HEALTH EXPENDITURE, IMMUNIZATION AND HEALTH STATUS IN NIGERIA

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Abstract

This study examined the impact of health expenditure, immunization on health status in Nigeria with the objectives of evaluating the relationship between government's health expenditure on immunization and infant mortality in Nigeria; examining the effect of foreign agencies' health expenditure on immunization and life expectancy in Nigeria and investigating the relationship between government's expenditure on immunization and maternal mortality in Nigeria. In order to achieve these objectives, three econometric models were estimated using the Error Correction Mechanism. The variables included were percentage coverage of immunized children (PIC), Official development assistance of multinational (ODM), Net Official inflow of WHO on communicable diseases (UDP), Net official inflow of UNCEF on vaccine preventable diseases and communicable diseases control (UCF), Public health expenditure to GDP (PDP) and Physicians (per 1000 population) (PHYS) as the independent variables while Three major health status indicators- infant mortality rate (IMR), Life expectancy at birth (LFX), Maternal mortality (MAM) were the dependent variables. Annual time series data collected from the Central Bank of Nigeria (CBN) Statistical Bulletin and the World Development Indicators (WDI) were used, and the ADF test was employed in testing for unit root of the variables, which revealed that all the variables were stationary at the first difference 1(1) while the Johansen co-integration result revealed that Nigeria's health statuses were cointegrated with the explanatory variables. The regression result of the first model showed that PIC, ODM and PYS have an inverse relationship with, and significant impact on infant mortality rate in Nigeria while PDP has direct relationship with, and significant impact on infant mortality rate. UNDP has direct relationship with, but insignificant impact on infant mortality rate while UCF has an indirect relationship with, and insignificant impact on infant mortality rate in the country. From the regression results obtained from the second model, ODM, PDP and UDP have direct relationship with, and significant impact on Nigeria's life expectancy while PYS has an inverse relationship with, and significant impact on life expectancy. Finally, the third model estimation showed that ODM, PDP and PYS have inverse impact on maternal mortality rate while PIC, UDP and UCF have direct impact on maternal mortality rate in Nigeria. The study further revealed that government expenditure on immunization does not reduce the number of infant deaths in the country. However, government expenditure on health stemmed maternal mortality, and promoted life expectancy while foreign agency health expenditure on immunization stems infant mortality and maternal mortality and improved life expectancy in the country. In light of the above, the study made the following recommendations; that foreign agencies should increase their expenditure on immunization in order to increase percentage coverage of immunized children and there is need for government to increase, train and retraining of healthcare personnel most especially the physicians in the country in order to improve Nigerian health status.

Keywords: Health, Expenditure, Immunization, Health Status, Nigeria.

Introduction

Background to the Study

One of the key elements of developing human capital is health, which also serves as the foundation for an individual's productivity. Being healthy is a source of wellbeing and one of the things that people throughout the world cherish the most. Education, health, training, migration, and other abilities that can boost production are all included in the economic concept of human capital. One of the primary expansions of the neoclassical growth models and the primary driver of growth in a number of endogenous growth models is human capital. It is impossible to overstate the importance of health to the social and economic advancement of any economy.

Health care is for the living, not the dead, Imahe (2018) pointed out that funding health care is a life resource. According to Igberaese, Onogbosele, Imaru, and Okao (2023), this is consistent with the traditional Grossman model of health investment, which states that while health stock depreciates with age, investment increases health stock and shifts death time to the future, extending life expectancy. For this reason, both the private sector and the government should be heavily involved in providing health care to its inhabitants. With an average health provision of just over 3%, Nigeria's health spending has often been characterized as inadequate (WHO, 2022). Government-funded health spending per capita was $11.2 between 2000 and 2019, while private spending was $49.8. These figures were much less than the $86, which is roughly the minimum amount needed to guarantee universal health care for basic treatments. In a similar vein, public health spending as a percentage of GDP was low at 0.65%, below the recommended 4-5 percent of GDP needed to provide universal health care. At 4.2%, the government's health spending as a proportion of gross government spending is still significantly below the 15% goal established in the 2001 Abuja Declaration (CBN, 2022).

Furthermore, both ongoing and capital expenses have fluctuated dramatically over time due to erratic oil income brought on by variations in world oil prices. Recurrent government spending on the health sector grew from 15.2 billion Naira, or less than 4 percent of the total budget, to 369.4 billion Naira, or less than 5 percent, between 2000 and 2020. The capital expenditure, however, varied and in 2020 was less than 195 billion Naira (CBN, 2022). This indicates that the Nigerian government has been spending more on medical supplies and services than on facilities and equipment for healthcare.

Nigeria and other developing nations continue to face the burdens of several Vaccine-Preventable Diseases (VPDs), despite the fact that the present and widespread strategy to vaccine use essentially controls a variety of infectious diseases. According to Roukens and Visser (2008), 90% of the 200,000 or so VPD cases that occur each year occur only in Sub-Saharan Africa. As a result, crippling diseases like

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poliomyelitis, mumps, measles, meningitis, and typhoid fever persist in spreading, either directly causing fatalities or severely impairing their quality of life. As of 2016, Nigeria was rated as the 15th country in Africa with the highest rates of morbidity and mortality due to the alarming prevalence of chronic diseases (UNDP, 2017).
Nigeria has an abundance of medical professionals. However, it is estimated that 39% of all deliveries are attended by trained medical professionals. Nigeria spends relatively less on health, according to the spending trend (Punch, Newspaper, 2022). This opinion was supported by the Punch editorial board, which on January 16, 2022, bemoaned the concerning departure of medical experts (Onisanwa, 2014). Longevity and health promotion depend on quality health care services. Nigeria's life expectancy for both sexes was 54.49 years in 2019, according to World Bank (2020) statistics, indicating a negligible improvement. Nigeria was ranked 161 out of 195 countries in the world based on life expectancy in 2019, which is lower than that of South Africa, which was 61.46 years, Libya, which was 70.61 years, Egypt, which was 70.23 years, and India, which was 69.16 years. According to a study of Nigeria's financial trends across time, the Federal Government has consistently allocated between 5% and 6% of its budget on health and has never gone over that amount. The health sector is hampered by poor government leadership, disjointed healthcare delivery, a tight budget, poor health infrastructure, unequal staffing, and a lack of cooperation amongst important stakeholders.

Statement of the Problem

The effect of government health spending on a few health indicators has been the subject of numerous research conducted in Nigeria on a dispersed basis (Karim, 2016; Yaqub, Ojapinwa & Yussuff, 2017; Olatubi, Oyediran, Adubi & Oluwakemi, 2018). Many of these studies ignored vaccination in favor of concentrating on how government funding and ongoing medical expenses affect these health indicators. No study has fully examined the effects of private and public health spending, as well as health grants and donations from external/international agencies like UNICEF, WHO, and UNDP, on three health indicators in a single study with respect to health outcomes like life expectancy and child mortality. Furthermore, previous research on health spending and health outcomes may have frequently taken into account the impact of total health spending without taking into account the impact of vaccination effectiveness on particular health indicators. It is clear that a large number of studies have been conducted to look into the connection and causality between Nigerian health condition and health spending. Nonetheless, it has been noted that research on Nigeria's vaccination spending in relation to health status has been scant or nonexistent over the years. Therefore, the impact of vaccination spending on a number of important health metrics, including maternal mortality, life expectancy, and newborn mortality, has frequently been disregarded. This may have made it difficult for policy makers to clearly ascertain and differentiate the effect of the government's immunization expenditure and foreign agencies expenditure on immunization programme on health status in the country. Consequently, very little is known on the contributions of immunization and vaccination programmes on health status in Nigeria. This knowledge gap is filled in this study to bring about a more complete study of the impact of national and international interventions on the health status and quality of lives of Nigerians. Thus, the dearth of empirical literature on the impact of such interventions would be reduced, as the study increases the horizons of knowledge in the field of Health Economics.

Objectives of the Study

The main objective of this study is to evaluate the relationship between immunization expenditure and health status in Nigeria. Specifically, the objectives of the study are to:

i. examine the relationship between government's health expenditure on immunization and infant mortality in Nigeria;
ii. examine the effect of foreign agencies health expenditure on immunization and life expectancy in Nigeria and
iii. investigate the relationship between government's expenditure on immunization and maternal mortality in Nigeria.

Hypotheses of the Study

The following hypotheses were formulated:

Ho: Government's health expenditure on immunization has no significant relationship with infant mortality in Nigeria

Ho: Expenditure of foreign agencies on immunization has no significant relationship with life expectancy in Nigeria.

Ho: Government's health expenditure on immunization has no significant relationship with maternal mortality in Nigeria.

Literature Review

Conceptual Review

Overview of Health Status

There are many health indicators. According to Yaqub, Ojapinwa, and Yussuff (2017), some of these include life expectancy, the number of infant deaths under five years of age, the mortality rate for both male and female children, maternal health, child nutrition, public health spending per capita, the prevalence of HIV and malaria, the number of deaths from diabetes and cardiovascular diseases, nutrition, and sanitation status. Health status is defined as the measuring of health. Since health has multiple dimensions, so does health status, which has a range of metrics (Mwabu, 2018). Productivity at work, academic ability, and intellectual, physical, and emotional development are all influenced by one's health. The ability to make more money will increase as diseases are eradicated and personal health improves. Improving Nigerians' health is the aim of this health reform in order to reduce poverty to a level that is acceptable around the world. According to Aranda (2010), the expectation of better health status is the main driver of health expenditure, and health investment determines health status. It has long been recognized that a significant portion of Nigerians are in bad health. Due to increased knowledge of the contributing elements and the connection between economic growth and health, the Nigerian health care problem has drawn renewed attention (Oni, 2014). Inadequate laboratory facilities, a lack of basic infrastructure and equipment, and a lack of consumer awareness and participation are some of the main challenges affecting Nigeria's health system. Other factors include inadequate human resource management, low pay and motivation, a lack of equitable and sustainable health care funding, unfair and unequal political and economic ties between Nigeria and developed countries, incentives for health workers, and structures that are already making the brain drain syndrome worse. Health workers also refuse to accept postings to rural areas. There is a severe lack of doctors in Nigeria, and over time, low pay for healthcare professionals has negatively impacted the morale of Nigerian doctors who now work overseas (Aranda, 2010).

Theoretical Literature

The Grossman Health Investment Model

The Grossman health modelis also referred to as the Grossman model of healthcare investment because of its emphasis on investment in health stock. It was put forward by Michael Grossman in 1972, and indicates that improved health stock leads to healthy and extended life, with death pushed forward into the future.

The simple version of Grossman health model is stated as follows:

$$H_{t+1} - H_t = I_t - \delta_t H_t$$

Where:

H_{t+1} = Health capital at the beginning of an interval, $_{t+1}$

I_t- Gross investment during the interval t

δ_t= Rate of depreciation that is assumed constant within a given time interval t and exogenously dependent only on an individual's age (Igberaese & Iseghohi, 2017 andIgberaese et-al, 2023)

"The model states that health depreciates with age and that investments have multiplier effects on health and longevity, as such investments reduce sick times and postpone death of the individual into a far future". Igberase et-al (2023) believed that the individual will have longer period to contribute to the labour force. They believe that to achieve such investment and extension of life, there must be established systems of healthcare delivery meant to help both the rich and the poor.

"Therefore, when a country spends its resources on the healthcare of its residence, it is actually to increase national outputs, which is the aim of the Grossman model, provided that disabilities of the residence are not yet measured beyond the Instrumental Activities of Daily Living (IADL). Such a country has not only reduced the overall Burden of Disease (BoD) and Cost of Illness (CoI) but has also enabled growth. Nonetheless, Igberaese and Iseghohi (2017) advocated that if disability is already measured beyond the Instrumental Activities of Daily Living (IADL) to the Activities of Daily Living (ADL), the patient need not utilize any healthcare investment model and could demand for death to free resources, reduce BoD and

CoI. This stage of disability measurement must be avoided in the first place by formulating good healthcare models" (Igberaese et.al, 2023).

Empirical Literature

The impact of public health spending on health indicators in Nigeria was examined by Yaqub, Ojapinwa, and Yussuff (2017). Both ordinary least squares and two-stage least squares were used to regress life expectancy data on public health spending. The findings indicated that life expectancy is negatively impacted by public health spending.

Sango-Coker and Bein (2018) examined the effects of public, private, and public-private healthcare systems on West African life expectancy. Between 1999 and 2014, data were gathered from World Bank Indicators using pairwise correlation and pooled regression. Research findings indicated that women outlived men and that, for the public healthcare system, life expectancy and healthcare spending were positively correlated. For the private healthcare industry, the findings indicated a negative correlation between these variables.

Imoughele (2020) investigated the effects of public health expenditure on child health outcomes in Nigeria, which was proxy by among other indicator, infant mortality. The study uses time series data spanning from 1990 to 2019, employing the Error Correction method to draw out both long-run and short- run dynamic impacts of among other variables, immunization (IMN) on the child health outcome. The result of the study showed that public health expenditure had direct and significant effect on infant mortality. The policy import of the result is that public health expenditure in Nigeria has not improved the country infant mortality. However, immunization has positive and insignificant effect on Nigeria infant. The study recommended that government should at least, allocate 15% annual budget to health sector government should improve and sustain the immunization of children against diseases.

Akinola and Asaolu (2022) employed Auto Regressive Distributed Lag (ARDL) and Toda-Yamamoto techniques to examine the impact of government expenditure on health and other development assistance on life expectancy, using data from 1981 to 2019 from World Development Indicators and Central Bank of Nigeria Statistical Bulletin. Official Development Assistance (ODA) showed a positive but insignificant impact on life expectancy in Nigeria while government expenditure on health showed a positive and significant relationship. The result from Toda-Yamamoto technique showed that there was a unidirectional causality running from foreign aids to life expectancy. The causal feedback relationship between life expectancy and government expenditure on health implied that increase in government spending on health facilities can lead to an improvement in life expectancy in Nigeria. Also, an improvement in health quality or life expectancy may increase the population which will in turn force the government to increase health spending so as to care for the citizens, especially the aging population. They concluded that foreign aid was not effective in improving life expectancy in Nigeria. They recommended that government should increase her spending on health to improve life expectancy in Nigeria.

Iyakwari, Awujola and Ogwuche (2023) examined the effect of health expenditure on life expectancy in Nigeria using time series data from 1990 to 2021 and the ARDL and ECM models. The short-run analysis revealed that indicates that health expenditure may take time to have an impact on life expectancy. They found a negative relationship between health capital expenditure, health recurrent expenditure in the long run, while out-of-pocket health expenditure had a positive relationship with life expectancy. They recommended that the Nigerian government should take action to address the negative correlation between health capital expenditure and life expectancy by allocating sufficient funding to the health sector and implementing policies such as tax incentives and subsidies to encourage citizens to invest more in their healthcare and reduce out-of-pocket expenses for essential healthcare service.

Methodology

Techniques of Data Estimation

The Error Correction Model (ECM) technique is used to analyze data with Eview 9 of econometric software. The unit-root test is carried out, using the Augmented Dickey Fuller (ADF) and the Johansen Co-integration test is also carried out.

Model Specification

The study adapted the model of Ezeani and Efobi, (2018) who analyzed the effect of health expenditure on health status; life expectancy in Nigeria, which is also for maternal mortality and infant mortality. The implicit form of the model form is:

$LE = (LHEX, CHEX, RHEX, OPHEX$ (i)

Where: LE is Life expectancy at birth, LHEX is total health expenditure, CHEX is health capital expenditure, RHEX is health recurrent expenditure and OPHEX is out-of-pocket health expenditure.

Given the objective of the study, equation (i) is hereby transformed into a mathematical function as follows:

$$IMR_t = f(PIC_t, ODM_t, UDP_t, UCF_t, PDP_t, PYS_t) \quad \text{(ii)}$$

$$LFX_t = f(PIC_t, ODM_t, UDP_t, UCF_t, PDP_t, PYS_t) \quad \text{(iii)}$$

$$MAM_t = f(PIC_t, ODM_t, UDP_t, UCF_t, PDP_t, PYS_t) \quad \text{(iv)}$$

Where:

IMR_t = Infant mortality rate

LFX_t= life expectancy at a time t in Nigeria

MAM_t = Maternal Mortality (number of deaths of mothers during child birth)

PIC_t= Percentage coverage of immunized children aged 12-23month (%)

ODM_t = Official Development Assistance of Multinational corporations for immunization and sanitation programmes (Millions)

UDP_t= Net official inflow of United Nation Development Programme (UNDP) on health services development (Million)

UCF_t = Net official inflow of UNICEF on vaccine preventable diseases (Millions)

PDP_t= Public Health expenditure to GDP (%)

PYS_t = Physicians (per 1000 population)

(All at time t in Nigeria)

Adopting a log-linear specification, the natural logarithm was taken on selected variables in order to reduce the aggregated values of the series. The econometric forms of the equations are given as follows:

$$Ln\, IMR_t = \alpha_0 + \alpha_1 PIC_t + \alpha_2 ln ODM_T + \alpha_3 ln UDP_t + \alpha_4 ln UCF_t + \alpha_5 PDP_t + \alpha_6 PYS_t + u_t \quad \text{(v)}$$

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$\alpha_1 - \alpha_5 < 0$

$$ln\ LFX = \beta_0 + \beta_1 PIC_t + \beta_2 lnODM_T + \beta_3 lnUDP_t + \beta_4 lnUCF_t + \beta_5 PDP_t + \beta_6 PYS_t + \varepsilon_t \quad (vi)$$

$\beta_1 - \beta_6 > 0$

$$lnMAM = \gamma_0 + \gamma_1 PIC_t + \gamma_2 lnODM_T + \gamma_3 lnUDP_t + \gamma_4 lnUCF_t + \gamma_5 PDP_t + \gamma_6 PYS_t + z_t \quad (vii)$$

$\gamma_1 - \gamma_6 < 0$

Where:

u, ε and z = Disturbance term

t = time (yearly trend)

Equations (v), (vi).and (vii) are specified into the Error Correction Models respectively in equations (viii), (ix).and (x) as follows:

$$\Delta LnIMR = \delta_0 + \sum_{i=0}^{a} \sigma_1\, \Delta PIC_{t-1} + \sum_{i=0}^{\alpha} \varphi_1\, \Delta lnODAM_{t-1} + \sum_{i=0}^{\alpha} \tau_1\, \Delta ln\mathrm{UDP}_{t-1} + \sum_{i=0}^{\alpha} \Omega_1\, \Delta n\mathrm{UCF}_{t-1} + \sum_{i=0}^{\alpha} \mho_1\, \Delta \mathrm{PP}_{t-1} + \sum_{i=0}^{f} \lambda_1\, \Delta \mathrm{PYS}_{t-1} + \varepsilon_{t-1} + \mathrm{u}_t \quad (viii)$$

$$\Delta lnLFX = \delta_0 + \sum_{i=0}^{\alpha} \sigma_1\, \Delta PIC_{t-1} + \sum_{i=0}^{\alpha} \varphi_1\, \Delta lnODM_{t-1} + \sum_{i=0}^{\alpha} \tau_1\, \Delta ln\mathrm{UDP}_{t-1} + \sum_{i=0}^{\alpha} \omega_1\, \Delta ln\mathrm{UCF}_{t-1} + \sum_{i=0}^{\alpha} \Omega_1\, \Delta PDP_{t-1} + \sum_{i=0}^{\alpha} \mho_1\, \Delta \mathrm{PYS}_{t-1} + \varepsilon_{t-1} + \varepsilon_t \quad (ix)$$

$$\Delta lnMAM = \delta_0 + \sum_{i=0}^{\alpha} \sigma_1\, \Delta PIC_{t-1} + \sum_{i=0}^{\alpha} \varphi_1\, \Delta lnODM_{t-1} + \sum_{i=0}^{\alpha} \tau_1\, \Delta ln\mathrm{UDP}_{t-1} + \sum_{i=0}^{\alpha} \omega_1\, \Delta ln\mathrm{UCF}_{t-1} + \sum_{i=0}^{\alpha} \Omega_1\, \Delta PDP_{t-1} + \sum_{i=0}^{\alpha} \mho_1\, \Delta \mathrm{PYS}_{t-1} + \varepsilon_{t-1} + z_t \quad (x)$$

Where, $\delta_0$is the drift component, Δ is first-difference operator while *a is* the optimal lag lengths for each incorporated series. The error correction term for each equation is ε_{t-1} while the disturbance terms are $u_t \varepsilon_t$ and $z_t$for viii, ix and x respectively. The second part of the equation $\sigma_1, \varphi_1,\ \tau_1, \omega_1,\ \Omega_1, and\ \mho_1$represents the estimated coefficient of the variables in the models in equation viii, ix and x are estimated.

The Augmented Dickey–Fuller (ADF) test is adopted in this study to determine the order of integration and is stated as follows

$\Delta\gamma_t = \beta_1 + \beta_{2t} + \delta\gamma_{t-1} + \alpha_i \sum \Delta y_{t-1} + \sum_t$ (xi)

In equation ix, $\sum_t$ is a white noise error term and $\Delta\gamma_{t-1} = (\Delta\gamma_{t-1} + \Delta\gamma_{t-2})$, $\Delta\gamma_{t-2} = (\Delta\gamma_{t-2} + \Delta\gamma_{t-3})$, etc.

. The Johansen equation is stated as follows:

$\Delta \cup_{t-2} = \beta_0 + \delta\upsilon_{t-1} + \alpha \sum \Delta y_{t-1} + \sum t^y$ (xii)

The ECM is stated as:

$\Delta Y_t = \alpha_1 \Delta X_t + \alpha_2 u_{t-1} + \sum_t$
(xiii)

RESULTS AND DISCUSSION

Unit Root Test

The result of the ADF Unit root test is shown in table 1

Table 1: Unit Root test results on the Variables for Model 1

Var.	ADF statistics	Critical values		Order of Integration
		1%	5%	
LOG(IMR)	-4.7445	-3.6702	-2.9640	*I(1)*
LOG(LFX)	-4.7445	-3.6702	-2.9640	*I*(*1*)
LOG(MAM)	-5.0034	-3.6702	-2.9640	*I*(1)
PCIC	-6.8609	-3.6702	-2.9640	*I*(1)
LOG(ODM)	-6.9350	-3.6702	-2.9640	*I(1)*
LOG(UDP)	-6.8573	-3.6702	-2.9640	*I*(1)
LOG(UCF)	-5.0988	-3.6702	-2.9640	*I*(1)
PDP	-6.1897	-3.6702	-2.9640	*I(1)*
PYS	-3.9541	-3.6702	-2.9640	*I(1)*

Source: Author's Estimation Results, 2025 using Eview 9

Results from Table 2 on the ADF statistics indicated that all the series were not stationary at level that is,. integrated at order zero *I*(0) but rather stationary at first difference i.e. integrated at order one *I*(1). Hence, the null hypothesis of no unit root exist was rejected for all the series. This is because all the series - infant mortality rate (IMF),Life expectancy at birth (LFX),Maternal mortality (MAM), percentage coverage of immunized children (PIC),Official development assistance of multinational(ODM),Net Official inflow of WHO on communicable disease(UDP), Net official inflow of UCF on vaccine preventable diseases (VPDs) and communicable disease control (UCF), Public health expenditure to GDP (PDP) and Physicians (per 1000 population) are integrated at same order of first differencing. This justifies the support for a use of a Johansen-Cointegration test and Error Correction mechanism (ECM) to establish the existence of a long run relationship among the series in the equation and also estimate their relationship.

Co-integration Test for Model 1

Conventionally, since the unit root test showed that the variables were stationary at first order difference 1(1), we, therefore, test for co-integration among these variables by employing the Johansen co-integration test.

Table 2: Summary of Johansen Co-Integration Trace Test Results for Model 1

Sample (adjusted): 1992 2023
Included observations: 32 after adjustments
Trend assumption: Linear deterministic trend
Series: LOG(IMR) PIC LOG(ODM) PDP PHYS LOG(UDP) LOG(UCF)
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.872294	179.1303	125.6154	0.0000
At most 1 *	0.760774	117.3894	95.75366	0.0007
At most 2 *	0.629959	74.47899	69.81889	0.0202
At most 3	0.464065	44.65474	47.85613	0.0969
At most 4	0.382050	25.94244	29.79707	0.1304
At most 5	0.315833	11.50202	15.49471	0.1824
At most 6	0.003840	0.115411	3.841466	0.7341

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
*** denotes rejection of the hypothesis at the 0.05 level**
****MacKinnon-Haug-Michelis (1999) p-values**

Source: Author's Estimation Results, 2025 using Eview9

Table 3 Summary of Johansen Co-Integration Maximum Eigenvalue for Model 1

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.872294	61.74082	46.23142	0.0006
At most 1 *	0.760774	42.91045	40.07757	0.0233
At most 2	0.629959	29.82425	33.87687	0.1413
At most 3	0.464065	18.71229	27.58434	0.4370
At most 4	0.382050	14.44043	21.13162	0.3300
At most 5	0.315833	11.38660	14.26460	0.1359
At most 6	0.003840	0.115411	3.841466	0.7341

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's Estimation Results, 2025 using Eview 9

The Johansen Co-integration trace result in table 3 shows that there exists three (3) co-integrating equations at 5% level of significance. Also Johansen Co-integration Maximum Eigenvalue in table 4.5 shows that there exists two (2) co-integrating equations at 5% level of significance. This is because the likelihood ratio is greater than critical values at 5%. This shows that there is a long run relationship between Nigeria's infant mortality rate (IMR) and percentage coverage of immunized children (PIC),Official development assistance of multinational (ODM),Net Official inflow of WHO on communicable disease(UDP), Net official inflow of UCF on vaccine preventable diseases (VPDs) and communicable disease control (UCF), Public health expenditure to GDP (PDP) and number of Physicians. The result indicates that, in the long run; Nigeria's infant mortality rate can be efficiently predicted using the specified explanatory variables.

Error Correction Mechanism (ECM) for Model 1

Table 4: Results of the Error Correction Model for Model 1: Dependent Variable DLOG(IMR)

Variable	Coefficient	Standard Error	t-Statistic	Prob.
D(PIC)	-0.0029*	0.0008	-3.4257	**0.0021**
DLOG(ODM)	-0.0131*	0.0044	-2.9864	**0.0062**
D(PDP)	0.1218*	0.0433	2.8134	**0.0094**
D(PYS)	-0.4351*	0.1685	-2.5830	**0.0160**
DLOG(UDP)	0.0022	0.0120	0.1841	**0.8554**
DLOG(UCF)	-0.0150	0.0171	-0.8754	**0.3897**
ECM(-1)	-0.8090*	0.1793	-4.5129	**0.0002**
C	**-0.0170**	**0.0017**	**-10.0911**	**0.0000**

$R^2 = 0.8398$ $R^{-2} = 0.8014$

F-Statistic = 21.8493* Prob (F-Statistic) = 0.0000

D.W Statistic 1.8074

Note: *Significant at 5 per cent = 2.093

Source: Author's Estimation Results, 2025 using Eview 9

From Table 4, it could be observed that all the variables met their expected signs which are consistent with the a priori expectation except net Official inflow of WHO on communicable disease DLOG(UDP) and Public health expenditure to GDP (PDP). The regression result reveals that percentage coverage of immunized children (PIC) has an inverse and significant impact on Nigeria's infant mortality rate D(IMR). One per cent increase in PIC leads to 0.0029 per cent decrease in Nigeria's infant mortality rate. This is consistent with a priori expectation. This result supports the fact that increase in immunization coverage of children reduces the number of death of children in the country.

The result further shows that official development assistance of multinational LOG(ODM)has an inverse and significant impact on the infant mortality rate. 1% increase in LOG(ODM)will lead to 0.0131% decrease in Nigeria's infant mortality rate. This is consistent with the a priori expectation. This result supports the fact that a well-managed and funding of health sector from official development assistance of multinational has the ability to reduce infant mortality rate in the country.

This finding is consistent with Kotsadam, Ostby, Rustad, Tollefsen and Urdal (2018) and Imoughele (2020) findings, whose studies had revealed that foreign aid reduces infant mortality rate in Nigeria. The coefficient of public health expenditure to GDP D(PDP) is positively signed which indicates that a direct relationship exists between public health expenditure and Nigeria's infant mortality rate. This is not consistent with the a priori expectation. The value of the coefficient is 0.1218 which implies that one per cent increase in D(PDP) leads to 0.1218 per cent increase in infant mortality when other regressors are held constant. The coefficient of D (PDP) is statistically significance at 5% level of significance with a probability value of 0.0094 and a T-value 2.8134which is greater than the critical value of 2.093. Thus, the alternate hypothesis is accepted, that is, Public health expenditure has a significant impact on Nigeria's infant mortality rate proxy for health status. The inverse and significance of this variable is attributed to the poor government budget to health sector and this finding conform to Imoughele (2020) who reported that public health expenditure in Nigeria has not improved the country's child health outcomes.

The coefficient of the number of Physicians (per 1000 population)D(PYS)) is negatively signed. This shows that the variable has an inverse relationship with the Nigeria's infant mortality rate. The value of the coefficient is -0.4351which implies that one per cent increase in D(PYS)leads to 0.4351 per cent decrease in the Nigerian infant mortality rate. The variable is statistically significant with a probability value of 0.0160and T-Value -2.5830, which is greater than the critical value of 2.093. Thus, we accept the alternate hypothesis that the number of Physicians (per 1000 population) has a significant impact on Nigeria infant mortality rate. This is in line with Imoughele (2020) who empirically investigated the nexus between public health expenditure and child health outcomes in Nigeria and reported that density of physicians have inverse and significant effect on Nigerian child health outcomes.

The coefficient of net official inflow of WHO on communicable disease DLOG(UDP) is positively signed, this shows that LOG(UDP) has a direct relationship with the Nigeria infant mortality rate. This result is not consistent with the a priori expectation. The value of the coefficient is 0.0022which implies that one percent increase in DLOG(UDP)which leads to 0.0022 percent increase in the Nigeria's infant mortality rate under the reference period when other independent variables are held constant. The coefficient of the variable is statistically insignificant at 5%

level of significance with a probability value of 0.1841and T-Value 0.1841which is less than the critical value of 2.093. Thus, the alternate hypothesis is rejected, that is Net Official inflow of WHO on communicable disease has a robust effect on Nigeria's infant mortality rate. The coefficient of net official inflow of UCF expenditure on vaccine preventable and communicable disease control LOG (UCF) has an inverse and insignificant impact on the Nigeria infant mortality rate. One per cent increase in LOG(UCF) leads to 0.0044per cent increase in infant mortality rate. This is not consistent with the a'priori expectation. This implies that increase in official inflow of UCEF expenditure on vaccine preventable and communicable disease control in the country has not reduces the prevalence of infant mortality rate in the country.

The result from Table 5 shows that the coefficient of ECM is negative -0.8090 and significant at 5% per cent critical level. This shows that about 81% disequilibrium in the Nigerian infant mortality rate in the previous one year was corrected for in the current year. The significance of the ECM is an indication and a confirmation of the existence of a long run equilibrium relationship between Nigerian infant mortality rate and the independent variables used in this study. The robustness of the error correction method further buttresses that only 81 per cent is corrected in the previous year. This means that the explanatory variables had the tendency to reduce the growth of Nigerian infant mortality rate all things being equal during the period of the study.

The coefficient of determination (R^2) value of 0.8393 implies that 84per cent of the total variation in the Nigerian infant mortality rate is explained by changes in the endogenous variables. Subsequently, 16 per cent is unexplained due to error term while the adjusted coefficient of determination (R^{-2}) Value of 0.8014 implies that 80 per cent of the total variation in Nigeria infant mortality rate is explained by changes in the endogenous variables when the coefficient of determination is adjusted for degree of freedom. This implies that 20 per cent is unexplained due to error term.

The F-Statistic is highly significant at 5% level of significance with the probability value of 0.0000. This is further strengthened by a high F-ratio of 21.8493which is greater than the critical value of 2.66, and thus we can say that the model has a high goodness of fit while the Durbin Watson Statistic of 1.8074 indicates that autocorrelation was highly minimized.

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Diagnostic statistical testing for Model 1

Table. 5. Diagnostic Tests on the Real Estimated Mining and Quarrying Model 1

Purpose of test	Test	Test statistic	Probability	Conclusion
Normality	Jarque-Bera	0.5670	0.7535	Normal
Heteroscedasticity	Breusch–Pagan-Godfrey Heteroskedasticity Test	0.4981	0.8261	No heteroscedasticity
Serial correlation	Breusch–Godfrey serial correlation LM test	2.8741	0.0769	No serial correction
Homoscedasticity	Ramsey RESET Test	1.6294	0.2151	No Homoscedasticity

Source: Author's Estimation Results, 2025 using Eview 9

From table 5 above, Breusch–Pagan-Godfrey, Heteroskedasticity Ramsey RESET Test among others, revealed that not only the robustness of the estimated equation results but the desired properties of an econometric model. The diagnostic tests confirm the suitability of the estimated model. The Breusch–Godfrey LM test statistics indicates that the model did not have significant serial correlation problem. Moreover, the Breusch–Pagan-Godfrey and Ramsey RESET test show that the residuals are homoscedastic and the model has correct functional form.

Co-integration Test for Model 2

Table 6: Summary of Johansen Co-integration Trace Test for Model 2

Sample (adjusted): 1992 2023
Included observations: 32 after adjustments
Trend assumption: Linear deterministic trend
Series: LOG(LFX) PIC LOG(ODM) PDP PYS LOG(UDP) LOG(UCF)
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized		**Trace**	**0.05**	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.850512	172.8117	125.6154	0.0000
At most 1 *	0.732749	115.7955	95.75366	0.0011
At most 2 *	0.605373	76.20848	69.81889	0.0141
At most 3 *	0.492619	48.31404	47.85613	0.0452
At most 4	0.404387	27.95928	29.79707	0.0803
At most 5	0.312058	12.41437	15.49471	0.1381
At most 6	0.038981	1.192838	3.841466	0.2748

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Author's Estimation Results, 2025 using view9

Table 7 Summary of Johansen Co-Integration Maximum Eigenvalue Test for Model 2

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		**Max-Eigen**	**0.05**	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.850512	57.01613	46.23142	0.0025
At most 1	0.732749	39.58706	40.07757	0.0567
At most 2	0.605373	27.89444	33.87687	0.2184
At most 3	0.492619	20.35476	27.58434	0.3171
At most 4	0.404387	15.54491	21.13162	0.2525
At most 5	0.312058	11.22153	14.26460	0.1435
At most 6	0.038981	1.192838	3.841466	0.2748

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
Source: Author's Estimation Results, 2025 using Eview9

The Johansen Co-integration trace result in table 6 shows that there exists four (4) co-integrating equations at 5% level of significance. Also Johansen Co-Integration Maximum Eigenvalue in table 4.9 shows that there exists one (1) co-integrating equations at 5% level of significance. This is because the likelihood ratio is greater than critical values at 5%. This displays that there is long run relationship between Nigeria's life expectancy (LFX) and percentage coverage of immunized children (PIC),Official development assistance of multinational (ODM),Net Official inflow of WHO on communicable disease(UDP), Net official inflow of UCF on vaccine preventable diseases (VPDs) and communicable disease control (UCF), Public health expenditure to GDP (PDP) and number of Physicians. The result indicates that, in the long run; Nigeria's life expectancy can be efficiently predicted using the specified explanatory variables.

ECM Results for Model 2

There exist co-integration between the dependent variable and the explanatory variables and the stationary of the variable at first difference. As a result, error correction mechanism was used to capture the relationship between the variables (dependent and independent) as well as the speed of adjustment to determine equilibrium of model two as shown below

Table 8: Results of the Error Correction Model for Model 2: Dependent Variable DLOG (LFX)

Variable	Coefficient	Standard Error	t-Statistic	Prob.
D(PIC)	0.0002	0.0002	1.2167	**0.2361**
DLOG(ODM)	0.0018*	0.0007	2.4346	**0.0231**
D(PDP)	0.0085*	0.0033	2.6137	**0.0150**
D(PYS)	-0.0738*	0.0322	-2.2920	**0.0306**
DLOG(UDP)	0.6211*	0.1253	4.9564	**0.0000**
DLOG(UCF)	0.0044	0.0046	0.9602	**0.3469**
ECM(-1)	-0.6770*	0.0801	-8.4550	**0.0000**
C	**0.0046**	**0.0012**	**3.9046**	**0.0007**

$R^2 = 0.8531 R^{-2} = 0.8179$

F-Statistic = 24.1983* Prob (F-Statistic) = 0.0000

D.W Statistic 1.6224 **Note:** *Significant at 5 percent = 2.093

Source: Author's Estimation Results, 2025 using Eview 9

From Table 8, it could be observed that the entire variables met their expected signs which are consistent with the a priori expectation except number of physicians. The regression result reveals that percentage coverage of immunized children (PIC) has direct but insignificant impact on Nigeria's life expectancy DLOG(LFX). 1% increase in DLOG(LFX). leads to 0.0002per cent increase in Nigeria's life expectancy. This is consistent with a priori expectation. This result supports the fact that increase in immunization coverage of children enhance their life quality and promote long life. This finding is in line with Imoughele (2020) findings, whose study revealed that immunization has improved Nigerian health status.

The result further shows that Official development assistance of multinational LOG(ODM)has direct and significant impact on the life expectancy. 1% increase in LOG(ODM)will lead to 0.0018per cent increase in Nigeria's life expectancy. This is consistent with the a priori expectation. This result supports the fact that a well-managed and funding health sector from multinational development assistance to Nigeria in funding health sector encourages life expectancy of Nigerian. This result is consistent with Musa, Abdullahi and Mijama'a (2021) and Akinola and Asaolu (2022) whose study revealed that foreign aid to the health sector significantly exerted positive impact on life expectancy rate in Nigeria.

The coefficient of Public health expenditure to GDP D(PDP) is positively signed which indicates that a direct relationship exists between public health expenditure and Nigeria's life expectancy. This conforms to the a priori expectation. The value of the coefficient is 0.0085which implies that one per cent increase in D(PDP) leads to 0.0085% increase in Nigerian life expectancy when other regressors are held constant. The coefficient of D(PDP) is statistically significance at 5%level of significance with a probability value of 0.0150 and a T-value 2.6137which is greater than the critical value of 2.093. Thus, the alternate hypothesis is accepted, that is, Public health expenditure has a significant impact on Nigeria's life expectancy proxy for health status. The finding is in line with Umar, Rotimi and John (2022) whose results revealed that public expenditure on health has a significant effect on Nigerian health status. Furthermore, Oluwatoyin, Adegboye and Fagbeminiyi (2015) had earlier found that public spending on health has significant relationship with health outcomes and productivity in Nigeria. This outcome agreed with the result of Eneji, Juliana and Onabe (2013) who found that public health care expenditure is an explanatory variable for health status.

The coefficient of the number of Physicians (per 1000 population)D(PYS)) is negatively signed. This shows that the variable has an inverse relationship with the Nigeria's life expectancy. The value of the coefficient is -0.0738which implies that one per cent increase in D(PYS) leads to 0.0738% decrease in the Nigerian life expectancy. The variable is statistically significant with a probability value of

0.0306and T-Value -2.2920, which is greater than the critical value of 2.093. Thus, we accept the alternate hypothesis that the number of Physicians (per 1000 population)has a significant impact on Nigeria life expectancy.

The coefficient of net official inflow of WHO on communicable disease DLOG(UDP) is positively signed, this shows that LOG(UDP) has a direct relationship with the Nigerian life expectancy. This result is not consistent with the a priori expectation. The value of the coefficient is 0.6211which implies that one percent increase in DLOG(UDP)which leads to 0.6211% increase in the Nigeria's life expectancy rate under the study period. The coefficient of the variable is statistically significant at 5% level of significance with a probability value of 0.0000and T-Value 4.9564which is greater than the critical value of 2.093. Thus, the alternate hypothesis is accepted, that is, Net Official inflow of WHO on communicable disease has a robust effect on Nigerian life expectancy.

The coefficient of net official inflow of UCF expenditure on vaccine preventable and communicable disease control LOG (UCF) has a direct and insignificant impact on the Nigerian life expectancy. One percent increase in LOG(UCF) leads to 0.0044percent increase in life expectancy. This is not consistent with the a priori expectation. This implies that increase in official inflow of UCF expenditure on vaccine preventable and communicable disease control in the country leads to increase in Nigeria life expectancy. The result from Table 4.10 shows that the coefficient of ECM is negative -0.6770 and significant at 5% percent critical level. This shows that about 68 per cent disequilibrium in the Nigeria life expectancy in the previous one year are corrected for in the current year. The significance of the ECM is an indication and a confirmation of the existence of a long run equilibrium relationship between Nigeria's life expectancy and the independent variables used in the study. The robustness of the error correction method further buttresses that only 68 per cent is corrected in the previous year. This means that the explanatory variables had the tendency to improve Nigeria's life expectancy rate all things being equal.

The coefficient of determination (R^2) value of 0.8531 implies that 85per cent of the total variation in the Nigerian life expectancy rate is explained by changes in the endogenous variables. Subsequently, 15% is unexplained due to error term while the adjusted coefficient of determination (R^{-2}) Value of 0.8179 implies that 82% of the total variation in Nigeria life expectancy rate is explained by changes in the endogenous variables when the coefficient of determination is adjusted for degree of freedom. This implies that 18per cent is unexplained due to error term.

The F-Statistic is highly significant at 5% level of significance with the probability value of 0.0000. This is further strengthened by a high F-ratio of 24.1983 which is greater than the critical value of 2.66 and thus we can say that the model has a high goodness of fit while the Durbin Watson Statistic of 1.6224 indicates that autocorrelation was highly minimized.

Diagnostic statistical testing for Model 2

Table. 9. Diagnostic Tests for Model Two

Purpose of test	Test	Test statistic	Probability	Conclusion
Normality	Jarque-Bera	0.3795	0.8272	Normal
Heteroscedasticity	Breusch–Pagan-Godfrey Heteroskedasticity Test	0.5454	0.7687	No heteroscedasticity
Serial correlation	Breusch–Godfrey serial correlation LM test	0.6823	0.4177	No serial correction
Homoscedasticity	Ramsey RESET Test	0.6282	0.4363	No Homoscedasticity

Source: Author's Estimation Results, 2025 using Eview 9

From table 9 above, Breusch-Godfrey LM test, Breusch–Pagan-Godfrey, Heteroskedasticity Ramsey RESET Test among others, revealed that not only the robustness of the estimated equation results but the desired properties of an econometric model. The diagnostic tests confirm the suitability of the estimated model. The Breusch–Godfrey LM test statistics indicates that the model did not have significant serial correlation problem. Moreover, the Breusch–Pagan-Godfrey and Ramsey RESET test show that the residuals are homoscedastic and the model has correct functional form.

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Co-integration Test for Model 3

Table 10: Johansen Co-integration Trace Test for Model 2

Sample (adjusted): 1992 2023

Included observations: 32 after adjustments

Trend assumption: Linear deterministic trend

Series: LOG(MAM) PIC LOG(ODM) PDP PYS LOG(UDP) LOG(UCF)

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized		**Trace**	**0.05**	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.803836	153.2998	125.6154	0.0004
At most 1 *	0.712542	104.4357	95.75366	0.0110
At most 2	0.597321	67.03532	69.81889	0.0817
At most 3	0.436986	39.74685	47.85613	0.2317
At most 4	0.346172	22.51334	29.79707	0.2708
At most 5	0.245834	9.766026	15.49471	0.2992
At most 6	0.042463	1.301733	3.841466	0.2539

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Author's Estimation Results, 2025 using Eview9

Table 11: Johansen Co-integration Maximum Eigenvalue Test for Model 3

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		**Max-Eigen**	**0.05**	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.803836	48.86411	46.23142	0.0256
At most 1	0.712542	37.40037	40.07757	0.0972
At most 2	0.597321	27.28847	33.87687	0.2482
At most 3	0.436986	17.23351	27.58434	0.5600
At most 4	0.346172	12.74731	21.13162	0.4758
At most 5	0.245834	8.464292	14.26460	0.3335
At most 6	0.042463	1.301733	3.841466	0.2539

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
Source: Author's Estimation Results, 2025 using Eview9

The Johansen Co-integration trace result in table 12 shows that there exist two (2) co-integrating equations at 5% level of significance. Also Johansen Co-integration Maximum Eigenvalue in table 11 shows that there exist one (1) co-integrating equations at 5% level of significance. This is because the likelihood ratio is greater than critical values at 5%. This displays that there is long run relationship between Nigeria's maternal mortality and percentage coverage of immunized children (PIC),Official development assistance of multinational (ODM),Net Official inflow of WHO on communicable disease(UNDP), Net official inflow of UCF on vaccine preventable diseases (VPDs) and communicable disease control (UCF), Public health expenditure to GDP (PDP) and number of Physicians. The result indicates that, in the long run; Nigeria's maternal mortality can be efficiently predicted using the specified explanatory variables.

Error Correction Mechanism (ECM) Results for Model 3

There exist co-integration between the dependent variable and the explanatory variables and the stationary of the variable at first difference. As a result, error correction mechanism was used to capture the relationship between the variables (dependent and independent) as well as the speed of adjustment to determine equilibrium of model three as shown below

Table 12: Results of the Error Correction Model for Model 3: Dependent Variable DLOG (MAM)

Variable	Coefficient	Standard Error	t-Statistic	Prob.
D(PIC)	0.0005	0.0007	0.7389	**0.4674**
DLOG(ODM)	-0.0047	0.0030	-1.5618	**0.1320**
D(PDP)	-0.0302	0.0260	-1.1595	**0.2582**
D(PHYS)	-1.9828	0.8199	-2.4184	**0.0229**
DLOG(UDP)	0.1875	0.0403	4.6534	**0.0001**
DLOG(UCF)	0.2736	0.0541	5.0562	**0.0000**
ECM(-1)	-0.4509	0.1772	-2.5442	**0.0181**
C	**-0.0162**	**0.0048**	**-3.3832**	**0.0026**

$R^2 = 0.8784$ $R^{-2} = 0.8492$

F-Statistic = 30.1047* Prob (F-Statistic) = 0.0000

D.W Statistic 2.1960

Note: *Significant at 5 percent= 2.093

Source: Author's Estimation Results, 2025 using Eview 9

From Table 12, it could be observed that the entire variable met their expected negative signs which are consistent with the a priori expectation except percentage coverage of immunized children (PIC) UDP and UCF. The regression result reveals that percentage coverage of immunized children (PIC) has direct but insignificant impact on Nigeria's maternal mortality DLOG(MAM). One% increase in (PIC)leads to 0.0005% increase in Nigeria's maternal mortality. This is consistent with a priori expectation. This result supports the fact that immunization coverage of children does not reduce maternal mortality in the country. The result further shows that Official development assistance of multinational LOG(ODM) has an inverse and insignificant impact on the maternal mortality. One per cent increase in LOG(ODM)will lead to 0.0047 percent decrease in Nigeria's maternal mortality. This is consistent with the a priori expectation. This result supports the fact that a well-managed and funding health sector from multinational development assistance to Nigeria reduces the number of women death during child bearing.

The coefficient of public health expenditure to GDP D(PDP) is negatively signed which indicates that an inverse relationship exists between public health expenditure and Nigeria's maternal mortality. This conforms to the a priori expectation. The value of the coefficient is -0.0302 which implies that one per cent increase in D(PDP) leads to 0.0302 per cent decrease in Nigerian maternal mortality when other regressors are held constant. The coefficient of D(PDP) is statistically insignificance at 5 percent level of significance with a probability value of 0.2582 and a T-value 1.1595which is less than the critical value of 2.093. Thus, the alternate hypothesis is rejected, that is, Public health expenditure has a significant impact on Nigeria's maternal mortality proxy for health status. This conforms to Nwankwo (2018) findings who had reported that public health expenditure is a vital factor in reducing incidences of maternal mortality in Nigeria since it has an inverse and significant impact on maternal mortality rate

The coefficient of the number of Physicians (per 1000 population)D(PYS)) is negatively signed. This shows that the variable has an inverse relationship with the Nigeria's maternal mortality. The value of the coefficient is -1.9827which implies that one percent increase in D(PYS) leads to 1.9827 per cent decrease in the Nigerian maternal mortality. The variable is statistically significant with a probability value of 0.0229and T-Value -2.4184, which is greater than the critical value of 2.093. Thus, we accept the alternate hypothesis that the number of Physicians (per 1000 population) has a significant impact on Nigeria maternal mortality.

The coefficient of net official inflow of WHO on communicable disease DLOG(UDP) is positively signed, this shows that LOG(UDP) has a direct relationship with the Nigeria maternal mortality. This result is not consistent with the a priori expectation. The value of the coefficient is 0.1875which implies that one percent increase in DLOG(UDP)which leads to 0.1875 per cent increase in the Nigeria's maternal mortality. This is not in line with the a'priori expectation. The coefficient of the variable is statistically significant at 5% level of significance with a probability value of 0.0001and T-Value 4.6534 which is greater than the critical value of 2.093. Thus, the alternate hypothesis is accepted, that is Net Official inflow of WHO on communicable disease has no robust effect on the reduction of maternal mortality in Nigeria.

The coefficient of net official inflow of UCF expenditure on vaccine preventable and communicable disease control LOG(UCF) has a direct and significant impact on the Nigeria maternal mortality. One per cent increase in LOG(UCF) leads to 0.2736 percent increase in maternal mortality. This is not consistent with the a priori expectation. This implies that increase in official inflow of UCF expenditure on vaccine preventable and communicable disease control in the country leads to increase in Nigeria maternal mortality.

The result from Table .12 shows that the coefficient of ECM is negative -0.4509 and significant at 5% per cent critical level. This shows that about 45 per cent disequilibrium in the Nigeria maternal mortality in the previous one year was corrected for in the current year. The significance of the ECM is an indication and a confirmation of the existence of a long run equilibrium relationship between Nigeria's maternal mortality and the independent variables used in the study. The robustness of the error correction method further buttresses that only 45% is corrected in the previous year. This means that the explanatory variables had the tendency to improve Nigeria's life expectancy rate all things being equal.

The coefficient of determination (R^2) value of 0.8784 implies that 88% of the total variation in the Nigerian maternal mortality rate is explained by changes in the endogenous variables. Subsequently, 12 per cent is unexplained due to error term while the adjusted coefficient of determination (R^{-2}) Value of 0.8492 implies that 85 per cent of the total variation in Nigerian maternal mortality rate is explained by changes in the endogenous variables when the coefficient of determination is adjusted for degree of freedom. This implies that 15 per cent is unexplained due to error term. The F-Statistic is highly significant at 5% level of significance with the probability value of 0.0000. This is further strengthened by a high F-ratio of 30.1047 which is greater than the critical value of 2.66, and thus we can say that the model has a high goodness of fit while the Durbin Watson Statistic of 2.1960 indicates that autocorrelation was highly minimized.

Diagnostic statistical testing for Model 3

Table 13: Diagnostic tests for Model 3

Purpose of test	Test	Test statistic	Probability	Conclusion
Normality	Jarque-Bera	0.2171	0.8972	Normal
Heteroscedasticity	Breusch–Pagan-Godfrey Heteroskedasticity Test	1.1605	0.3624	No heteroscedasticity
Serial correlation	Breusch–Godfrey serial correlation LM test	0.5142	0.6053	No serial correction
Homoscedasticity	Ramsey RESET Test	3.5946	0.0712	No Homoscedasticity

Source: Author's Estimation Results, 2025 using Eview9

From table 13, all the tests as captured by Jarque-Bera, Breusch-Godfrey LM test, Breusch–Pagan-Godfrey, Heteroskedasticity Ramsey RESET Test among others, revealed not only the robustness of the estimated equation results but the desired properties of an econometric model. The diagnostic tests confirm the suitability of the estimated model. The Breusch–Godfrey LM test statistics indicate that the model did not have significant serial correlation problem. Moreover, the Breusch–Pagan-Godfrey and Ramsey RESET test show that the residuals are homoscedastic and the model has correct functional form.

Policy Implication of the Study

From the relationships of the explanatory variables with the dependent variables in the study, certain implications can be drawn. Percentage coverage of immunized children which were meant to reduce infant mortality in Nigeria actually met our a priori expectation. However, policy instruments to sustain and make this result more effective should be adopted since there were alleged cases of infant mortalities in the country as reported in the literature reviewed. Official development assistance of multinational equally agreed to the inverse a priori expectation used in the study; but that is not say that meaningful impact has been made as there were still cases of infant deaths associated to poor vaccination and immunization in the country as claimed by literature. Perhaps, policy options in ensuring effective monitoring of funds utilization can be adopted in order to improve health status in Nigeria. Public health expenditure did not meet intention of reducing Nigeria's infant mortality rate as it was positively related to infant death rate. Probably, diversion of funds as well inadequate funding of health sector over the period under consideration could be responsible. The number of physicians (per 1000 population) is insufficient to reduce infant mortality even though the desired the inverse relationship was met. Obviously, the brain loss of train medical petitioner in the over years is responsible for this ugly state of affairs, hence policy injection to ensure reversal of this trend. Official inflow of WHO on communicable is positively signed which is quite undesirable; perhaps due to improper monitoring of allocated funds to combat Nigeria infant mortality rate.

Although immunization of children is related to longevity, even in Nigeria, it has not been so effective to increase Nigeria's life expectancy. This may not be far from the little effort put in it, that is, not enough to sustain lives from childhood to adulthood. Development assistance of multinational was well implemented and monitored to add to longevity in Nigeria, and the result is fantastic, even though other factors may

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still be militating against life expectancy. There may also be factor militating against life expectancy in Nigeria other than public health expenditure to GDP, as result shows that all is well between these variables. There is a big problem with number of physicians (per 1000 population)with respect to Nigeria's life expectancy.There is anurgent need to improve on the number of physical per 1000 in order to improve life expectancy. The brain loss cannot continue to be after as it is presently. Official inflow of WHO on communicable disease DLOG(UDP) has no problem with Nigeria life expectancy in Nigeria. This means that all is well between the variables. The low life expectancy can only be due to other reasons. Net official inflow of UCF expenditure on vaccine preventable and communicable disease control is well directed towards Nigeria life expectancy even though it is yet sufficient.

Percentage coverage of immunized children does not affect the reduction of maternal mortality in Nigeria. So, policies to reduce maternal mortality should not include immunization. There is sufficient number and good of gynecologists for reduce number of Nigeria's maternal mortality. Official inflow of WHO on communicable disease and net official inflow of UCF expenditure on vaccine preventable and communicable disease control are not directed towards maternal mortality in Nigeria, even though they could go a long way to reduce it.

Conclusion and Recommendations

Based on the results in this study, it becomes obvious that government expenditure on immunization did not reduce the number of infant deaths in the country. However, government expenditure on health stems maternal mortality and promotes life expectancy in Nigeria. Furthermore, foreign agency health expenditure on immunization stems infant mortality and maternal mortality and improved the country life expectancy. It is therefore, justifiable to conclude that all infant deaths and maternal mortality reduce with increasing expenditure on immunization while life expectancy increases with rising expenditure on immunization.

The following recommendations were made for policy implementation:

Government should allocate more funds and adequate personnel in order to increase percentage coverage of immunized children (PIC) to further decrease the number of infant deaths. This will help to reduce infant mortality in the country.

The donor agencies should increase their donations and continue to monitor usage while the government should also increase monitoring of these donations and grants collected from various international agencies in the fight to control and prevent diseases affecting infant mortality, life expectancy and maternal mortality in Nigeria.
The federal government should introduce national immigration policies that would help to reduce the number of physicians migrating to other countries, leading to brain drain, by initiating some welfare policies vis-à-vis packages that would attract Nigerian and foreign medical physicians who are living in diaspora to render their medical services in order to have adequate physicians to combat infant mortality and life expectancy. This may help in increasing the number of physicians per child and promote life expectancy in Nigeria.
There is need for government to increase, train and retraining of healthcare personnel most especially the physicians in the country in order to improve Nigerian health status of infant mortality and life expectancy.

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