBS
Quality of Governance (GO)	WDI

Sources: Author's Computation, 2023

3.3 Technique of Analysis

The Augmented Dickey Fuller (ADF) unit root test was employed to test for the stationary of the variables. The ADF unit root test result was used to determine the choice of the use ARDL or VAR as the technique of analysis of the study. Using ADF, we can determine how many times a variable need to be differenced to become stationary. It is accepted that if the ADF test statistic is greater than the critical value of 5 percent, then the variable is stationary, but if the ADF test statistic is less than the critical value, then the variable is not stationary and the null hypothesis is rejected.

4.0 Presentation of Results and Analysis

Table 4.1. Descriptive Statistic.

Variables	$lnIMR_t$	$lnLER_t$	$lnPEH_t$	$lnTEC_t$	$InGo_t$
Mean	4.4534	3.8970	3.5526	0.8171	-1.0283
Median	4.4246	3.9066	4.1312	3.1088	-1.0010
Maximum	4.7318	4.0153	6.0482	4.6219	-0.8972
Minimum	4.0293	3.8174	-1.8961	-4.7325	-1.2133
Std. Dev.	0.2061	0.0587	2.1941	3.9395	0.0874
Skewness	-0.0519	-0.0105	-0.8076	-0.4495	-0.6682
Kurtosis	1.7792	1.7042	2.6486	1.3760	2.3850
Jarque-Bera	2.0641	2.3093	3.7570	4.7378	2.9758
Probability	0.3563	0.3152	0.1528	0.0936	0.2258
Sum	146.963	128.600	117.234	26.9658	-33.9326
Observations	33	33	33	33	33

Source: Author's Computation using E-views 10, 2023.

The Table 4.1 presents the descriptive statistics. The dependent variables *InIMR* and InLER displays low deviations with a maximum value of 4.7318 and 4.0153 with minimum values of 4.0293 and 3.8174 respectively. The independent variable InPEH indicated a low deviation from the sample mean with maximum at 6.048152 and minimum at -1.8960. The independent variable InTEC also indicated a low deviation from the sample with maximum 4.6219 and minimum -4.7325. Furthermore, variable InGo indicates a low deviation from sample with a minimum value -1.2133 and a maximum value of -1.028262. All the variables under investigation proves that their mean values are positive except InGO variable with a negative mean value.

From the Table 4.1, all the variables are found to be negatively skewed with values -0.051944, -0.01047, -0.807592, -0.449528 and -0.668219 for InIMR, InLER, InPEH, InTEC and InGo respectively. In the Table 4.1, the reported Kurtosis are platykurtic with values less than 3. From the Table 4.1, the Jarque-Bera statistics demonstrated that all the variables are normally distributed with probability values greater than 0.05.

4.1 Root Test

In this section, the results of the unit root test are presented in Table 4.2 to evaluate the stationary property of the variables, which is their predictability.

Table 4.2. Unit Root Analysis result

Variables	At Level		At First Difference		Order of integration
	ADF Statistic	P-value	ADF Statistic	P-value	
LNIMR	1.247594	0.9978	-0.237055	0.04924	I(1)
LNLER	0.59128	0.9871	-2.866152	0.041	I(1)
LNPEH	-2.836892	0.1982	-9.004908	0	I(1)
LNTEC	-0.941665	0.3012	-2.327862	0.0215	I(1)
Go	-4125449	0.0142			I(0)

Source: Author's Computation using E-views 10.

The stationary result shows that Governance is stationary at levels while life expectancy rate, infant mortality rate, public health expenditure and technology were stationary after first their differences were taken. This is an indication that the ARDL bound test for long run relationship is suitable for estimating the models. Co-integration test was conducted for the two models to test if there is long run relationship between the variables using the bound test since the variables are stationary at first difference. The result is given in the Table 4.3.

Table 4.3. Bound Test Result for Infant Mortality Rate (IMR)

$lnIMR_t$= F ($lnPEH_t$, $lnTEC_t$, Go_t)		Critical values for bound test:	
F-statistics	**Sig. level**	**Lower bounds**	**Upper bounds**
-3.873809	1% level	3.65	4.66
Lag length	5% level	2.79	3.67
(2,0,0,1)	10% level	2.37	3.2

Source**: Author's Computation using E-views 10.**

The bound test cointegration test for first objective shows that there exists a long run relationship among the variables. The null hypothesis is that no levels relationship exists while the alternative hypothesis is that relationship exist. The value of the f-statistics is 3.873809 and is higher than both the lower and upper bounds at 5% and 10% significance levels. The researcher went ahead to estimate the long-run and short-run relationship between infant mortality, public health expenditure, technology and governance by estimating ARDL and ECM models.

Table 4.4. Bound test result for Life Expectancy Rates (LER)

$InLER_t$ = F ($InPEH_t$, $InTEC_t$, Go_t)		Critical values for bound test:	
F-statistics	**Sig. level**	**Lower bounds**	**Upper bounds**
-3.83281	1% level	3.65	4.66
Lag length	5% level	2.79	3.67
(1,0,0,1)	10% level	2.37	3.2

Source: Author's Computation using E-views 10, 2023.

The bound test co-integration test for second objective shows that there exists long run relationship among the variables. The null hypothesis is that no levels relationship exists while the alternative hypothesis is that relationship exist. The value of the f-statistics is 3.383281, which is higher than the lower bounds but lower than the upper bounds at 5% significance levels. Therefore, only the short-run ARDL model will be estimated to investigate the relationship between life expectancy rate, public health expenditure and governance.

Table 4.5 displays the result of the long-run and short-run relationship between infant mortality, public expenditure on health, technology and governance in Nigeria. The long-run result shows that both public expenditure on health and technology haves a negative and statistically significant impact on infant mortality rate at 5% level of significant. The result shows that 5 percent rises in the public health expenditure and technology would lead to decrease in infant mortality rate by 0.047669 and 0.439331 percent respectively.

Table 4.5. Estimated Long-run and Short-run Results

Dependent Variable = $lnIMR_t$				
	Long-run results		**Short-run results**	
Variables	**Coefficient**	**T-ratio (p values)**	**Coefficient**	**T-ratio (p values)**
$lnPEH_t$	-0.047669	-1.948573(0.0475)	-0.00905	0.706433(0.0452)
$lnTEC_t$	-0.439331	1.591964(0.0334)	0.011717	1.528705(0.1607)
Go_t	0.10188	-1.006586(0.5975)	-0.425497	-0.017083(0.6137)
Constant	4.755612	6.47882(0.0000)	2.126148	5.744737(0.0000)
ECT (-1)			-0.798282	0.0009

Source: Author's Computation using E-views 10, 2023.

While governance has a positive but statistically insignificant relationship with infant mortality rate in Nigeria. On the other hand, the short-run result reveal that, public health expenditure has a negative and statistically significant effect on the infant mortality rate at 5% level of significant, while technology reported a positive but statistically insignificant effect on infant mortality rate. The coefficient of governance is negative and statistical insignificant in affecting infant mortality rate in the short-run analysis. This shows that in the short-run, 5 percentage increase in public health expenditure will lead to 0.009 percent decrease in infant mortality rate in Nigeria. The ECT which measures the speed of adjustment of the short run dynamics to long run equilibrium is negatively signed ECT (-) as expected. Meaning that 80% of the deviation of the variables in the short run will automatically be restored in the long run within a year.

Table 4.6. Estimated Long-run and Short-run Result

Dependent Variable = $lnLER_t$				
	Long-run results		**Short-run results**	
Variables	**Coefficient**	**T-ratio (p values)**	**Coefficient**	**T-ratio (p values)**
$lnPEH_t$	-0.057669	-1.948573(0.0475)	-0.031287	3.070307(0.0133)
$lnTEC_t$	0.639331	1.591964(0.0334)	0.000619	0.130476(0.8991)
Go_t	0.20188	1.006586(0.0575)	-0.034058	-0.402388(0.6968)
Constant	5.655612	6.47882(0.0000)	3.753159	8.52294(0.0000)
ECT (-1)			-0.898282	0.0009

Source: Author's Computation using E-views 10, 2023.

Table 4.6 shows the long-run and short-run estimates for the effects of public expenditure on health, technology and governance on life expectancy rate. The long-run results shows that public expenditure on health has a negative and statistically significant impact on life expectancy rate at 5% level of significance, while technology has a positive and statistically significant effect on life expectancy rate in the long-run. Governance also reported a positive and statistically significant influence on life expectancy rate in the long-run analysis at 10% level of significance. A 10 percent increase in public expenditure on health is associated with a 0.0576 percent decrease in life expectancy rate in the long-run in Nigeria. Similarly, the short-run results revealed a negative and statistically significant relationship between public expenditure on health and life expectancy rate at 5% level of significance. The relationship between technology and life expectancy rate in the short-

run shows a positive and statistically insignificant impact whereas governance indicated a negative and statistically insignificant impact on life expectancy rate in Nigeria.

The ECT which measures the speed of adjustment of the short run dynamics to long run equilibrium is negatively signed ECT (-) as expected. Meaning that 90% of the deviation of the variables in the short run will automatically be restored in the long run within a year.

4.4 Post-Estimation Test

After estimating the long-run and short-run relationship between the dependent variable and independent variables, diagnostic tests were conducted to check the reliability and stability of the results.

Table 4.7. Breuch-Pagan- Godfrey Heteroscedasticity Test

F-statistic	Prob. F(4,22)	Obs*R-squared	P-value
1.442587	0.5462	7.43213	0.3258

Source: Author's Computation using E-views 10, 2023.

Table 4.7 shows the Breuch-Pagan- Godfrey Heteroscedasticity Test. The result shows that there is no heteroscedasticity in the model since the probability value of both F-statistical and R-squared are greater than 0.05

Table 4.8. Breusch-Godfrey Serial Correlation LM Test.

F-statistic	Prob. F (2,32)	Obs*R-squared	P-value
0.738769	0.567423	1.45621	0.4552

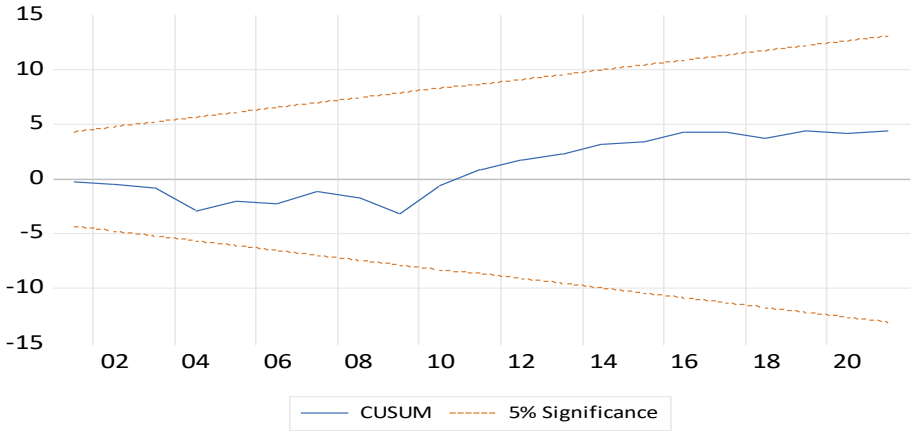
Source: Author's computation, 2023.

A Breusch-Godfrey serial correlation LM Test is presented in Table 4.8. The model shows no serial correlation. Both F-statistic and R-squared appear to be greater than 0.05, supporting this claim.

The result of the cumulative sum of recursive residuals (CUSUM) test and cumulative sum of squares of recursive residuals (CUSUMQ) shows the stability of the model. The plots (CUSUM and CUSUMQ) stay within the critical limits of 5% significance level as shown in figure 4.1 and 4.2 below.

From the CUSUM chart above, it shows the blue line lying between the two red lines, which means the model is stable. The blue is lying between the 5% significance level.

Figure 4.1: Plot of Cumulative Sum of Recursive Residuals



Source: Computed using E-views 10, 2023.

4.5 Discussion of Findings

This study examines the impact of public expenditure on health, technology and health outcomes in Nigeria utilizing time series data from 1989 to 2022. The result of the relationship between infant mortality and public expenditure on health revealed negatively significant impacts on infant mortality rate both in the short-run and long-run at 5% level. Technology has significant negative impact on infant mortality rate only in the long-run and not in short-run, while governance has no significant relationship with infant mortality rate at all, both in the short-run and long-run periods. This indicates that both public expenditure on health and technology reduces infant mortality rate in Nigeria. This result is corroborated the findings of Musa (2022) and Umaru et al. (2022), though it is contrary to the findings of Osemwengie et al. (2023) where they discovered that government expenditure has a positive effect on infant mortality rate. Though our finding is in line with our apriori expectation that government expenditure on health will decrease the rates of infant mortality in Nigeria. Furthermore, the adoption and the use of technology is expected to bring about innovation and invention in the health sector on ways to improve lives of new born babies as validated by the findings of this study.

Similarly, the results of the analysis of the relationship between life expectancy rate and public expenditure on health shows that public health expenditure impacts life expectancy rate negatively at 5% statistically significant level both in the short-run and long-run periods. This finding is in tandem with the study of Nwanosike et al. (2022). Meaning that public expenditure on health has not improved the lives of Nigerians in the period under review. While technology has a positive and statistical insignificant relationship with life expectancy rate at 5% level. Governance was discovered to have a positive and statistically significant relationship with life expectancy rate only in the long-run analysis.

5.0 Conclusion and Recommendations

This study investigated the relationship between public expenditure on health, technology and health outcomes in Nigeria from 1989 to 2022. The study's findings show a negative and statistically significant relationship between public expenditure and infant mortality rate in Nigeria. Also, there exists a significant positive relationship between technology variable, infant mortality rate and life

expectancy rate. Finally, at 5% level of significance, public expenditure on health has a negative relationship with life expectancy rate in Nigeria. The followings are the suggested recommendation for policy actions:

1. The primary Healthcare Development Agency of the government should ensure that the primary healthcare centers are well equipped to cater to the needs of pregnant mothers and their newborn because of their closeness to the people.

2. Government should invest in sophisticated technological equipment such as telemedicine in the health sector in line with global best practices. Not only would it improve on lives of Nigerians, it will also reduce medical tourism abroad thereby reducing the pressure on the Naira.

3. The public servants should be charged on transparency and accountability in handling health budgets and those found culpable should be dealt with in line with the civil service rules.

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