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# Government HealthCare Expenditure and Infant Mortality in Nigeria.

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**Abstract**

This study investigates the determinants of infant mortality in Nigeria, focusing on the roles of government healthcare expenditure (both capital and recurrent), per capita income, and tertiary school enrolment rate from 1981 to 2023. Using annual time series data obtained from the World Development Indicators (WDI) (2023) and CBN Statistical Bulletin (2023) the analysis employs the Augmented Dickey-Fuller (ADF) unit root test, Johansen cointegration technique, and a parsimonious error correction model (ECM) to examine both long- and short-run relationships among the variables. The descriptive statistics revealed considerable variations in the data, particularly in capital health expenditure, while the unit root tests confirmed that the variables were integrated of order one, I(1). The Johansen cointegration test established the existence of three cointegrating relationships, indicating a stable long-run association among the variables. The ECM results showed that government capital healthcare expenditure and per capita income significantly reduce infant mortality in both the short and long run, while recurrent health expenditure and tertiary school enrolment had delayed or marginal effects. The study concludes that strategic investment in healthcare infrastructure, income-enhancing policies, and improved educational attainment are critical to reducing infant mortality in Nigeria. Based on the findings, the study recommends increased and sustained capital spending in the health sector, efficient use of recurrent health funds, poverty reduction strategies, and strengthened educational policies.

**Keywords**: Health Expenditure, Infant mortality, school enrolment rate, per capita income, healthcare services

## 1.1 Introduction

Healthcare is a cornerstone of human capital development and a fundamental determinant of a natin's socioeconomic progress. Access to quality healthcare services significantly enhances life expectancy, reduces morbidity, and improves overall well-being. Among the critical health indicators used to evaluate a country's healthcare system is infant mortality, which reflects the number of deaths of infants under one year of age per 1,000 live births within a specific period. Infant mortality is not only a measure of the health status of a population but also an indicator of the effectiveness of healthcare policies and the socio-economic conditions of a nation (World Health Organization [WHO], 2021).

Globally, there has been remarkable progress in reducing infant mortality over the past few decades, driven by advancements in medical technology, improved healthcare access, and targeted interventions such as immunization and maternal health programs. However, sub-Saharan Africa, including Nigeria, continues to face disproportionately high rates of infant mortality. Nigeria's infant mortality rate remains one of the highest in the world, contributing significantly to the global burden of child mortality (United Nations Children's Fund [UNICEF], 2022). According to the World Bank (2023), Nigeria recorded an infant mortality rate of 56.7 deaths per 1,000 live births in 2022, far above the global average of 28.2 per 1,000 live births.

A major factor influencing infant mortality in Nigeria is the inadequacy of healthcare expenditure. Healthcare expenditure encompasses the financial resources allocated to maintain and improve health systems, including spending on infrastructure, personnel, medical supplies, and public health programs. Empirical evidence suggests that increased healthcare spending is associated with improved health outcomes, including reductions in infants and maternal mortality (Akinyemi et al, 2020). However, Nigeria's healthcare sector has been plagued by chronic underfunding and inefficiencies. The country has consistently fallen short of the 15% healthcare expenditure target set by the Abuja Declaration in 2001, where the African Union member states committed to allocating at least 15% of their national budgets to health (WHO, 2021).

The implications of underinvestment in healthcare are profound. Poor funding limits access to essential health services, including antenatal care, skilled birth attendance, immunizations, and neonatal care, which are critical for reducing infant mortality. Additionally, the inequitable distribution of healthcare resources, particularly between urban and rural areas, exacerbates disparities in health outcomes. In rural communities, where a significant proportion of Nigeria's population resides, the lack of healthcare facilities and trained personnel contributes to high rates of preventable infant deaths.

Consequently, the primary objective of this study is to analyze the impact of government healthcare expenditure on infant mortality in Nigeria using time series data.

## 2.0 Literature Review

### 2.1 Theoretical Literature

#### 2.1.1 Grossman's Health Production Function (1972)

Grossman's Health Production Function, introduced in 1972, and is a seminal theoretical framework in health economics that views health as both a consumption good and an investment good. As a consumption good, health directly contributes to an individual's utility or well-being, while as an investment good, it enhances productivity by increasing the number of healthy days available for labor and other activities. Grossman conceptualized health as a form of "human capital" that individuals can invest in and maintain over time, influenced by decisions about healthcare utilization, lifestyle choices, and socioeconomic factors.

#### 2.2.2 Human Capital Theory

The Human Capital Theory, developed by economists Gary Becker (1964) and Theodore Schultz (1961), posits that individuals and societies derive economic benefits from investing in people's education, skills, health, and knowledge. This theory views human capital as a form of productive wealth, akin to physical capital, that contributes to economic growth and development. The central tenet is that investments in human capital enhance individuals' productivity, earning potential, and overall well-being, which in turn drives societal progress. Human capital investments are multidimensional and include education, training, and healthcare. These investments are critical for improving the quality and quantity of the workforce, fostering innovation, and sustaining economic competitiveness.

### 2.2.3 Resource Allocation Theory

Resource Allocation Theory, rooted in economic principles, focuses on the efficient distribution of limited resources to achieve maximum utility or benefit. This theory is grounded in the works of Lionel Robbins (1932), who defined economics as the science of allocating scarce resources among competing ends. The theory emphasizes the need to prioritize the allocation of resources, particularly when demands exceed available supply, to maximize societal welfare. In the healthcare context, Resource Allocation Theory provides a framework for understanding how governments, institutions, and individuals distribute financial, human, and material resources to achieve optimal health outcomes.

## 2.3 Empirical Literature

Akpan et al. (2023) examined the effect of government health expenditure on infant mortality in Nigeria using a vector autoregressive (VAR) model from 1995 to 2020. Their findings indicated that government health expenditure has a statistically significant negative effect on infant mortality in the long term. However, the study also found that short-term impacts were less pronounced, suggesting that healthcare expenditures require time to translate into improved health outcomes. The authors emphasized the importance of increasing public health funding and prioritizing maternal and child health services to accelerate improvements in infant survival rates.

Ajala and Ogundipe (2022) analyzed the relationship between government healthcare spending and infant mortality using panel data for Nigerian states between 1990 and 2019. Their study found that an increase in healthcare expenditure significantly reduces infant mortality, particularly in states with better health infrastructure. The authors noted that the effectiveness of healthcare spending is influenced by regional differences in healthcare access, which underlines the need for targeted resource allocation. The study suggested that decentralized health spending at the state level could more effectively address local health challenges and reduce infant mortality rates.

Ogunleye et al. (2021) conducted a study on the impact of healthcare expenditure on infant and child mortality in Nigeria, covering the period 1985–2019. Their findings confirmed that government expenditure on healthcare had a strong negative relationship with infant mortality, with the highest impacts occurring in urban areas. The study attributed this disparity to the greater availability of healthcare infrastructure and services in urban centers, as well as a higher concentration of healthcare professionals. The authors called for more equitable distribution of healthcare resources between urban and rural areas to address the persistently high infant mortality rates in rural Nigeria.

Ogunyemi et al. (2022) conducted a study on the effect of public healthcare expenditure on infant mortality in Nigeria using data from 1980 to 2020. The authors employed time-series analysis and found a significant negative relationship between government health expenditure and infant mortality rates. Specifically, they concluded that increases in healthcare spending led to a reduction in infant mortality, with the most substantial impact seen in maternal health programs and vaccination initiatives. The study highlighted the importance of ensuring that healthcare resources are directed toward primary healthcare, which directly impacts maternal and child health outcomes.

Eze et al. (2021) analyzed the impact of healthcare spending on child health outcomes in Nigeria by using cross-country panel data for 35 sub-Saharan African countries, including Nigeria. The study found that a 1% increase in per capita healthcare expenditure was associated with a 0.4% reduction in infant mortality. In the Nigerian context, however, the study emphasized the inefficiencies in resource allocation and the uneven distribution of healthcare services, which dampened the effectiveness of healthcare spending in rural areas. The authors concluded that simply increasing expenditure is insufficient; there must be strategic allocation toward equitable healthcare delivery and addressing regional disparities.

### 2.3.1 Literature Gap

A consistent finding across studies, such as Ogunyemi et al. (2022) and Ajala and Ogundipe (2022), is that while increased healthcare expenditure correlates with reduced infant mortality, the efficiency of this spending remains under-explored. Literature tends to focus primarily on the quantity of expenditure rather than its quality or efficiency in healthcare delivery. Also, literature is silent on the component that healthcare expenditure that impacts infant mortality more significantly. Ajala and Ogundipe (2022) acknowledge the inefficiencies in Nigeria's healthcare system but do not delve deeply into how these inefficiencies can be rectified or measured in terms of specific policy changes or governance reforms. Thus, this study differs from others as it decomposed healthcare expenditures into government recurrent and capital expenditures and ascertain their individual impacts on infant mortality in Nigeria.

## 3.0 Methodology

### 3.1 Research Design.

This study used a time-series econometric design (cointegration/ECM) for accuracy to realize the purposes of the study. This research design is necessary because the selected research area for investigation is empirical, quantitative, and analytical where the response and explanatory variables are perceived over a time frame for any variation that can occur.

3.2 Method of Data Collection The study used a secondary data because the research work is analytical. Times series data relating to the dependent and explanatory variables used covered a period of 1981 to 2023. All the data employed in this study were obtained from the World Development Indicators (2023) and Central Bank of Nigeria Statistical Bulletin (2023).

### 3.3 Model Specification

To achieve the specified objectives of this study, the functional, mathematical and econometric relationship between the dependent variable and the independent variables are seen in the equation below:

$$IFMR = f\,(GRHE, GCHE, TSER, PCI) \quad \ldots\ldots\ldots \; 3.1$$

Equation 3.1 is expressed mathematically as

$$IFMRt = \alpha 0 + \beta 1GRHEt + \beta 2GCHEt + \beta 3SERt + \beta 4PCIt \quad \ldots\ldots\ldots \; 3.2$$

The econometric model of the study from equation 3.2 is given as:

$$IFMRt = \alpha 0 + \beta 1GRHEt + \beta 2GCHEt + \beta 3SERt + \beta 4PCIt + \mu t \quad \ldots\ldots\ldots \; 3.3$$

Where:

IFMR = Infant mortality rate

 

GRHE = Government Recurrent Healthcare Expenditure
GCHE = Government Capital Healthcare Expenditure
TSER= School enrolment rate
PCI = Per capita income
$\alpha 0$ and $\beta 1$ = slope and Regression coefficients respectively
$\mu$ = the error term which accounts for other likely factors which could influence IFMR that are not already captured in the model.
t = time series component.

## 3.4 Method of Data Analysis

The data for this study were analyzed using the Ordinary Least Squares (OLS) estimation techniques, under the framework of the error correction model.

## 4.0 Results and Discussions

Table 4.1: Descriptive statistics

| | GCHE | GRHE | IFMR | PCI | TSER |
|---|---|---|---|---|---|
| Mean | 2211.725 | 23949.38 | 101.4419 | 1120.274 | 0.062047 |
| Median | 696.8000 | 22421.05 | 104.0000 | 1107.200 | 0.062000 |
| Maximum | 11066.24 | 83168.64 | 126.0000 | 1611.700 | 0.104000 |
| Minimum | 4.750000 | 2159.490 | 68.00000 | 670.4000 | 0.021000 |
| Std. Dev. | 3056.784 | 19372.54 | 20.82958 | 296.0055 | 0.025036 |
| Skewness | 1.604884 | 0.913691 | -0.200321 | 0.116663 | 0.009479 |
| Kurtosis | 4.710542 | 3.596260 | 1.422899 | 1.714912 | 1.787789 |
| Jarque-Bera | 23.70119 | 6.619935 | 4.743905 | 3.056391 | 2.633420 |
| Probability | 0.000007 | 0.036517 | 0.093298 | 0.216927 | 0.268016 |
| Sum | 95104.19 | 1029823. | 4362.000 | 48171.80 | 2.668000 |
| Sum Sq. Dev. | 3.92E+08 | 1.58E+10 | 18222.60 | 3680008. | 0.026326 |
| Observations | 43 | 43 | 43 | 43 | 43 |

Source: Authors' computation using EViews 13

Table 4.1 presents the descriptive statistics for the key variables used in this study: Government Capital Healthcare Expenditure (GCHE), Government Recurrent Healthcare Expenditure (GRHE), Infant Mortality Rate (IFMR), Per Capita Income (PCI), and Tertiary School Enrolment Rate (TSER), covering a total of 43 observations. The mean values provide insight into the central tendency of each variable over the study period. The average government capital expenditure on healthcare was ₦2,211.73 million, significantly lower than the average recurrent expenditure of ₦23,949.38 million, suggesting that recurrent expenses dominate health sector spending in Nigeria. The mean infant mortality rate stood at 101.44 deaths per 1,000 live births, which indicates a relatively high rate of infant deaths despite ongoing investments in healthcare. The average per capita income was ₦1,120.27, reflecting the broader macroeconomic conditions affecting household welfare. The tertiary school enrolment rate averaged 6.2%, indicating limited access to education in some parts of the country.

The dispersion of the data, as reflected by the standard deviation, reveals considerable variability in the data, particularly for GCHE and GRHE, with standard deviations of ₦3,056.78 million and ₦19,372.54 million, respectively. This suggests inconsistent patterns in government spending across the years. IFMR also shows moderate variability with a standard deviation of 20.83, indicating fluctuations in infant mortality over time. PCI and TSER show relatively lower variations with standard deviations of ₦296.01 and 0.025, respectively. The skewness values suggest that GCHE and GRHE are positively skewed, indicating a longer tail to the right, while

 

IFMR has a slight negative skew, pointing to more frequent higher mortality values. PCI and TSER are nearly symmetric with values close to zero.

The kurtosis values show that GCHE (4.71) and GRHE (3.60) have heavier tails than the normal distribution, indicating the presence of outliers or extreme values. IFMR, PCI, and TSER exhibit platykurtic distributions (kurtosis < 3), meaning the distributions are flatter than normal. The Jarque-Bera statistics test for normality indicates that the GCHE and GRHE distributions are significantly non-normal (p-values < 0.05), while IFMR, PCI, and TSER do not significantly deviate from normality (p-values > 0.05). These findings are important for model specification and selection of appropriate estimation techniques in the subsequent econometric analysis.

Table 4.2: Unit root test results (ADF tests)

| | Augment Dickey-Fuller Test | | | | |
|---|---|---|---|---|---|
| Series | Levels | First Diff. | 5% C.V | Ord. of Int. | Decision |
| GCHE | -1.945275 | -6.780834 | -4.443649 | I(1) | Accept |
| GRHE | -2.390627 | -3.110008 | -2.935001 | I(1) | Accept |
| IFMR | -0.943126 | -3.027927 | -2.935001 | I(1) | Accept |
| PCI | 1.572372 | -5.604109 | -2.935001 | I(1) | Accept |
| TSER | -0.018612 | -10.53565 | -4.443649 | I(1) | Accept |
| ECT | -2.554847 | - | -1.949097 | I(0) | Accept |

Source: Authors' computation using EViews 13

Table 4.2 presents the results of the Augmented Dickey-Fuller (ADF) unit root test used to assess the stationarity of the variables employed in the study. Stationarity is a critical property in time series analysis, as the presence of unit roots (i.e., non-stationarity) in data can lead to spurious regression results. Each variable was tested both at levels and at first differences, and their results are compared with the 5% critical value to determine their order of integration.

From the table, all the main variables—Government Capital Healthcare Expenditure (GCHE), Government Recurrent Healthcare Expenditure (GRHE), Infant Mortality Rate (IFMR), Per Capita Income (PCI), and Tertiary School Enrolment Rate (TSER)—are found to be non-stationary at level, as their ADF test statistics at levels are higher (less negative) than the respective 5% critical values. However, after taking the first difference, all variables become stationary, as the ADF test statistics at first difference are more negative than the 5% critical values. For example, the ADF test statistic for GCHE at level is -1.945275, which is less negative than the 5% critical value of -4.443649, indicating non-stationarity. However, at first difference, the ADF statistic is -6.780834, well below the critical value, confirming that GCHE is stationary at first difference, or integrated of order one, I(1). A similar pattern is observed for GRHE, IFMR, PCI, and TSER, all of which are found to be I (1).

The Error Correction Term (ECT) is also tested for stationarity to validate its appropriateness in an Error Correction Model (ECM). The ECT is stationary at level (I(0)), as its ADF test statistic of -2.554847 is less than the critical value of -1.949097. This confirms that the residuals from the cointegration equation are stationary, satisfying a key requirement for the application of ECM and indicating the presence of a long-run equilibrium relationship among the variables.



 

The unit root test results justify the use of cointegration and error correction modeling techniques in the study, as all variables are integrated of order one, I(1), while the ECT is stationary at level. This implies that although the individual series may exhibit stochastic trends, a stable long-run relationship exists among them, allowing for meaningful econometric modeling of the impact of healthcare expenditure on infant mortality in Nigeria.

Table 4.3: Johansen Cointegration test Result

Endogenous variables: IFMR GCHE GRHE PCI TSER
Deterministic assumptions: Case 3 (Johansen-Hendry-Juselius):
Cointegrating relationship includes a constant. Short-run dynamics includes a constant

Unrestricted Cointegration Rank Test (Trace)

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** Critical Value |
|---|---|---|---|---|
| None * | 0.992169 | 284.1823 | 69.81889 | 0.0000 |
| At most 1 * | 0.664176 | 85.34496 | 47.85613 | 0.0000 |
| At most 2 * | 0.514072 | 40.60712 | 29.79707 | 0.0020 |
| At most 3 | 0.178715 | 11.01760 | 15.49471 | 0.2104 |
| At most 4 | 0.069318 | 2.945333 | 3.841465 | 0.0861 |

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

Unrestricted Cointegration Rank Test (Max-eigenvalue)

| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** Critical Value |
|---|---|---|---|---|
| None * | 0.992169 | 198.8373 | 33.87687 | 0.0000 |
| At most 1 * | 0.664176 | 44.73785 | 27.58434 | 0.0001 |
| At most 2 * | 0.514072 | 29.58952 | 21.13162 | 0.0026 |
| At most 3 | 0.178715 | 8.072267 | 14.26460 | 0.3714 |
| At most 4 | 0.069318 | 2.945333 | 3.841465 | 0.0861 |

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

Source: Authors' computation using EViews 13

Table 4.3 presents the Johansen Cointegration Test results using both the Trace statistic and the Max-Eigenvalue statistic to determine the number of cointegrating relationships among the variables: Infant Mortality Rate (IFMR), Government Capital Health Expenditure (GCHE), Government Recurrent Health Expenditure (GRHE), Per Capita Income (PCI), and Tertiary School Enrolment Rate (TSER). The test was conducted under the Johansen-Hendry-Juselius framework with a deterministic trend assumption that includes a constant in both the cointegrating equations and the short-run dynamics.

The Trace test results show that the null hypothesis of no cointegration (None) is rejected at the 5% level, as the trace statistic (284.1823) exceeds the critical value (69.81889) with a p-value of 0.0000. Similarly, the hypotheses of at most one cointegrating equation and at most two are also rejected, as their trace statistics (85.34496 and 40.60712, respectively) are higher than the respective 5% critical values. However, the null hypotheses of at most three and at most four cointegrating equations are not rejected, as their trace statistics (11.01760 and 2.945333) fall below their respective critical values. Therefore, the trace test indicates the existence of three cointegrating equations, implying a long-run equilibrium relationship among the variables.

Similarly, the Max-Eigenvalue test supports this conclusion. The test rejects the null hypothesis of no cointegration with a max-eigenvalue statistic of 198.8373, which is significantly greater than the 5% critical value of 33.87687. The subsequent hypotheses of at most one and at most two cointegrating vectors are also rejected based on their respective max-eigenvalue statistics (44.73785 and 29.58952), both exceeding their critical values. The null hypotheses for at most three and at most four cointegrating relationships are not rejected, consistent with the trace test. Hence, the Max-Eigenvalue test also confirms the presence of three cointegrating vectors at the 5% significance level.

The implication of these results is that there exists a stable, long-run equilibrium relationship among infant mortality rate, healthcare expenditures (both recurrent and capital), per capita income, and school enrolment rate in Nigeria during the study period. This justifies the application of an Error Correction Model (ECM) to capture both the short-term dynamics and long-term relationships among the variables. It also underscores the interconnectedness of public health financing, income levels, educational attainment, and health outcomes in the Nigerian context, supporting the theoretical expectation that investments in healthcare and education significantly affect infant mortality over time.

Table 4.4: Parsimonious ECM Result

Dependent Variable: IFMR
Method: Least Squares
Included observations: 41 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 181.2664 | 49.08412 | 3.692975 | 0.0008 |
| D(GCHE) | -0.027196 | 0.005049 | -5.386365 | 0.0000 |
| D(GRHE) | -0.000215 | 0.000794 | -0.270760 | 0.7882 |
| D(GRHE(-1)) | -0.002027 | 0.000570 | -3.554627 | 0.0011 |
| D(PCI) | -0.658912 | 0.226127 | -2.913900 | 0.0063 |
| D(TSER) | -44823.95 | 25961.14 | -1.726579 | 0.0933 |
| ECT(-1) | -0.629155 | 0.218625 | -2.877782 | 0.0024 |

| | | | |
|---|---|---|---|
| R-squared | 0.662689 | Mean dependent var | 100.3415 |
| Adjusted R-squared | 0.603164 | S.D. dependent var | 20.70822 |
| S.E. of regression | 13.04513 | Akaike info criterion | 8.128959 |
| Sum squared resid | 5785.966 | Schwarz criterion | 8.421520 |
| Log likelihood | -159.6437 | Hannan-Quinn criter. | 8.235494 |
| F-statistic | 11.13288 | Durbin-Watson stat | 1.637905 |
| Prob(F-statistic) | 0.000001 | | |

Source: Authors' computation using EViews 13

Table 4.4 presents the results of a parsimonious Error Correction Model (ECM) estimated using Ordinary Least Squares (OLS), with infant mortality rate (IFMR) as the dependent variable and a sample period covering 1983 to 2023. The ECM is designed to capture both short-run dynamics and the adjustment process towards long-run equilibrium, following the confirmation of cointegration among the variables in Table 4.3. The model includes the first differences of Government Capital Health Expenditure (D(GCHE)), Government Recurrent Health Expenditure (D(GRHE)), its lagged value (D(GRHE(-1))), Per Capita Income (D(PCI)), Tertiary School Enrolment Rate (D(TSER), and the lagged error correction term (ECT(-1)).

The results show that D(GCHE) has a statistically significant negative effect on infant mortality in the short run, with a coefficient of -0.027196 and a p-value of 0.0000. This implies that an increase in capital expenditure on health significantly reduces infant mortality, which is consistent with expectations since capital spending often involves investment in infrastructure and medical equipment that directly impacts health outcomes. Conversely, the current value of D(GRHE) is statistically insignificant (p = 0.7882), indicating that immediate recurrent health expenditures do not have a strong short-run effect. However, its lagged value, D(GRHE(-1)), is significant (p = 0.0011), suggesting a delayed impact of recurrent spending, possibly due to the time required for staff salaries, medical supplies, and other recurrent expenses to translate into improved healthcare delivery.

The coefficient of D(PCI) is negative and significant (p = 0.0063), indicating that an increase in per capita income leads to a reduction in infant mortality, likely due to improved living standards, better nutrition, and access to healthcare. Although D(TSER) has a negative coefficient (indicating a potential inverse relationship with infant mortality), it is only marginally significant (p = 0.0933), suggesting a weaker short-run influence of school enrolment on infant health outcomes, possibly due to the indirect or long-term nature of educational impacts.

Importantly, the error correction term (ECT (-1)) is negative and statistically significant (coefficient = -0.629155, p = 0.0024), confirming the existence of a stable long-run relationship among the variables. The negative sign indicates that deviations from the long-run equilibrium are corrected over time, with about 63% of the disequilibrium adjusted within a year. The model also exhibits good overall fit, with an R-squared value of 0.6627, implying that about 66% of the variation in infant mortality is explained by the explanatory variables. The F-statistic is significant (p = 0.000001), confirming the joint significance of the model, while the Durbin-Watson statistic of 1.64 suggests the absence of severe autocorrelation in the residuals.

Therefore, the ECM results affirm the importance of capital health expenditure and income levels in reducing infant mortality in Nigeria, while highlighting that the effects of recurrent spending and education may manifest with a lag or over the longer term. These findings support targeted investment in capital healthcare projects and policies aimed at improving income and education to achieve sustainable improvements in child health outcomes.

## 4.2 Model Diagnostic Tests

### 4.2.1 Residual Diagnostic Tests Results

 

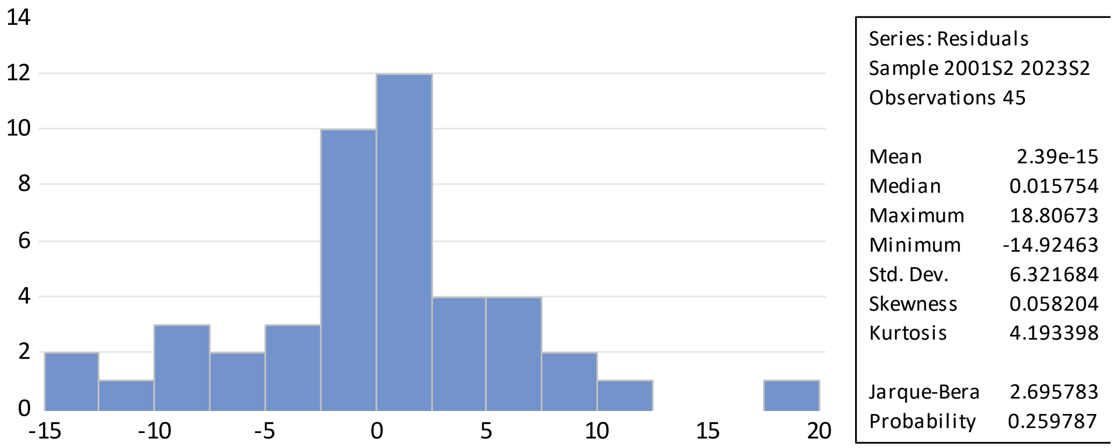


Figure 4.1: Histogram normality plot
Source: Authors' plot from regression residuals using EViews 13

The histogram normality plot displayed In Table 4.1 represents the distribution of residuals from the estimated error correction model in the study. The histogram is approximately bell-shaped and centered around zero, which visually suggests that the residuals may follow a normal distribution, a critical assumption in classical linear regression models for the validity of inference (Gujarati & Porter, 2009).

Quantitatively, several statistics support the visual impression of normality. The mean of the residuals is approximately zero (2.39e-15), and the median (0.015754) is also close to zero, indicating that the residuals are symmetrically distributed. The skewness of 0.0582 is very close to zero, suggesting minimal asymmetry in the distribution. Moreover, the kurtosis value of 4.193398 is slightly above the normal distribution's benchmark value of 3, indicating mild leptokurtosis, i.e., a distribution with heavier tails than the normal.

Importantly, the Jarque-Bera (JB) test statistic of 2.659783 and the corresponding p-value of 0.259787 provide formal evidence in support of normality. Since the p-value is greater than the conventional 0.05 significance level, we fail to reject the null hypothesis of normally distributed residuals. This implies that the assumption of normality is not violated in this model, which reinforces the reliability of the estimated parameters, test statistics, and confidence intervals (Wooldridge, 2013).

From the above, the histogram, along with the JB test, skewness, and kurtosis statistics, confirms that the residuals from the model are normally distributed.

Table 4.5: Serial Correlation Test

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

| | | | |
|---|---|---|---|
| F-statistic | 0.924234 | Prob. F(2,31) | 0.4075 |
| Obs*R-squared | 2.532266 | Prob. Chi-Square(2) | 0.2819 |

Source: Authors' computation using EViews 13

The results from the Breusch-Godfrey Serial Correlation LM test in Table 4.5 suggest that there is no significant evidence of serial correlation in the residuals of the model up to two lags. The null hypothesis of no serial correlation is tested with two different statistics: the F-statistic and the Obs*R-squared statistic.

The F-statistic value is 0.924234, and its associated probability value is 0.4075. Since the probability value is greater than the commonly used significance level of 0.05, we fail to reject the null hypothesis, indicating that there is no significant serial correlation up to two lags in the model.

Similarly, the Obs*R-squared statistic is 2.532266, with a corresponding probability of 0.2819. Again, this p-value exceeds the 0.05 threshold, which further supports the decision to fail to reject the null hypothesis. Therefore, the test results provide no evidence of serial correlation, meaning that the residuals of the model do not exhibit a pattern of autocorrelation up to two lags. This implies that the model is well-specified in terms of the assumption of no serial correlation, and the residuals appear to behave randomly.

## 4.3 Model Stability Tests

Table 4.6: Ramsey Reset Test

Ramsey RESET Test
Equation: UNTITLED
Omitted Variables: Squares of fitted values
Specification: D(IFMR) C D(GCHE) D(GRHE) D(GRHE(-1)) D(PCI) D(TSER) ECT(-1)

| | Value | Df | Probability |
|---|---|---|---|
| t-statistic | 0.398575 | 32 | 0.6929 |
| F-statistic | 0.158862 | (1, 32) | 0.6929 |
| Likelihood ratio | 0.222847 | 1 | 0.6369 |

F-test summary:

| | Sum of Sq. | Df | Mean Squares |
|---|---|---|---|
| Test SSR | 8.686340 | 1 | 8.686340 |
| Restricted SSR | 1758.402 | 33 | 53.28492 |
| Unrestricted SSR | 1749.716 | 32 | 54.67862 |

LR test summary:

| | Value |
|---|---|
| Restricted LogL | -146.3259 |
| Unrestricted LogL | -146.2145 |

Source: Authors’ computation using EViews 13

The Ramsey RESET test results presented in Table 4.6 provide an evaluation of the model's specification. The purpose of this test is to detect whether there are any omitted variables or incorrect functional forms in the model. The test is conducted by adding the squares of the fitted values to the model as explanatory variables, and the results are assessed through the t-statistic, F-statistic, and likelihood ratio.

The t-statistic is 0.398575, and its associated p-value is 0.6929. This p-value is well above the typical significance level of 0.05, indicating that there is no significant evidence to suggest that the model suffers from misspecification due to omitted variables or functional form errors.

Similarly, the F-statistic is 0.158862 with a p-value of 0.6929, which again exceeds the 0.05 threshold. This further suggests that there is no significant misspecification in the model.

 

The likelihood ratio test provides another perspective on the model's specification. The likelihood ratio statistic is 0.222847, and its p-value is 0.6369, which also indicates no evidence of model misspecification. Both the restricted and unrestricted log-likelihood values (−146.3259 and −146.2145, respectively) further show minimal difference between the two models, reinforcing the conclusion of no significant specification issues.

The F-test and LR test summaries confirm that the sum of squared residuals (SSR) does not significantly differ between the restricted and unrestricted models, suggesting that the inclusion of the squared fitted values does not improve the model's fit. The restricted SSR is 1758.402, while the unrestricted SSR is 1749.716, showing a negligible improvement in model fit with the addition of the squared fitted values.

So, the results from the Ramsey RESET test do not indicate any significant issues with model specification. The p-values across the t-statistic, F-statistic, and likelihood ratio test all suggest that the model is correctly specified and does not suffer from omitted variables or incorrect functional form.

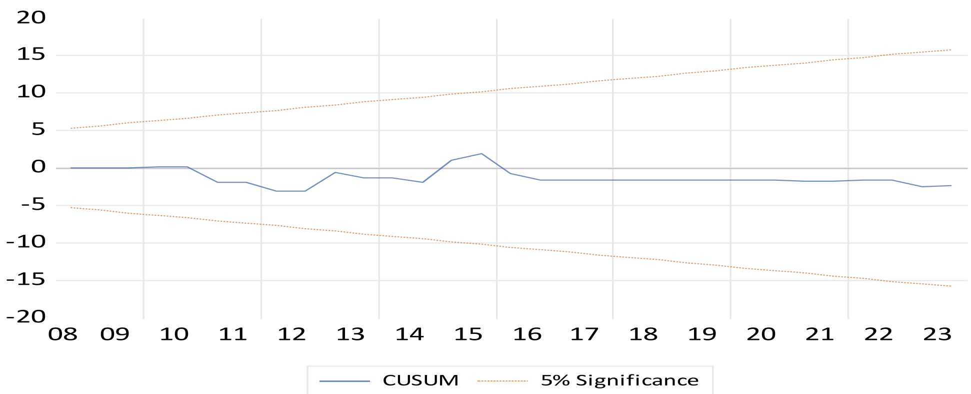


Figure 4.2: Cumulative Sum of Square Test

Figure 4.2 shows that there are no structural breaks in the estimated model or the series associated with it. This is because, as seen in the plot, the blue line lies perfectly between the upper- and lower-5 percent critical bounds denoted by the two red lines. This also confirms that there are no outliers in the estimated Error Correction model, thereby further supporting its stability status and making it fit for policy recommendations and predictions.

## 4.4 Hypotheses Testing

Based on the results from Table 4.4 (Parsimonious Error Correction Model), the hypotheses regarding the determinants of infant mortality rate (IFMR) in Nigeria were tested and presented below.

Hypothesis 1 (Ho1): Government capital healthcare expenditure does not have a significant impact on the infant mortality rate in Nigeria.

The coefficient of the first difference of government capital healthcare expenditure (D(GCHE)) is -0.027196 and is statistically significant at the 1% level (p = 0.0000). This strong level of significance indicates that increased capital spending on healthcare—such as infrastructure, facilities, and equipment—has a significant negative effect on infant mortality, suggesting that it contributes to a reduction in infant deaths in Nigeria. Thus, hypothesis of the study is rejected in its null form.



 

Hypothesis 2 (Ho2): Government recurrent healthcare spending does not significantly impact infant mortality rates in Nigeria.

The current value of D(GRHE) has a p-value of 0.7882, indicating it is not statistically significant in the short run. Therefore, while the immediate effect is negligible, recurrent health spending contributes insignificantly to infant health over time, justifying the rejection of hypothesis two in its null form.

Hypothesis 3 (Ho3): Tertiary school enrolment rate (TSER) does not significantly impact infant mortality rates in Nigeria.

This hypothesis is not rejected at the conventional 5% level. The coefficient for D (TSER) is negative (-44823.95), suggesting that increased tertiary school enrolment may reduce infant mortality; however, the p-value is 0.0933, which is marginally above the 5% threshold but below 10%. This implies a weak or borderline significance, warranting cautious interpretation. Therefore, while there is some evidence that higher educational enrolment could lower infant mortality, it is not strong enough to reject the null hypothesis at the 5% level.

Hypothesis 4 (Ho4): Per capita income does not significantly impact infant mortality rates in Nigeria.

This hypothesis is clearly rejected. The coefficient of D(PCI) is -0.658912, and it is statistically significant at the 1% level (p = 0.0063). This result confirms that rising per capita income is associated with declining infant mortality, possibly due to improved access to nutrition, healthcare, and living conditions that come with higher income levels.

4.5 Discussion of Findings

The significant and negative relationship between government capital healthcare expenditure (GCHE) and infant mortality rate (IFMR) highlights the crucial role of physical investment in health infrastructure. Capital expenditures include spending on hospitals, clinics, medical equipment, and other durable healthcare assets. The negative coefficient indicates that as GCHE increases, infant mortality declines significantly. This finding aligns with the work of Akpan et al. (2023), and Ajala and Ogundipe (2022), who found that public health investment improves child survival in African countries. Similarly, Ogunleye et al. (2021) established that increased capital spending on health leads to better health outcomes by enhancing access and quality of healthcare services. The result emphasizes the importance of sustained capital investment in health infrastructure to reduce preventable infant deaths in Nigeria.

Recurrent healthcare expenditure (GRHE), which includes salaries, drugs, and other consumables, does not exhibit a significant contemporaneous effect on infant mortality. However, the study reveals a statistically significant lagged effect, suggesting that the benefits of recurrent spending may materialize over time. This finding is consistent with Akinlo and Sulola (2019), who argue that recurrent health expenditure may take time to influence health indicators, especially in systems plagued by inefficiencies and corruption. Therefore, while recurrent spending is important for sustaining day-to-day healthcare operations, its impact on health outcomes like infant mortality may only be observable in the medium to long term. This underscores the need for efficient use of the recurrent health budgets to ensure that services are effectively delivered.

 

Per capita income (PCI) was also found to have a strong and statistically significant negative relationship with infant mortality. This result reinforces the idea that income is a key determinant of health, supporting the Grossman model of health production. Higher income levels improve household access to better nutrition, sanitation, housing, and healthcare services, all of which contribute to reduced infant mortality. This finding is corroborated by studies such as Ogunyemi et al. (2022), who found income to be a strong determinant of child mortality across countries. In the Nigerian context, this result suggests that efforts to reduce poverty and improve household income will contribute significantly to better infant health outcomes.

The tertiary school enrolment rate (TSER), used as a proxy for educational attainment, shows a negative but weakly significant effect on infant mortality at the 10% level. This implies that while education, particularly at the tertiary level, may contribute to reduced infant mortality through improved health knowledge and decision-making, the effect is not robust in this study. This contrasts slightly with the findings of Rukky (2022) who emphasized the strong link between maternal education and child survival. A possible explanation for the weak effect may be that tertiary education is less widespread in Nigeria, and its influence on infant mortality is indirect compared to basic education. Nevertheless, the result points to the potential long-term benefits of expanding educational access, especially for women, in reducing infant deaths.

## 5.0 Conclusion and Recommendation

### 5.1 Conclusion

This study concludes that infant mortality in Nigeria is significantly influenced by government investment in healthcare infrastructure, household income levels, and, to a lesser extent, educational attainment. In particular, capital health expenditure and per capita income play critical roles in reducing infant deaths, while recurrent expenditure and education exhibit more gradual or lagged impacts.

The results also underscore the existence of a long-run relationship between the selected socio-economic factors and infant mortality, suggesting that long-term planning and consistent investments are vital in the effort to improve infant survival in Nigeria.

### 5.2 Policy Recommendations

Based on the empirical findings, the following recommendations are offered:

1. The government should prioritize sustained and substantial capital investments in healthcare infrastructure such as hospitals, maternity centres, and neonatal units, particularly in underserved rural areas. These investments will improve access to quality health services and reduce preventable infant deaths.
2. Although recurrent health expenditure showed delayed significance, it remains essential for the day-to-day functioning of healthcare facilities. Policies should ensure efficient allocation, accountability, and sustained funding to avoid service disruptions and staff shortages.
3. Given the significant role of per capita income in reducing infant mortality, economic empowerment programs, employment generation, and targeted poverty alleviation efforts should be intensified. Improved household income translates directly into better nutrition, access to healthcare, and living standards for infants and mothers.
4. While the effect of tertiary enrolment was modest, education remains a vital determinant of health behavior. Government should expand access to basic and tertiary

 

education, with a focus on female literacy, as educated mothers are more likely to adopt health-enhancing practices and access maternal services.

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