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Inflation and Health Outcomes in Nigeria: An Econometric Analysis

Ezekwu, Chika Bright (Ph.D)
Department of Economics, Ignatius Ajuru University of Education
Rumuolumeni, Port Harcourt, Rivers State, Nigeria
ezekwuchika@gmail.com

&

Igwe, Anastasia Ukamaka
Department of Economics, Ignatius Ajuru University of Education
Rumuolumeni, Port Harcourt, Rivers State, Nigeria
amaksigwe@gmail.com

ABSTRACT

High inflation leads to higher out-of-pocket healthcare expenses, reduced access to care, and poorer health outcomes. This paper investigated empirically the effect of inflation on health outcomes in Nigeria using annual time series covering a period of 35 years, which is between 1990 and 2024. The study used Under-5 Mortality Rate (UFM), Life Expectancy (LEXP), and Maternal Mortality Rate (MAM) to proxy health outcomes as the dependent variable whereas Inflation (INF), Gross Domestic Product per capita (GDPPC), Government Expenditure on Health (GEH), and Unemployment (UNEMP) were used as the independent variables. were collected from secondary sources and analyzed using descriptive statistics, unit root test, and ECM modeling techniques were adopted for the analysis. The results of the ECM shows that Inflation (INF) increases Under-Five Mortality Rate (UFM); GDP per capita (GDPPC) reduces Under-5 Mortality Rate (UFM); Government Expenditure on Health (GEH) increases Under-Five Mortality Rate (UFM); Unemployment (UNEMP) has no significant effect on Under-5 Mortality Rate (UFM); Inflation (INF) reduces Life Expectancy (LEXP); GDP per capita (GDPPC) reduces Life Expectancy (LEXP); Government Expenditure on Health (GEH) has no significant effect on Life Expectancy (LEXP); Unemployment (UNEMP) reduces Life Expectancy (LEXP); Inflation (INF) increases Maternal Mortality Rate (MAM); GDP per capita (GDPPC) reduces Maternal Mortality Rate (MAM); Government Expenditure on Health (GEH) reduces Maternal Mortality Rate (MAM); and Unemployment (UNEMP) increases Maternal Mortality Rate (MAM) in Nigeria. The study therefore concludes that Inflation (INF) significantly increases Under-5 Mortality Rate (UFM) and Maternal Mortality Rate (MAM, indicating that rising prices may reduce household access to essential healthcare and nutrition for children and also negatively impacts maternal health services in Nigeria within the period of study. The study therefore recommends that Government should implement macroeconomic policies aimed at controlling inflation, such as monetary tightening and fiscal discipline, since inflation significantly increases under-five and maternal mortality rates and reduces life expectancy, stabilizing prices can improve health outcomes.

Keywords: Inflation, Health, Health Outcomes, Unit Root Test, Error Correction Model.

Introduction

The world faces myriads of health financing challenges as the global health burden evolves. Nations all over the world have set an ambitious health policy agenda for the next fifteen years with prioritization of universal health coverage and improved access to health coverage and improved access to health care under the sustainable development goals. The scale of investment needed for equitable access to health services means global health is one of the key economic opportunities for decades to come (Krech, Kickbusch, Franz & Wells, 2024). Krech et al. further noted that "adding an explicit health component (H) to the environment, social and governance (ESG) investment criteria, creating into mainstream financial actors' business practices and investment objective" thus, under the sustainable development goals (SDGS) nations have set themselves ambitious health policy goals and targets. These goals ranges from reducing the burden of reproductive health, maternal health, new born and child health, to attaining universal health, coverage, to the growing chronic problem of non-communicable diseases.

Recently however, it has become clean as observed by Krech et al., (2024) that banks are a powerful partner for better health in a post-2015 world. The magnitude of market growth and investment volume needed to achieve the sustainable development goals illustrate that global health constitutes one of the key economic development strategies for decades to come consequently, international investors have long been active in the health sector, and the global health themes underpinning these investments have generated superior returns over time. This reflected in the development of stock market indices as noted by world economic forum (2014). According to World Economic Forum (2014), since 2006, the MSCI world index rose by 60%-70% while the health care index rose by almost 150% also, in emerging markets, the index of the overall economy rose by 20% - 25%, while the healthcare sector equities rose by more than 160% since January, 2006.

From the foregoing, it is evident that financial actors will play multiple roles as lenders, intermediaries, and investors across the spectrum of debt instruments and equity investment, from venture capital to public equity markets. Furthermore, functionally financial institutions provide credit for investment, liquidity for bringing financial gaps of individual or companies and risk management services by pooling risks (Nell & Douglass, 2013).

The improvement of health system performance has become a key policy issue in most developed nations and many initiatives to measure system performance being put in place. The reason to improve the health systems performance include the increase of elderly people and the prevalence of chronic diseases, the onset of new and emerging medical technologies, the increasing public expectations, and the wide availability of internet-based information and others (Mcloughlili et al., 2001).

Performance of health care system in various theoretical framework has been classified by certain performance attributes, among them the quantity of care, access to care and the cost of care, (Baukauskaite & Dragnet, 2007). Thus, there is an agreement

on some concepts of performance such as, health outcomes or effectiveness and various aspects of responsiveness (patient satisfaction or patience experience) (Hurst & Jee-hughes, 2001). In any case, health outcomes for this study will be anchored on health outcomes such as under-five mortality, life expectancy, maternal and child health among them. These indicators are necessary to measure health outcomes. It is clear that the selection of performance indications is based in the decision on what is important in health and health care" and also on what can be scientifically and operationally measured (Ibrahim, 2001)**.**

Following from the foregoing, this study investigated the effect of inflation on health outcomes in Nigeria.

Literature Review

Theoretical Literature Review

Mosley and Chen Theory of Child Survival in Developing Countries

Traditionally, social science research on child morality has focused on the association between socio-economic status and levels and patterns of mortality in populations. Correlations between mortality and socioeconomic characteristics are used to generate causal inferences about the mortality determinants. Income and maternal education, for example are two commonly measured correlates (and inferred causal determinants) of child mortality in developing countries population (Mosley & Chen, 1984).

The theory of child survival in developing countries by Mosley and Chen (1984) proposes a new analytical framework for the study of the determinants of child survival in developing countries. The approach incorporates both social and biological variables and integrates research methods employed by social and medical scientists. It also provides for the measurement of morbidity and mortality in a single variable. The framework is based on the premise that all social and economic determinants of child mortality necessarily operate through a common set of biological mechanisms, or proximate determinants, to exert an impact on mortality. The framework according to Mosley & Chen (1984) is intended to advance research on social policy and medical interventions to improve child survival.

The key to the theory is the identification of a set of proximate determinants or intermediate variables that directly influence the risk of morbidity and mortality. All social and economic determinants must operate through these variables to affect child survival. According to Mosely and Chen (1984), the proximate determinants are grouped into five categories:

i. Maternal factors: age; parity; birth interval;
ii. Environmental contamination: air, food/water/fingers; skin/soil/inanimate objects; insects' vectors;
iii. Nutrient deficiency: calories; protein; micronutrients (vitamins and minerals);
iv. Injury: accidental; intentional; and
v. Personal illness control: personal preventive measures; medical treatment.

For this study, the theory of child survival is a useful indication that positive improvements in all the proximate determinants will positively affect mortality and morbidity thereby increasing the rate of child survival in Nigeria. A reduction in environmental contamination and personal illness is needed to enhance child survival among under-five children improvement in maternal factors and nutritional deficiency is also needed to balance longevity among under-five children in Nigeria, all things being equal.

Concept of Inflation

Fernando (2024) defined inflation as a gradual loss of purchasing power that is reflected in a broad rise in prices for goods and services over time. The inflation rate is calculated as the average price increase of a basket of selected goods and services over one year. That is, high inflation means that prices are increasing quickly, while low inflation means that prices are growing more slowly. This inflation can be considered with deflation, which occurs when prices decline and purchasing power increases.

The Concept of Healthcare Sector

According to Khartit (2021), the health care sector consists of businesses that provide medical services, manufacture medical equipment or otherwise facilitate the provision of healthcare to patient. Alao and Brink (2022) noted that the health care sector is the economic sector concerned with the provision, distribution and consumption of goods and services to meet the health needs of individuals and communities.

Health Outcomes

Health outcomes are the health consequences that result from the planned treatment, intervention, or series of intervention within the healthcare system. Health outcomes may be calculated for an individual or group, or population. As noted by Definitive healthcare (2024), some health outcomes that may be measured include: mortality, safety of care, readmissions, patient experience, effectiveness of care, efficient use of medical imaging, and timeliness of care.

These measures are the targets that health care organizations try to improve. This is because measuring health outcomes help improves population health and patient care experience while also reducing the per capital cost of health care and clinician burn out.

Empirical Literature Review

Although numerous studies explore the health implications of macroeconomic variables, systematic investigation of inflation rate and health outcome nexus has been scarce. Ani et al. (2024) investigated inflation and health as a global scoping review. From 8923 screened recovers, 69 empirical studies were analyzed. This study explored a wide range of health-related risk factors (e. g. diet, substance use, stress, and violence) and outcomes (e. g. life expectancy, mortality, suicidal behaviour, and mental health) linked to inflation, across diverse contexts and timeframes. The findings of the study suggest a predominantly negative effect of inflation on health, with specific socioeconomic groups facing greater risks.

Bilalli et al. (2024) studied the impact of inflation on financial sector performance from OECD countries. The result from the study consistently indicates a negative correlation between inflation and the key financial sector performance. These findings according to the study underscore the importance of maintaining low and stable financial sector.

Strivastavs et al. (2023) studied health care expenditure and bank deposits in a cross-country analysis. The study utilized annual data for bank deposits to GDP, inflation, banking system stability (Z-Score) and GDP growth rate, covering the period 2000-2020, from the World Bank data base. However, the result was stronger in high income countries and those with a high level of healthcare infrastructure.

Tinoco-zermeino et al. (2022) carried out a study on inflation and bank credit, the aim of the paper was to assess empirically the effects of inflation rates on bank credit using panel data of the 32 Mexican states during 2003-2015. The main empirical result of the study indicates that inflation rates exert negative effects on credit in the long run, but these effects tend to be positive in the short run.

Movahed et al. (2021) studied the impact of inflation and it's uncertainly on pharmaceutical prices: evidence from Iran. The monthly time series of consumer price index from 2001 to 2017 was used to calculate inflation uncertainty based on a generalized auto regressive conditional heteroscedasticity model. The results from the study revealed that inflation uncertainty did not affect the inflation in the pharmaceutical prices, but inflation can be a cause of pharmaceutical inflation. From the results, although inflation uncertainty has no association with pharmaceutical inflation, it seems that it could affect pharmaceutical inflation through inflation in other sectors.

Okeya et al. (2020) investigated the effects of central bank monetary policy on health and economic growth in Nigeria (1986-2016): a re-assessment using secondary data collected from central bank bulletin. The empirical results revealed that money supply, prime lending rate and health growth rate. The study found out that money supply, real exchange rate and prime lending rate have direct relationship with health and economic growth as measured by gross domestic product while interest rate and bank rate have indirect and insignificant effect on health and economic growth.

Cheng & Witvorapong (2019) Studied health care policy uncertainly, real health expenditures and Health care inflation in the USA. The study investigated the effects of health care policy uncertainly (HCPU) On the US health sector based on a structural VAR model estimated with Bayesians method over a period of 1985Q, 2017Q. The findings of the study revealed that HCPU exerts a negative and significant impact on the growth rate of real health expenditures and healthcare inflation. It has an especially persistent effect on health care inflation and explains a generous portion of the post -2007 decline in the growth rate of health care services prices in the USA. The study further revealed that HCPU also dampers the growth rate of GDP and general inflation, eliciting cautiousness from economic agents and acting as a negative aggregate demand shock.

Murthy & Okunade (2018) carried out a study to investigate whether "is the health care price inflation in US urban areas stationary? evidence from panel unit root

tests. The study aims to investigate for the first time in the literature, the stochastic properties of the US aggregate healthcare price inflation rate series, using the data on health-care inflation rates for a panel of 17 major US urban areas for the period 1966-2006. The empirical findings of the study indicate that after controlling for the presence of cross-sectional dependence, finite sample bias, and asymptotic normality, the US aggregate health care price inflation rate series can be characterized as a non-stationary process and not as a negative-wise stationary innovation process.

He (2018) investigated inflation and health in a Schumpeterian growth model: theory and evidence. The study incorporated endogenous health investment in a scale invariant Schumpeterian growth model. The result from the study revealed a significant, negative effect of inflation on out-of-pocket expenditure (% of total expenditure on health) of the world development indicators of the World Bank, which provides support for the study's theory.

Namini (2018) studied healthcare expenditure, economic growth, and inflation in the 67 countries: a panel co-integration approach. The aim of the study was to explain the relationship between the healthcare expenditure, economic growth and inflation in a panel data of the 67 countries from the period of 1995 to 2013 by using panel Co-integration analysis. The results from the study show that the CPI inflation has the most effect on health care expenditure rather than the PCE inflation. The econometric results from vector error correction model (VECM) showed that there is a strong short-run ganger causality from economic growth and price index to health care expenditure in both models.

Methodology

This paper adopted the quasi-experimental research design.

Model Specification

This study estimated three models each capturing an objective and it is expressed in equation form.

Model One: Under –5 Mortality Model.

This model captured objective one and it was adopted from the work of Salatin & Bidari (2014) and Bao, Tao, Afzae & Dorduncu (2022) but with some modifications in terms of the variables.

$$UFM = f(INF, GDPPC, GEH, UNEMP) \quad (1)$$

The ordinary least square (OLS) form of the equation is written as:

$$UFM = a_0 + a_1 INF + a_2\, GDPPC + a_3\, GEH + a_4\, UNEMP + U \quad (2)$$

Where; $a_1 > 0$; $a_2 < 0$; $a_3 < 0$, $a_4 > 0$

UFM	=	under-five mortality rate
INF	=	Inflation rate
GDPPC	=	GDP per capita
GEH	=	Government Expenditure on Health
UNEMP	=	Unemployment rate
a_0	=	Constant
a_1 - a_4	=	coefficients of explanatory variables
U	=	error term

Model Two: Life Expectancy at Birth Model

This captured objective two and was adopted from the work of Salatin & Bidari (2014) and Bao et al., (2022) but with some modifications in terms of the variables.

LEXP = f (INF, GDP per CAP, GEH, UNEMP) (3)

The ordinary least squares (OLS) form of the equation is written as:

$LEXP = b_0 + b_1INF + b_2GDPPC + b_3GEH + b_4UNEMP + U$ (4)

$b_1 < o; b_2 > 0; b_3 > 0; b_4 < 0$

LEXP	=	Life expectancy at birth
INF	=	Inflation rate
GDPPC	=	GDP per capita
GEH	=	Government Expenditure in Health
UNEMP	=	Unemployment rate
bo	=	Constant
$b_1 – b_4$	=	Coefficient of explanatory variables
U	=	error term

Model Three: Maternal Mortality Model

This captured objective three and was adopted from the work of Salatin & Bidari (2014) and Bao et al (2022) but with some modification in terms of the variables.

MAM = f (INF, GDPPC, GEH, UNEMP) (5)

The ordinary least square (OLS) form of the equation is written as:

$MAM = C_0 + C_1INF + C_2GDPPC + C_3GEH + C_4UNEMP + U$ (6)

$C_1.> 0; C_2 < 0; C_3 < 0; C_4 > 0$

Where;

MAM	=	Material mortality rate
INF	=	Inflation rate
GDPPC	=	GDP per capita
GEH	=	Government Expenditure on Health
UNEMP	=	Unemployment rate
C_0	=	constant
C_1- C_4	=	Coefficient of explanatory variables
U	=	error term

Estimation Technique

This study employed descriptive statistics, unit root test, Co-integration, and Error Correction Mechanism (ECM) modelling techniques to estimate the effect of the explanatory variables on the dependent variable.

Unit Root Test

The study conducted the Augmented Dickey Fuller (ADF) test so as to check whether each data series is integrated and has a unit root. It is now a common practice to examine the time series properties of economic data as a guide to a subsequent multivariate modeling and inference. If we discover that the variables are integrated of

order greater than or equal to one, then it could be the case that these variables are co-integrated. Hence, the study employed the Augmented Dickey-Fuller test (ADF) to test for the stationarity of our data at level and at difference.

Error Correction Mechanism (ECM)

The error correction mechanism (ECM) was first used by Sargan and later popularized by Engel and Granger to correct for disequilibrium. An important theorem, known as the Granger representation theorem, states that if two variables Y and X are co-integrated, then relationship between the two can be expressed as ECM. In other words, there is a long-run relationship between them, (Iyeli, 2010).

The necessary condition for fitting an error correction representation is the existence of at least one co-integrated vector in the system. In other words, the error correction model is internally consistent only if at least one co-integrating vector exists. In order to determine the number of co integrating equation in the Vector Error Correction Model (VECM), the Johansen (1988) approach was adopted.

If co-integration is established, a parsimonious error correction model will be estimated. This will be preceded by estimation of an over parameterized model in order to remove variable that were either not correctly signed or insignificance.

Because of this, the ECM has important implications: the fact that the two variables are cointegrated implies that there is some adjustment process preventing the errors in the long-run relationship from becoming larger and larger (Asteriou and Hall, 2011).

The Error Correction Mechanism (ECM) terms of the models is specified as follows:

$$\Delta UFM_t = \Phi_0 + \Phi_{1_1}\Delta INF_{t-} + \Phi_{1_{2t}} GDPPC_t + \Phi_{1_3}\Delta GEH_t + \Phi_{1_4}\Delta UNEMP_t + \Phi_4 \varepsilon_{t-1} + U_{t1} \quad (7)$$

$$\Delta LEXP_t = \Phi_0 + \Phi_{1_1}\Delta INF_{t-} + \Phi_{1_{2t}} GDPPC_t + \Phi_{1_3}\Delta GEH_t + \Phi_{1_4}\Delta UNEMP_t + \Phi_4 \varepsilon_{t-1} + U_{t2} \quad (8)$$

$$\Delta MAM_t = \Phi_0 + \Phi_{1_1}\Delta INF_{t-} + \Phi_{1_{2t}} GDPPC_t + \Phi_{1_3}\Delta GEH_t + \Phi_{1_4}\Delta UNEMP_t + \Phi_4 \varepsilon_{t-1} + U_{t3} \quad 9)$$

Where;

β_0 is the constant terms, UFM, LEXP, MAM, INF, GDPPC, GEH, and UNEMP are as earlier defined,

$\Phi_0 - \Phi_5$ are the coefficients of independent variables

$\Phi_4 \varepsilon_{t-1}$ is the error terms,

Δ = first difference of the variable, U_t = white noise disturbance error term.

Post Estimation Tests:

To ensure that the estimated model is robust and unbiased, the fitness of the model was determined by checking goodness of fit statistics and conducting diagnostics tests.

Result and Discussions

Descriptive Statistics

Table 1 below presents the result of the descriptive statistics of the variables employed in the estimations in this study.

Table 1: Descriptive Statistics Test Results

	UFM	LEXP	MAM	INF	GDPPC	GEH	UNEMP
Mean	154.9143	49.72600	1127.467	18.33257	317609.4	143.2849	14.34000
Median	145.2000	50.38000	1124.000	13.01000	226245.0	81.91000	13.90000
Maximum	209.8000	54.46000	1285.000	72.84000	1028712.	468.6400	27.40000
Minimum	104.9000	45.48000	993.0000	5.390000	5093.070	0.150000	3.500000
Std. Dev.	35.90778	3.017789	70.17972	15.66996	308578.0	155.5025	7.699054
Skewness	0.281728	-0.121868	0.324039	2.200667	0.766491	0.838774	-0.125980
Kurtosis	1.597318	1.551519	2.791545	7.021038	2.391439	2.303994	1.681559
Jarque-Bera	3.332293	3.146361	0.675877	51.82987	3.967222	4.810445	2.627582
Probability	0.188974	0.207385	0.713239	0.000000	0.137572	0.090245	0.268799
Sum	5422.000	1740.410	39461.33	641.6400	11116329	5014.970	501.9000
Sum Sq. Dev.	43838.52	309.6396	167456.5	8348.623	3.24E+12	822155.3	2015.365
Observations	35	35	35	35	35	35	35

Source: *Author's Computation (2025)*

The result of the descriptive statistics in Tables 1 shows that Under-Five Mortality Rate (UFM) has a mean value of 154.9143 with a standard deviation of 35.90778. The skewness value of Under-Five Mortality Rate (UFM) is positive (0.281728), meaning that Under-Five Mortality Rate (UFM) has a long-right tail while the kurtosis value of Under-Five Mortality Rate (UFM)is 1.597318 (i.e. less than 3), meaning that it is platykurtic. That is, it has a flat distribution, meaning that the series are lower than the mean sample.

Life Expectancy (LEXP) has a mean value of 49.72600 with a standard deviation of 3.017789. The skewness value of Life Expectancy (LEXP) is negative (-0.121868), meaning that Life Expectancy (LEXP) has a long-left tail while the kurtosis value of Life Expectancy (LEXP) is 1.551519 (i.e. less than 3), meaning that it is platykurtic. That is, it has a flat distribution, meaning that the series has low value lower than the sample mean.

Maternal Mortality Rate (MAM) has a mean value of 1127.467 with a standard deviation of 70.17972. The skewness value of Maternal Mortality Rate (MAM) is positive (0.324039), meaning that Maternal Mortality Rate (MAM) has a long-left while the kurtosis value of Maternal Mortality Rate (MAM) is 2.791545 (i.e. less than 3), meaning that it is platykurtic. That is, it has a flat distribution, meaning that the series has low value lower than the sample mean.

Inflation (INF) has a mean value of 18.33257 with a standard deviation of 15.66996. The skewness value of Inflation (INF) is negative (2.200667), meaning that Inflation (INF) has a long-left tail while the kurtosis value of Inflation (INF) is 7.021038 (i.e. greater than 3), meaning that it is leptokurtic. That is, it has a peak distribution, meaning that the series has more value higher than the sample mean.

Gross Domestic Product per capita (GDPPC) has a mean value of 317609.4 with a standard deviation of 308578.0. The skewness value of Gross Domestic Product per capita (GDPPC) is positive (0.766491), meaning that Gross Domestic Product per capita (GDPPC) has a long-right tail while the kurtosis value of Gross Domestic Product per capita (GDPPC) is 2.391439 (i.e. less than 3), meaning that it is platykurtic. That is, it has a flat distribution, meaning that the series has low value lower than the sample mean.

Government Expenditure on Health (GEH) has a mean value of 143.2849 with a standard deviation of 155.5025. The skewness value of Government Expenditure on Health (GEH) is positive (0.838774), meaning that Government Expenditure on Health (GEH) has a long-right tail while the kurtosis value of Government Expenditure on Health (GEH) is 2.303994 (i.e. less than 3), meaning that it is platykurtic. That is, it has a flat distribution, meaning that the series has low value lower than the sample mean.

While Unemployment (UNEMP) has a mean value of 14.34000 with a standard deviation of 7.699054. The skewness value of Unemployment (UNEMP) is negative (-0.125980), meaning that Unemployment (UNEMP) has a long-right tail while the kurtosis value of Unemployment (UNEMP) is 1.681559 (i.e. less than 3), meaning that it is platykurtic. That is, it has a flat distribution, meaning that the series has low value lower than the sample mean. Again, one important observation in this table is the Jarque-Bera statistics of the variables. It shows that the values of INF is greater than 5.99, meaning that they do not have a normal distribution while UFM, LEXP, MAM, GDPPC, GEH and UNEMP has a value less than 5.99, suggesting that they have a normal distribution.

Based on these observations, it is therefore necessary to test for the stationarity of the variables and the long run relationship since using the variables at level might give a spurious result. The unit root test is conducted so as to make the variables stationary. The study adopts the Augmented Dickey Fuller (ADF) unit root test procedure.

Unit Root Test for Model One (Under-Five Mortality Rate (UFM) Model)

Tables 2 below presents the result of stationarity test for each of variables used using Augmented Dickey Fuller (ADF) test.

Table 2: Unit Root Test Results for Model One (Under-Five Mortality Rate (UFM) Model)

Variables	ADF at Level	ADF at 1st Difference	Status	Remarks
UFM	-2.463506	-5.169509	I(1)	Stationary
LEXP	0.069437	-3.646342	I(1)	Stationary
MAM	-1.892096	-5.938096	I(1)	Stationary
INF	-2.237259	-4.760123	I(1)	Stationary
GDPPC	1.075593	-7.303771	I(1)	Stationary
GEH	0.326534	-6.316342	I(1)	Stationary
UNEMP	-2.139660	-5.054909	I(1)	Stationary
Critical Values				
1% level	-3.646342	-3.653730		
5% level	-2.954021	-2.957110		
10% level	-2.615817	-2.617434		

Source: *Author's Computation (2025)*

The outcomes of unit root test in Table 3 for the Model, reveals that all the variables were not stationary at level but were stationary at difference. Hence, this study concludes that the variables used in model were integrated of order one, that is I(1). Since the ADF results indicate that the series are of the same order of integration, we proceed to conduct co-integration.

(ii) Co-integration Test Result for Model One (Under-Five Mortality Rate (UFM) Model)

The result of co-integration test for Model one is presented in Table 3 below. This will enable us determine if there exists long run equilibrium relationship among variables applied in this model.

Table 3: Co-integration Test Result for Model One (Under-Five Mortality Rate (UFM) Model)

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.** Critical Value
None *	0.653402	97.19665	69.81889	0.0001
At most 1 *	0.602383	62.23024	47.85613	0.0013
At most 2 *	0.402897	31.79548	29.79707	0.0290
At most 3	0.355000	14.77853	15.49471	0.0639
At most 4	0.009285	0.307839	3.841465	0.5790

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 *	0.653402	34.96641	33.87687	0.0370
At most 1 *	0.602383	30.43476	27.58434	0.0209
At most 2	0.402897	17.01695	21.13162	0.1712
At most 3 *	0.355000	14.47069	14.26460	0.0464
At most 4	0.009285	0.307839	3.841465	0.5790

Max-eigenvalue test indicates 2 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: *Author's Computation (2025)*

The co-integration outcomes in Table 3 above reveals that the trace test statistics indicate three (3) co-integrating equation at 5% significance level while the max-eigenvalue

statistics indicate two (2) co-integrating equation at 5 % significance level. This suggests that there exists a long-run relationship among variables in the model. Accordingly, the study rejects the null hypothesis of no co-integration amongst the variables but accepts the alternative hypothesis.

(ii) Over-Parameterized ECM Estimation Results for Model One (Under-Five Mortality Rate (UFM) Model)

The result of over-parameterized ECM estimation of the Model is presented in table 4 below.

Table 4: Over-parameterized ECM Estimation Results for Model One (Under-Five Mortality Rate (UFM) Model)

Dependent Variable: DLOG(UFM)
Method: Least Squares
Date: 04/29/25 Time: 00:12
Sample (adjusted): 1993 2024
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.007284	0.006263	-1.162915	0.2619
DLOG(UFM(-1))	1.340659	0.776914	1.725622	0.1037
DLOG(UFM(-2))	-0.811154	0.763663	-1.062189	0.3039
D(INF)	-0.000482	0.000326	-1.478540	0.1587
D(INF(-1))	0.000390	0.000311	1.254291	0.2278
D(INF(-2))	-0.000123	0.000232	-0.528854	0.6042
DLOG(GDPPC)	-0.088608	0.026282	-3.371473	0.0039
DLOG(GDPPC(-1))	0.004203	0.026756	0.157083	0.8771
DLOG(GDPPC(-2))	0.031593	0.026448	1.194519	0.2497
DLOG(GEH)	0.009274	0.005922	1.565961	0.1369
DLOG(GEH(-1))	0.009908	0.005725	1.730507	0.1028
DLOG(GEH(-2))	0.013835	0.005031	2.750159	0.0142
D(UNEMP)	-0.000878	0.000485	-1.809057	0.0893
D(UNEMP(-1))	0.000554	0.000418	1.327785	0.2029
D(UNEMP(-2))	-0.000256	0.000454	-0.564612	0.5802
ECM(-1)	-0.143168	0.078775	-1.817423	0.0879

R-squared	0.743223	Mean dependent var	-0.020498
Adjusted R-squared	0.502495	S.D. dependent var	0.012674
S.E. of regression	0.008940	Akaike info criterion	-6.289767
Sum squared resid	0.001279	Schwarz criterion	-5.556899
Log likelihood	116.6363		-6.046842
F-statistic	3.087393	Durbin-Watson stat	1.485324
Prob(F-statistic)	0.015897		

Source: *Author's Computation (2025)*

(iii) Parsimonious ECM of the Model One (Under-Five Mortality Rate (UFM) Model)

The result of ECM estimation of the Model is obtainable in table 5 below.

Table 5: Parsimonious ECM Estimation Results for Model One (Under-Five Mortality Rate (UFM) Model)

Dependent Variable: DLOG(UFM)
Method: Least Squares
Date: 04/29/25 Time: 00:16
Sample (adjusted): 1993 2024
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.003260	0.005313	-0.613595	0.5458
DLOG(UFM(-1))	0.634496	0.176381	3.597304	0.0016
D(INF)	-0.000181	0.000215	-0.840048	0.4099
D(INF(-1))	0.000636	0.000229	2.773791	0.0111
DLOG(GDPPC)	-0.086764	0.022888	-3.790750	0.0010
DLOG(GDPPC(-2))	-0.043660	0.020880	-2.090956	0.0483
DLOG(GEH(-1))	0.002989	0.002939	1.016877	0.3203
DLOG(GEH(-2))	0.009325	0.003547	2.628984	0.0153
D(UNEMP)	-0.000442	0.000357	-1.238112	0.2287
ECM(-1)	-0.435041	0.160366	-2.712806	0.0108

R-squared	0.678531	Mean dependent var	-0.020498
Adjusted R-squared	0.547021	S.D. dependent var	0.012674
S.E. of regression	0.008530	Akaike info criterion	-6.440074
Sum squared resid	0.001601	Schwarz criterion	-5.982031
Log likelihood	113.0412	Hannan-Quinn criter.	-6.288246
F-statistic	5.159536	Durbin-Watson stat	1.788544
Prob(F-statistic)	0.000810		

Source: *Author's Computation (2025)*

From Table 5, it shows that the explanatory variables included in the model explained about 55 percent of variation in Under-Five Mortality Rate (UFM) in Nigeria as shown by Adjusted-R^2 of 0.547021; the remaining 45 percent is explained by the error term. The F-statistic of 5.159536 with a prob. value of 0.000810 shows that the model is statistically significant; and that independent variables are significant explanatory factors of the dependent variable. The above implies that model has a goodness of fit and Durbin Watson Statistic of 1.788544 reveals that there is minimal serial autocorrelation among variables used in model. Also, the Error correction coefficient (ECM) is statistically significant and appropriately signed. This reveals that secondary school enrolment in Nigeria adjust to changes in explanatory variables by about 44 per cent annually.

Furthermore, From Table 5, the result of the short run estimation shows that Inflation (INF) has a positive (0.000636) relationship with Under-Five Mortality Rate (UFM), suggesting that a unit increase in Inflation (INF) increases Under-Five Mortality Rate (UFM) by 0.000636 units in Nigeria. The positive effect of Inflation (INF) on Under-Five Mortality Rate (UFM) confirms to a priori and therefore is line with economic theory. The coefficient of Inflation (INF) is statistically significant at 5 percent level in the short run. The study therefore rejects the null hypothesis that there is no significant relationship between Inflation (INF) and Under-Five Mortality Rate (UFM) but do not reject the alternative hypothesis in the short run.

Both current and past lag 2 of Gross Domestic Product per capita (GDPPC) has a negative (-0.086764 and -0.043660, respectively) relationship with Under-Five Mortality Rate (UFM), suggesting that a unit increase in Gross Domestic Product per capita (GDPPC) decreases Under-Five Mortality Rate (UFM) in Nigeria. The negative effect of Gross Domestic Product per capita (GDPPC) on Under-Five Mortality Rate (UFM) conforms to a priori and therefore is in line with economic theory. The negative effect of Gross Domestic Product per capita (GDPPC) on Under-Five Mortality Rate (UFM) is statistically significant at 5 percent level. The study therefore rejects the null hypothesis that there is no significant relationship between Gross Domestic Product per capita (GDPPC) and Under-Five Mortality Rate (UFM) in the short run but do not reject the alternative hypothesis.

Government Expenditure on Health (GEH) has a positive (0.009325) relationship with Under-Five Mortality Rate (UFM), suggesting that a unit increase in Government Expenditure on Health (GEH) increases Under-Five Mortality Rate (UFM) by 0.009325 units in Nigeria. The positive sign of Government Expenditure on Health (GEH) on Under-Five Mortality Rate (UFM) do not confirm to a priori and therefore not line with economic theory. The positive sign of Government Expenditure on Health (GEH) on Under-Five Mortality Rate (UFM) is statistically significant at 5 percent level. The study therefore rejects the null hypothesis that there is no significant relationship between Government Expenditure on Health (GEH) and Under-Five Mortality Rate (UFM) in the short run but do not reject the alternative hypothesis.

While Unemployment (UNEMP) has a negative (-0.000442) relationship with Under-Five Mortality Rate (UFM), suggesting that a unit increase in Unemployment (UNEMP) decreases Under-Five Mortality Rate (UFM) by 0.000442 units in Nigeria. The negative sign of Unemployment (UNEMP) on Under-Five Mortality Rate (UFM) confirm to a priori and therefore is in line with economic theory. The negative sign of Unemployment (UNEMP) on Under-Five Mortality Rate (UFM) is not statistically significant at 5 percent level. The study therefore accepts the null hypothesis that there is no significant relationship between Unemployment (UNEMP) and Under-Five Mortality Rate (UFM) in the short run.

(v) Post Estimation Test for the Model One (Under-Five Mortality Rate (UFM) Model)

The researcher conducted a diagnostic test to determine whether or not series were free from order autocorrelation (Breusch-Godfrey Serial Correlation LM Test) and heteroscedasticity (Breusch-Pagan-Godfrey Test).

The outcome of the diagnostic tests is presented in Table 6 below:

Table 6: Ramsey Reset Test, Serial Correlation LM Test and Homoscedasticity Test Results for Model One (Under-Five Mortality Rate (UFM) Model)

	F-Statistic	Prob. Value
Breusch-Godfrey Serial Correlation LM Test	0.183128	0.8340
Breusch-Pagan-Godfrey Heteroskedasticity Test	0.236933	0.9800

Source: *Author's Computation (2025)*

From Table 6, the outcome of autocorrelation test using Breusch-Godfrey Serial Correlation LM method showed F-statistics is 0.103337 with a Chi-Square probability value is 0.9022. This indicated that probability value of about 90 percent (0.9022) is larger than 5 percent (0.05) critical value; hence confirmed no serial correlation in model.

Again, result of heteroscedasticity test using Breusch-Pagan-Godfrey test showed the F-statistics is 0.363380 and a Chi-Square probability value is 0.9430. This suggested no evidence of heteroskedasticity in model since Chi-square probability value of about 94 percent is more than 5 percent ($p > 0.05$). So, residuals do have constant variance which is desirable in regression denoting that residual are Homoscedastic.

Unit Root Test for Model Two (Life Expectancy (LEXP) Model)

Tables 7 below presents result of stationarity test for each of variables used using Augmented Dickey Fuller (ADF) test.

Table 7: Unit Root Test Results for Model Two (Life Expectancy (LEXP) Model)

Variables	ADF at Level	ADF at 1st Difference	Status	Remarks
LEXP	0.069437	-3.646342	I(1)	Stationary
INF	-2.237259	-4.760123	I(1)	Stationary
GDPPC	1.075593	-7.303771	I(1)	Stationary
GEH	0.326534	-6.316342	I(1)	Stationary
UNEMP	-2.139660	-5.054909	I(1)	Stationary
Critical Values				
1% level	-3.646342	-3.653730		
5% level	-2.954021	-2.957110		
10% level	-2.615817	-2.617434		

Source: *Author's Computation (2025)*

The outcomes of unit root test in Table 7 for the Model, reveals that all the variables were not stationary at level but were stationary at difference. Hence, this study concludes that the variables used in model were integrated of order one, that is I(1). Since the ADF results indicate that the series are of the same order of integration, we proceed to conduct co-integration.

(ii) Co-integration Test Result for Model Two (Life Expectancy (LEXP) Model)

The result of co-integration test for Model is presented in Table 8 below. This will enable us determine if there exists long run equilibrium relationship among variables applied in this model.

Table 8: Co-integration Test Result for Model Two (Life Expectancy (LEXP) Model)

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.** Critical Value
None *	0.690537	90.77500	69.81889	0.0005
At most 1 *	0.601384	52.06876	47.85613	0.0191
At most 2	0.378171	21.71676	29.79707	0.3145
At most 3	0.141379	6.038794	15.49471	0.6910
At most 4	0.030104	1.008691	3.841465	0.3152

Trace test indicates 2 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 *	0.690537	38.70624	33.87687	0.0123
At most 1 *	0.601384	30.35200	27.58434	0.0215
At most 2	0.378171	15.67796	21.13162	0.2442
At most 3	0.141379	5.030103	14.26460	0.7380
At most 4	0.030104	1.008691	3.841465	0.3152

Max-eigenvalue test indicates 2 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: *Author's Computation (2025)*

The co-integration outcomes in Table 8 above reveals that both the trace test statistics and the max-eigenvalue statistics indicate two (2) co-integrating equation at 5 % significance level. This suggests that there exists a long-run relationship among variables in the model. Accordingly, the study rejects the null hypothesis of no co-integration amongst the variables but accepts the alternative hypothesis.

(ii) Over-Parameterized ECM Estimation Results for Model Two (Life Expectancy (LEXP) Model)

The result of overparametrized ECM estimation of the Model is presented in table 9 below.

Table 9: Overparameterized ECM Estimation Results for Model Two (Life Expectancy (LEXP) Model)

Dependent Variable: DLOG(LEXP)
Method: Least Squares
Date: 04/29/25 Time: 00:21
Sample (adjusted): 1993 2024
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003214	0.001869	1.719655	0.1048
DLOG(LEXP(-1))	0.650095	0.285152	2.279822	0.0367
DLOG(LEXP(-2))	-0.153565	0.225892	-0.679815	0.5063
D(INF)	0.000143	0.000135	1.060842	0.3045
D(INF(-1))	-0.000107	0.000111	-0.965181	0.3488
D(INF(-2))	0.000104	8.37E-05	1.244832	0.2311
DLOG(GDPPC)	0.019722	0.009335	2.112671	0.0507
DLOG(GDPPC(-1))	-0.006443	0.009985	-0.645310	0.5279
DLOG(GDPPC(-2))	-0.012054	0.009593	-1.256609	0.2269
DLOG(GEH)	-0.000781	0.002317	-0.336984	0.7405
DLOG(GEH(-1))	-0.002291	0.002173	-1.054604	0.3073
DLOG(GEH(-2))	-0.002303	0.002075	-1.110081	0.2834
D(UNEMP)	0.000184	0.000180	1.018583	0.3236
D(UNEMP(-1))	-5.82E-05	0.000154	-0.378843	0.7098
D(UNEMP(-2))	-0.000194	0.000173	-1.122048	0.2784
ECM(-1)	-0.420360	0.126975	-3.310575	0.0044

R-squared	0.729571	Mean dependent var	0.005290
Adjusted R-squared	0.476044	S.D. dependent var	0.004415
S.E. of regression	0.003196	Akaike info criterion	-8.347073
Sum squared resid	0.000163	Schwarz criterion	-7.614205
Log likelihood	149.5532	Hannan-Quinn criter.	-8.104148
F-statistic	2.877688	Durbin-Watson stat	1.745623
Prob(F-statistic)	0.021772		

Source: *Author's Computation (2025)*

(iii) Parsimonious ECM of the Model Two (Life Expectancy (LEXP) Model)

The result of ECM estimation of the Model is obtainable in table 10 below.

Table 10: Parsimonious ECM Estimation Results for Model Two (Life Expectancy (LEXP) Model)

Dependent Variable: DLOG(LEXP)
Method: Least Squares
Date: 04/29/25 Time: 00:29
Sample (adjusted): 1993 2024
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002284	0.001389	1.644281	0.1143
DLOG(LEXP(-1))	0.546052	0.160874	3.394282	0.0026
D(INF)	0.000107	7.69E-05	1.393002	0.1775
D(INF(-1))	-0.000167	8.13E-05	-2.049856	0.0325
DLOG(GDPPC)	-0.022931	0.007905	-2.900735	0.0083
DLOG(GDPPC(-2))	-0.017857	0.007201	-2.479729	0.0213
DLOG(GEH(-1))	-0.001155	0.000998	-1.157333	0.2595
DLOG(GEH(-2))	-0.001936	0.001231	-1.572941	0.1300
D(UNEMP(-2))	-0.000253	0.000130	-1.944538	0.0447
ECM(-1)	-0.584643	0.150090	-3.455426	0.0009

R-squared	0.686814	Mean dependent var	0.005290
Adjusted R-squared	0.558692	S.D. dependent var	0.004415
S.E. of regression	0.002933	Akaike info criterion	-8.575283
Sum squared resid	0.000189	Schwarz criterion	-8.117241
Log likelihood	147.2045	Hannan-Quinn criter.	-8.423455
F-statistic	5.360639	Durbin-Watson stat	1.850448
Prob(F-statistic)	0.000631		

Source: *Author's Computation (2025)*

From Table 10, it shows that the explanatory variables included in the model explained about 56 percent of variation in poverty in Nigeria as shown by Adjusted-R^2 of 0.558692; the remaining 44 percent is explained by the error term. The F-statistic of 5.360639 with a prob. value of 0.000631 shows that the model is statistically significant; and that independent variables are significant explanatory factors of the dependent variable. The above implies that model has a goodness of fit and Durbin Watson Statistic of 1.850448 reveals that there is minimal serial autocorrelation among variables used in model. Also, the Error correction coefficient (ECM) is statistically significant and appropriately signed. This reveals that secondary school enrolment in Nigeria adjust to changes in explanatory variables by about 58 per cent annually.

Furthermore, From Table 11, the result of the short run estimation shows that Inflation (INF) has a negative (-0.000167) relationship with Life Expectancy (LEXP), suggesting that a unit increase in Inflation (INF) reduces Life Expectancy (LEXP) by 0.000167 units in Nigeria. The negative effect of Inflation (INF) on Life Expectancy

(LEXP) confirms to a priori and therefore is line with economic theory. The coefficient of Inflation (INF) is statistically significant at 5 percent level in the short run. The study therefore rejects the null hypothesis that there is no significant relationship between Inflation (INF) and Life Expectancy (LEXP) but do not reject the alternative hypothesis in the short run.

Both current and past lag 2 of Gross Domestic Product per capita (GDPPC) has a negative (-0.022931 and -0.017857, respectively) relationship with Life Expectancy (LEXP), suggesting that a unit increase in Gross Domestic Product per capita (GDPPC) decreases Life Expectancy (LEXP) in Nigeria. The negative effect of Gross Domestic Product per capita (GDPPC) on Life Expectancy (LEXP) does not conform to a priori and therefore not in line with economic theory. The negative effect of Gross Domestic Product per capita (GDPPC) on Life Expectancy (LEXP) is statistically significant at 5 percent level. The study therefore rejects the null hypothesis that there is no significant relationship between Gross Domestic Product per capita (GDPPC) and Life Expectancy (LEXP) in the short run but do not reject the alternative hypothesis.

Past lag 1 and 2 of Government Expenditure on Health (GEH) has a negative (-0.001155 and -0.001936, respectively) relationship with Life Expectancy (LEXP), suggesting that a unit increase in Government Expenditure on Health (GEH) decreases Life Expectancy (LEXP) in Nigeria. The negative sign of Government Expenditure on Health (GEH) on Life Expectancy (LEXP) do not confirm to a priori and therefore not in line with economic theory. The negative sign of Government Expenditure on Health (GEH) on Life Expectancy (LEXP) is not statistically significant at 5 percent level. The study therefore accepts the null hypothesis that there is no significant relationship between Government Expenditure on Health (GEH) and Life Expectancy (LEXP) in the short run.

While Unemployment (UNEMP) has a negative (-0.000253) relationship with Life Expectancy (LEXP), suggesting that a unit increase in Unemployment (UNEMP) decreases Life Expectancy (LEXP) by 0.000253 units in Nigeria. The negative sign of Unemployment (UNEMP) on Life Expectancy (LEXP) confirm to a priori and therefore is in line with economic theory. The negative sign of Unemployment (UNEMP) on Life Expectancy (LEXP) is statistically significant at 5 percent level. The study therefore rejects the null hypothesis that there is no significant relationship between Unemployment (UNEMP) and Life Expectancy (LEXP) in the short run but do not reject the alternative hypothesis.

(v) Post Estimation Test for the Model Two (Life Expectancy (LEXP) Model)

The researcher conducted a diagnostic test to determine whether or not series were free from order autocorrelation (Breusch-Godfrey Serial Correlation LM Test) and heteroscedasticity (Breusch-Pagan-Godfrey Test).

The outcome of the diagnostic tests is presented in Table 11 below.

Table 11: Ramsey Reset Test, Serial Correlation LM Test and Homoscedasticity Test Results for Model Two (Life Expectancy (LEXP) Model)

	F-Statistic	Prob. Value
Breusch-Godfrey Serial Correlation LM Test	1.081296	0.3582
Breusch-Pagan-Godfrey Heteroskedasticity Test	0.674236	0.7235

Source: *Author's Computation (2025)*

From Table 11, the outcome of autocorrelation test using Breusch-Godfrey Serial Correlation LM method showed F-statistics is 1.081296 with a Chi-Square probability value is 0.3582. This indicated that probability value of about 36 percent (0.3582) is larger than 5 percent (0.05) critical value; hence confirmed no serial correlation in model.

Again, result of heteroscedasticity test using Breusch-Pagan-Godfrey test showed the F-statistics is 0.674236 and a Chi-Square probability value is 0.7235. This suggested no evidence of heteroskedasticity in model since Chi-square probability value of about 72 percent is more than 5 percent ($p > 0.05$). So, residuals do have constant variance which is desirable in regression denoting that residual are Homoscedastic.

Unit Root Test for Model Three (Maternal Mortality Rate (MAM) Model)

Tables 12 below presents the result of stationarity test for each of variables used using Augmented Dickey Fuller (ADF) test.

Table 12: Unit Root Test Results for Model Three (Maternal Mortality Rate (MAM) Model)

Variables	ADF at Level	ADF at 1st Difference	Status	Remarks
MAM	-1.892096	-5.938096	I(1)	Stationary
INF	-2.237259	-4.760123	I(1)	Stationary
GDPPC	1.075593	-7.303771	I(1)	Stationary
GEH	0.326534	-6.316342	I(1)	Stationary
UNEMP	-2.139660	-5.054909	I(1)	Stationary
Critical Values				
1% level	-3.646342	-3.653730		
5% level	-2.954021	-2.957110		
10% level	-2.615817	-2.617434		

Source: *Author's Computation (2025)*

The outcomes of unit root test in Table 12 for the model, reveals that all the variables were not stationary at level but were stationary at difference. Hence, this study concludes that the variables used in model were integrated of order one, that is I (1). Since the ADF results indicate that the series are of the same order of integration, we proceed to conduct co-integration.

(ii) Co-integration Test Result for Model Three (Maternal Mortality Rate (MAM) Model)

The result of co-integration test for Model is presented in Table 13 below. This will enable us determine if there exists long run equilibrium relationship among variables applied in this model.

Table 13: Co-integration Test Result for Model Three (Maternal Mortality Rate (MAM) Model)

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.** Critical Value
None *	0.740990	105.0389	69.81889	0.0000
At most 1 *	0.673655	60.45953	47.85613	0.0021
At most 2	0.383323	23.50616	29.79707	0.2221
At most 3	0.187529	7.553648	15.49471	0.5143
At most 4	0.020999	0.700359	3.841465	0.4027

Trace test indicates 2 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 *	0.740990	44.57935	33.87687	0.0018
At most 1 *	0.673655	36.95337	27.58434	0.0024
At most 2	0.383323	15.95251	21.13162	0.2276
At most 3	0.187529	6.853289	14.26460	0.5066
At most 4	0.020999	0.700359	3.841465	0.4027

Max-eigenvalue test indicates 2 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: *Author's Computation (2025)*

The co-integration outcomes in Table 13 above reveals that both the trace test statistics and the max-eigenvalue statistics indicate two (2) co-integrating equation at 5 % significance level. This suggests that there exists a long-run relationship among variables in the model. Accordingly, the study rejects the null hypothesis of no co-integration amongst the variables but accepts the alternative hypothesis.

(ii) Over-Parameterized ECM Estimation Results for Model Three (Maternal Mortality Rate (MAM) Model)

The result of over-parametrized ECM estimation of the Model is presented in table 14 below.

Table 14: Over-parameterized ECM Estimation Results for Model Three (Maternal Mortality Rate (MAM) Model)

Dependent Variable: DLOG(MAM)
Method: Least Squares
Date: 04/29/25 Time: 00:32
Sample (adjusted): 1993 2024
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001678	0.004741	-0.353972	0.7280
DLOG(MAM(-1))	0.507207	0.190214	2.666509	0.0169
DLOG(MAM(-2))	0.366835	0.206804	1.773835	0.0951
D(INF)	-6.58E-05	0.000343	-0.191860	0.8503
D(INF(-1))	0.000928	0.000264	3.511631	0.0029
D(INF(-2))	-7.56E-06	0.000208	-0.036292	0.9715
DLOG(GDPPC)	-0.085253	0.027185	-3.136025	0.0064
DLOG(GDPPC(-1))	-0.024218	0.031410	-0.771031	0.4519
DLOG(GDPPC(-2))	0.095342	0.029807	3.198674	0.0056
DLOG(GEH)	-0.005293	0.006025	-0.878380	0.3927
DLOG(GEH(-1))	0.006773	0.006148	1.101606	0.2869
DLOG(GEH(-2))	0.011095	0.006051	1.833657	0.0854
D(UNEMP)	-0.000458	0.000553	-0.827591	0.4201
D(UNEMP(-1))	-0.000269	0.000491	-0.546905	0.5920
D(UNEMP(-2))	0.000891	0.000525	1.698018	0.1089
ECM(-1)	-0.311731	0.093225	-3.343863	0.0041

R-squared	0.786978	Mean dependent var	-0.006305
Adjusted R-squared	0.587270	S.D. dependent var	0.016051
S.E. of regression	0.010312	Akaike info criterion	-6.004223
Sum squared resid	0.001701	Schwarz criterion	-5.271355
Log likelihood	112.0676	Hannan-Quinn criter.	-5.761298
F-statistic	3.940638	Durbin-Watson stat	1.915041
Prob(F-statistic)	0.004870		

Source: *Author's Computation (2025)*

(iii) Parsimonious ECM of the Model Three (Maternal Mortality Rate (MAM) Model)

The result of ECM estimation of the Model is obtainable in table 15 below.

Table 15: Parsimonious ECM Estimation Results for Model Three (Maternal Mortality Rate (MAM) Model)

Dependent Variable: DLOG(MAM)
Method: Least Squares
Date: 04/29/25 Time: 00:34
Sample (adjusted): 1993 2024
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.003627	0.003413	-1.062830	0.2999
DLOG(MAM(-1))	0.535732	0.160591	3.336015	0.0031
DLOG(MAM(-2))	0.334623	0.179986	1.859159	0.0771
D(INF(-1))	0.000868	0.000230	3.774235	0.0011
DLOG(GDPPC)	-0.086435	0.024400	-3.542479	0.0019
DLOG(GDPPC(-2))	0.091554	0.021759	4.207729	0.0004
DLOG(GEH)	-0.007883	0.004148	-1.900160	0.0712
DLOG(GEH(-1))	0.004199	0.004453	0.942844	0.3565
DLOG(GEH(-2))	0.009089	0.004158	2.185984	0.0403
D(UNEMP(-2))	0.001002	0.000412	2.431314	0.0241
ECM(-1)	-0.431449	0.138226	-3.121340	0.0038

R-squared	0.762004	Mean dependent var	-0.006305
Adjusted R-squared	0.648673	S.D. dependent var	0.016051
S.E. of regression	0.009514	Akaike info criterion	-6.205865
Sum squared resid	0.001901	Schwarz criterion	-5.702018
Log likelihood	110.2938	Hannan-Quinn criter.	-6.038854
F-statistic	6.723678	Durbin-Watson stat	2.115481
Prob(F-statistic)	0.000126		

Source: *Author's Computation (2025)*

From Table 15, it shows that the explanatory variables included in the model explained about 65 percent of variation in poverty in Nigeria as shown by Adjusted-R^2 of 0.648673; the remaining 35 percent is explained by the error term. The F-statistic of 6.723678 with a prob. value of 0.000126 shows that the model is statistically significant and that independent variables are significant explanatory factors of the dependent variable. The above implies that model has a goodness of fit and Durbin Watson Statistic of 2.115481 reveals that there is minimal serial autocorrelation among variables used in model. Also, the Error correction coefficient (ECM) is statistically significant and appropriately signed. This reveals that secondary school enrolment in Nigeria adjust to changes in explanatory variables by about 43 per cent annually.

Furthermore, From Table 16, the result of the short run estimation shows that Inflation (INF) has a positive (0.000868) relationship with Maternal Mortality Rate (MAM), suggesting that a unit increase in Inflation (INF) increases Maternal Mortality

Rate (MAM) by 0.000868 units in Nigeria. The positive effect of Inflation (INF) on Maternal Mortality Rate (MAM) confirms to a priori and therefore is line with economic theory. The coefficient of Inflation (INF) is statistically significant at 5 percent level in the short run. The study therefore rejects the null hypothesis that there is no significant relationship between Inflation (INF) and Maternal Mortality Rate (MAM) but do not reject the alternative hypothesis in the short run.

Both current and past lag 2 of Gross Domestic Product per capita (GDPPC) has a negative (-0.086435 and -0.091554, respectively) relationship with Maternal Mortality Rate (MAM), suggesting that a unit increase in Gross Domestic Product per capita (GDPPC) reduces Maternal Mortality Rate (MAM) in Nigeria. The negative effect of Gross Domestic Product per capita (GDPPC) on Maternal Mortality Rate (MAM) conforms to a priori and therefore is in line with economic theory. The negative effect of Gross Domestic Product per capita (GDPPC) on Maternal Mortality Rate (MAM) is statistically significant at 5 percent level. The study therefore rejects the null hypothesis that there is no significant relationship between Gross Domestic Product per capita (GDPPC) and Maternal Mortality Rate (MAM) in the short run but do not reject the alternative hypothesis.

Government Expenditure on Health (GEH) has a negative (-0.007883) relationship with Maternal Mortality Rate (MAM), suggesting that a unit increase in Government Expenditure on Health (GEH) decreases Maternal Mortality Rate (MAM) by 0.007883 units in Nigeria. The negative sign of Government Expenditure on Health (GEH) on Maternal Mortality Rate (MAM) confirm to a priori and therefore is in line with economic theory. The negative sign of Government Expenditure on Health (GEH) on Maternal Mortality Rate (MAM) is statistically significant at 5 percent level. The study therefore rejects the null hypothesis that there is no significant relationship between Government Expenditure on Health (GEH) and Maternal Mortality Rate (MAM) in the short run but do not reject the alternative hypothesis.

While Unemployment (UNEMP) has a positive (0.001002) relationship with Maternal Mortality Rate (MAM), suggesting that a unit increase in Unemployment (UNEMP) increases Maternal Mortality Rate (MAM) by 0.001002 units in Nigeria. The positive sign of Unemployment (UNEMP) on Maternal Mortality Rate (MAM) confirm to a priori and therefore is in line with economic theory. The positive sign of Unemployment (UNEMP) on Maternal Mortality Rate (MAM) is statistically significant at 5 percent level. The study therefore rejects the null hypothesis that there is no significant relationship between Unemployment (UNEMP) and Maternal Mortality Rate (MAM) in the short run but do not reject the alternative hypothesis.

(v) Post Estimation Test for the Model Three (Maternal Mortality Rate (MAM) Model)

The researcher conducted a diagnostic test to determine whether or not series were free from order autocorrelation (Breusch-Godfrey Serial Correlation LM Test) and heteroscedasticity (Breusch-Pagan-Godfrey Test).

The outcome of the diagnostic tests is presented in Table 16.

Table 16: Ramsey Reset Test, Serial Correlation LM Test and Homoscedasticity Test Results for Model Three (Maternal Mortality Rate (MAM) Model)

	F-Statistic	Prob. Value
Breusch-Godfrey Serial Correlation LM Test	1.787369	0.1944
Breusch-Pagan-Godfrey Heteroskedasticity Test	1.224262	0.3318

Source: *Author's Computation (2025)*

From Table 16, the outcome of autocorrelation test using Breusch-Godfrey Serial Correlation LM method showed F-statistics is 1.787369 with a Chi-Square probability value is 0.1944. This indicated that probability value of about 19 percent (0.1944) is larger than 5 percent (0.05) critical value; hence confirmed no serial correlation in model.

Again, result of heteroscedasticity test using Breusch-Pagan-Godfrey test showed the F-statistics is 1.224262 and a Chi-Square probability value is 0.3318. This suggested no evidence of heteroskedasticity in model since Chi-square probability value of about 33 percent is more than 5 percent ($p > 0.05$). So, residuals do have constant variance which is desirable in regression denoting that residual are Homoscedastic.

Discussions

Inflation and Under-Five Mortality Rate in Nigeria

The ECM result reveals that Inflation (INF) has a positive relationship with Under-Five Mortality Rate (UFM). This means that a unit increase in Inflation (INF) increases Under-Five Mortality Rate (UFM) in Nigeria in the short run within the period under review.

The findings of this study support previous work of Moser and Ichida (2001), Harper et al., (2003), Anyanwu and Erhijakpor (2009), and Bongaarts (2006). These scholars have found that inflation weakens public health investments and individual household capacity to care for children, leading to elevated child mortality rates.

GDP per capita and Under-Five Mortality Rate in Nigeria

The study reveals that Gross Domestic Product per capita (GDPPC) has a negative relationship with Under-Five Mortality Rate (UFM). This means that a unit increase in Gross Domestic Product per capita (GDPPC) reduces Under-Five Mortality Rate (UFM) in Nigeria in the short run within the period under review.

The findings of this study agree with the works of Lopez et al., (2006), Pradhan et al., (2003), Hsieh (2000), Bloom and Canning (2000), Gertler and Gruber (2002), Deaton (2003), and Stuckler et al., (2009**)** who found that Higher GDP per capita is a major factor in improving healthcare and reducing mortality rates in childhood, particularly in low-income countries.

Government Expenditure on Health and Under-Five Mortality Rate in Nigeria

The study reveals that Government Expenditure on Health (GEH) has a positive relationship with Under-Five Mortality Rate (UFM). This means that a unit increase in Government Expenditure on Health (GEH) increases Under-Five Mortality Rate (UFM) in Nigeria in the short run within the period under review.

The findings of this study agree with the works of Lewis (2006), Baldacci et al., (2003), Gupta et al., (2001), Rajkumar and Swaroop (2008) who found that in many developing countries such as Nigeria, increased government health expenditure is misused or inefficient, resulting in no improvement — and sometimes worsening — of health outcomes.

Unemployment and Under-Five Mortality Rate in Nigeria

The study reveals that Unemployment (UNEMP) has a negative relationship with Under-Five Mortality Rate (UFM). This means that a unit increase in Unemployment (UNEMP) decreases Under-Five Mortality Rate (UFM) in Nigeria in the short run within the period under review.

The negative findings of this study disagree with the works of Neumayer, (2004), Tapia Granados (2005), and Ruhm (2000) who found that economic downturns with rising unemployment are associated with declines in some mortality rates, but not specifically in child mortality, and findings are country-specific.

Inflation and Life Expectancy in Nigeria

The study reveals that Inflation (INF) has a negative relationship with Life Expectancy (LEXP). This means that a unit increase in Inflation (INF) reduces Life Expectancy (LEXP) in Nigeria in the short run within the period under review. The coefficient of Inflation (INF) is statistically significant at 5 percent with Life Expectancy.

The negative findings of this study agree with the works of Behrman and Deolalikar (1988), Easterly and Fischer (2001), WHO (2001), and IMF (2004) who found that Inflation is identified as a barrier to maintaining healthcare investments, with downstream effects on life expectancy.

GDP Per Capita and Life Expectancy in Nigeria

The ECM result reveals that Gross Domestic Product per capita (GDPPC) has a negative relationship with Life Expectancy (LEXP). This means that a unit increase in Gross Domestic Product per capita (GDPPC) decreases Life Expectancy (LEXP) in Nigeria in the short run within the period under review.

The findings of this study support previous work of Ezzati et al. (2008), Cornia and Menchini (2006), Deaton (2003), and Popkin (2006) who have found that despite rising GDP per capita in Nigeria, some counties experienced stagnation or decline in life expectancy, especially among disadvantaged groups.

Government Expenditure on Health and Life Expectancy in Nigeria

The study reveals that Government Expenditure on Health (GEH) has a negative relationship with Life Expectancy (LEXP). This means that a unit increase in Government Expenditure on Health (GEH) decreases Life Expectancy (LEXP) in Nigeria in the short run within the period under review.

The findings of this study disagree with the works of Evans et al., (2005), Rajkumar and Swaroop (2008), Anyanwu and Erhijakpor (2009), and Morrissey (2003) who found that Effective government health expenditure is associated with improved health outcomes, including life expectancy.

Unemployment and Life Expectancy in Nigeria

The study reveals that Unemployment (UNEMP) has a negative relationship with Life Expectancy (LEXP). This means that a unit increase in Unemployment (UNEMP) decreases Life Expectancy (LEXP) in Nigeria in the short run within the period under review.

The findings of this study disagree with the works of Tapia Granados (2005), Stuckler et al., (2009), Ruhm (2000), Marmot (2005), and Sullivan et al., & (2009) who found that Persistent unemployment correlates with long-term health declines and reduced life expectancy. That Unemployment significantly worsens public health outcomes, including reductions in life expectancy.

Inflation and Maternal Mortality Rate in Nigeria

The study reveals that Inflation (INF) has a positive relationship with Maternal Mortality Rate (MAM). This means that a unit increase in Inflation (INF) increases Maternal Mortality Rate (MAM) in Nigeria in the short run within the period under review.

The positive findings of this study support previous like Anyanwu and Erhijakpor (2007), UNICEF (2009), Tandon and Cashin (2010), Say et al., (2014), WHO (2015), Bredenkamp et al., (2017). These scholars have found that Inflation erodes government health budgets and purchasing power, limiting access to maternal health services and increasing maternal mortality.

GDP per capita and Maternal Mortality Rate in Nigeria

The study reveals that Gross Domestic Product per capita (GDPPC) has a negative relationship with Maternal Mortality Rate (MAM). This means that a unit increase in Gross Domestic Product per capita (GDPPC) reduces Maternal Mortality Rate (MAM) in Nigeria in the short run within the period under review.

The negative findings of this study agree with the works of McGuire (2006), Rajkumar and Swaroop (2008), Anyanwu and Erhijakpor (2009), and Bhalotra and Rawlings (2011). These scholars found that GDP per capita is a strong determinant of maternal health outcomes; higher GDP is associated with lower Maternal Mortality Rate (MAM).

Government Expenditure on Health and Maternal Mortality Rate in Nigeria

The study reveals that Government Expenditure on Health (GEH) has a negative relationship with Maternal Mortality Rate (MAM). This means that a unit increase in Government Expenditure on Health (GEH) decreases Maternal Mortality Rate (MAM) in Nigeria in the short run within the period under review.

The negative findings of this study agree with the works of Musgrove and Zeramdini (2001), Gupta et al., (2003), Anyanwu and Erhijakpor (2007), Bokhari et al., (2007) and Moreno-Serra and Smith (2015) have found that Increased government health spending significantly reduces maternal mortality in African countries including Nigeria.

Unemployment and Maternal Mortality Rate in Nigeria

The study reveals that Unemployment (UNEMP) has a positive relationship with Maternal Mortality Rate (MAM). This means that a unit increase in Unemployment (UNEMP) increases Maternal Mortality Rate (MAM) in Nigeria in the short run within the period under review.

The positive findings of this study agree with the works of Bhalotra (2007), Anyanwu and Erhijakpor (2007), Stuckler et al., (2009), Scheil-Adlung (2013) who found that Unemployment reduces household and government ability to fund maternal health services, contributing to higher maternal mortality.

Conclusion

We have in this paper examined inflation and economic growth in Nigeria: an econometric analysis. The results of the ECM shows that Inflation (INF) increases Under-Five Mortality Rate (UFM); GDP per capita (GDPPC) reduces Under-Five Mortality Rate (UFM); Government Expenditure on Health (GEH) increases Under-Five Mortality Rate (UFM); Unemployment (UNEMP) has no significant effect on Under-Five Mortality Rate (UFM); Inflation (INF) reduces Life Expectancy (LEXP); GDP per capita (GDPPC) reduces Life Expectancy (LEXP); Government Expenditure on Health (GEH) has no significant effect on Life Expectancy (LEXP); Unemployment (UNEMP) reduces Life Expectancy (LEXP); Inflation (INF) increases Maternal Mortality Rate (MAM); GDP per capita (GDPPC) reduces Maternal Mortality Rate (MAM); Government Expenditure on Health (GEH) reduces Maternal Mortality Rate (MAM); and Unemployment (UNEMP) increases Maternal Mortality Rate (MAM) in Nigeria during the period of study. The study therefore concludes that Inflation (INF) significantly increases Under-Five Mortality Rate (UFM) and Maternal Mortality Rate (MAM; indicating that rising prices may reduce household access to essential healthcare and nutrition for children and also negatively impacts maternal health services in Nigeria within the period of study.

Recommendations

Based on the findings of the study, the following recommendations were made:

i. Government should implement macroeconomic policies aimed at controlling inflation.
ii. Since higher GDP per capita is associated with lower mortality rates and higher life expectancy, reflecting improved living standards and access to healthcare, government should promote investment in diverse economic sectors.
iii. The government should conduct a comprehensive evaluation of health spending to ensure funds are effectively targeting maternal and child health services.
iv. High unemployment negatively impacts life expectancy and increases maternal mortality, indicating that economic stability contributes to better health outcomes. Hence, the government should create job opportunities through skills development programs and support for entrepreneurship, particularly targeting women and youth.

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