FISCAL SUSTAINABILITY AND HEALTH OUTCOMES IN NIGERIA

Rasaki Stephen Dauda
Olusola Joel Oyeleke
Olufemi Gbenga Onatunji
Department of Economics, Redeemer's University, Ede, Nigeria

ABSTRACT

This study examined the effect of fiscal sustainability on health outcomes in Nigeria, over the period 1980-2020. The Autoregressive Distributed Lag (ARDL) modelling approach was employed for data analysis with the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) techniques used for robustness and sensitivity checks, respectively. The findings showed that debt-to-GDP and debt-to-exports depressed life expectancy while their impacts on infant mortality were positive and statistically significant. Debt service-to-revenue ratio had a significant negative effect on life expectancy but a positive insignificant impact on infant mortality. The robustness checks results, using the FMOLS and DOLS techniques were consistent with the findings of the ARDL approach. It is therefore evident that fiscal deficit is a threat to health outcomes in Nigeria. Therefore, to address this problem, the Nigerian government should reduce her borrowing, boost economic growth, invest in human capital, and ensure moderate population growth.

Key words: fiscal sustainability, health outcomes, ARDL, Nigeria
JEL classification: E62, H68, I15

1. Introduction

Among the numerous problems the Nigerian economy has been faced with is the issue of fiscal deficit, spanning decades. According to the World Bank

(2022a, 1), Nigeria's "macroeconomic stability and policy predictability have consistently deteriorated over the last decade." The nation appears to be overwhelmed by a growing debt profile in the face of dwindling revenue, which in recent times has raised concerns among stakeholders within and outside the academia. Her total debt stock, which was US$86.39 billion in 2020, rose to US$95.78 billion in 2021 and later to US$103.11 billion by December 2022 (indicating percentage increases of 10.87% and 14.46% between 2020 and 2021, and between 2021 and 2022, respectively). The debt-to-GDP ratio as at December 31, 2021 stood at 22.47%; while the figure for December 2022 was 23.20% (DMO-Debt Management Office, 2022 & 2023). Her debt stock is projected to rise above 42.0% of the GDP by the end of 2026 while debt servicing is estimated to grow at the rate of 22.0% per annum between 2021 and 2026, which has the "potential to erode fiscal space and further contribute to fiscal deficits" (World Bank, 2022a, 146).

Moreover, her debt service-to-revenue ratio, which was about 61.40% in 2018 has continued to rise uncontrollably and has been projected by the International Monetary Fund (IMF) to reach 92% by the end of 2022 while the World Bank estimated that about 123.4% of the nation's revenue in 2023 would be used to service debt, which is far above the 22.5% threshold prescribed by the World Bank (Okeowo et al., 2018; Iyatse & Gyamfi, 2022; World Bank, 2022a; and Tunji, 2022). The implication of the debt service-to-revenue ratio is that for every 100 naira revenue generated, the country will spend 92 naira in servicing debt; which is not sustainable.

The current deteriorating state of macroeconomic stability in Nigeria has several implications for the performance of the nation's economy as well as health outcomes. Health is an important determinant of a nation's level of productivity, growth and sustainable development (Haacker, 2010; Dauda, 2017, 2019; and Dauda & Olaniyan, 2017). However, a continuous decline in revenue amidst sustained budget deficits and heavy debt burden is not only capable of dragging growth and development but is also likely to depress health outcomes.

Evidence from the World Bank (2023) reveals the disheartening situation of health outcome indicators in Nigeria in spite of some improvements recorded over the years. For instance, the country's maternal mortality ratio and under-five mortality rate remain triple digits while infant mortality rate is

double digits. Physicians and hospital beds per 1000 people are abysmally low, whereas, adult fertility and adolescent fertility rates as well as incidences of malaria and tuberculosis remain very high with average life expectancy just a little above 50 years.

Considering the above, there is the tendency that Nigeria's health outcome indicators will further deteriorate as a result of degenerating macroeconomic stability in the country. Ma, Hu and Zafar (2022, 1) noted that countries with high debt tend to accumulate more debts "to pay for good quality health and food care services to the masses." Citing other literature, such as Jacoby (2002), Matthews and Gallo (2011), Gathergood (2012), Berger, Collins and Cuesta (2016), and Alola and Ozturk (2021), Ma et al., 2022 also argued that financial stress like high debt profile can have severe effects on the health of a population while "a high degree of debt repayments" could induce anxiety, which is capable of contributing to "poor physical and mental health" as well as psychological distress that may worsen overall welfare. The authors further noted that debt stress could breed unhealthy behaviour, and lead to poor health conditions while debt accumulation can reduce or prevent access to resources for health-related investments. In fact, Harkins (2018, 10) reported that "unsecure debt has been associated with poorer self-rated physical health, long-term illness or disability, chronic fatigue, back pain, increased levels of obesity, and worse health and health-related quality of life."

The current worsening fiscal and debt performance of Nigeria that shows no sign of receding requires empirical study to ascertain its economic implications, particularly how it impacts the health outcomes in the country. Studies across the literature have investigated different aspects of macroeconomic effects of fiscal policies/sustainability in Nigeria and beyond (Liaropoulos & Goranitis, 2015; Adeosun, Ayodele & Jongbo, 2021; and Ma, Hu & Zafar, 2022); however, not many of them have focused on the health outcome effects of this issue. The available ones (Saibu, 2018; and Odewole et al., 2021) examined the health financing implication of fiscal sustainability while Ma, Hu and Zafar (2022), a panel study, focuses on whether or not foreign direct investment (FDI) matters for the influence of external debt on health in seven emerging economies of Asia, which all diverge substantially

from the current work. The present study therefore seeks to assess how fiscal sustainability affects health outcomes in Nigeria.

Moreover, the current paper, in addition to the use of ARDL, employed the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) correspondingly advanced by Phillips and Hansen (1990), and Stock and Watson (1993) for robustness and sensitivity checks respectively, which none of the studies cited above used. Both techniques accommodate mixed order of integration of variables and have been adjudged to be consistent estimators that take into account potential endogeneity and serial correlation issues.

The remainder of the paper is as follows: section 2 focuses on the review of literature, section 3 presents the theoretical framework and methodology of the study, section 4 examines empirical results while section five summarizes and concludes the paper with policy implications.

2. Literature Review

Extant studies have documented empirical evidence predominantly on sustainability of fiscal deficit or debt for different economies or regions with flagrant disregard for its effect on important macroeconomic variables, and with mixed findings. Ndoricimpa (2021) investigated the sustainability of the fiscal policy in Sweden, following the time-varying co-integration approach to examine multiple structural breaks in a co-integrating regression analysis. The findings show that the Swedish fiscal policy in general was unsustainable while the results based on multiple structural changes revealed weakly sustainable fiscal deficits. In the same vein, Hosen (2022) explored the fiscal deficit sustainability of ten different economies across the globe within the period 2001-2007, using three varied panel co-integration and the Vector Error Correction Model (VECM). The results of the study could not reject evidence of a long-run relationship between public revenues and expenditure, a development that implied sustainability of their fiscal deficits.

Similarly, using panel datasets, Owusu (2021) examined the sustainability of fiscal deficits in ten Eastern and Central European nations from 1997 to 2019. The findings generated from the preliminary test revealed that there was no co-integration, which indicated the absence of sustainability.

However, when both revenue and expenditure were disaggregated into two components (structural and cyclical) the results revealed evidence of weak sustainability in all the economies covered in the study. Nevertheless, findings from the paper did not provide for heterogeneity of the individual nations in term of revenue generation capability and the size of the economy.

Moreover, Esteve and Prats (2022) assessed the fiscal sustainability of the Spanish economy from 1850 to 2020, using different techniques to detect recurrent explosive behaviour and to identify periods of explosive government debt variations with fiscal adjustments. The findings revealed that there was fiscal unsustainability during the period of explosive public debt while sustainability was detected during the period of fiscal adjustment.

Oyeleke and Ajilore (2014) also examined the fiscal sustainability of the economy in Nigeria from 1980 to 2010. The attempt was to ascertain whether or not authorities in Nigeria had compromised on intertemporal budget constraint in their public finances. Employing an error correction technique, the study found that the sustainability of fiscal policy was fragile in Nigeria during the reference period.

Furthermore, Oyeleke and Adebisi (2014) investigated the fiscal policy sustainability of the Ghanaian economy between 1980 and 2010. The aim was to determine whether the intertemporal budget constraint had been violated as a prerequisite for membership in the West Africa Monetary Zone. The findings showed that equilibrium between government revenue and expenditure existed during the study period; the long-run relation was however, weak. Raising concerns about structural breaks accounting for unsustainability of fiscal policy in Nigeria, Usman and Adebisi (2017) studied the fiscal process in Nigeria from 1961 to 2013. The authors employed the ARDL bounds test co-integration approach and Bai-Perron multiple break point tests; the findings showed that the public finance was unsustainable in the entire reference period. However, after providing for structural breaks, which occurred in 1981, it was observed that public finances yielded strong sustainability.

Adebisi and Salako (2020) also employed ARDL bounds to determine the existence of equilibrium between public revenue and expenditure in Nigeria from 1961 to 2016. The outcome showed the existence of disequilibrium among the variables, which indicated lack of sustainability. Based on a long

historical dataset, Brady and Magazzino (2017) also explored equilibrium between public revenues and debts in Italy for the period 1862-2013. The authors used the Markov-regime switching method with breaks. After analysis, it was discovered that public finances of Italian authorities were not sustainable. However, after the break year, the study could not reject the sustainability of government finances when the co-integration test was conducted on the variables from 1947-2013.

Furthermore, the evidence provided by Clarke, Whitely and Reid (2022), who assessed fiscal sustainability of public debts in Jamaica during a highly explosive period and using the co-integration test and fiscal reaction function method with emphasis on breaks, revealed that irrespective of the political environment, Jamaica's debt was still sustainable.

It is apparent from the studies reviewed above that serious thought has not been given to the implication of sustainability of either debt or deficit on most macroeconomic variables.

On the health outcome implications of fiscal sustainability, a literature search failed to produce substantial results. Most of the available works dwell on financial/public finances sustainability in the health systems and within the growing healthcare expenditure across the globe. The focus is on the problem of the possibility of governments and other concerned parties adequately financing healthcare, given the rising cost of healthcare amidst population growth in some developing countries and the ageing population in advanced economies, in addition to "new technologies and consumer expectations around healthcare coverage and quality" (Thomson et al., 2009, p.1). Prominent among these studies are: Thomson et al. (2009), Liaropoulos and Goranitis (2015), Licchetta and Stelmach (2016), Colombier and Braendle (2018), and Odewole, Salawu and Salawu (2021). The overwhelming conclusion of these studies is that in the face of rising cost pressures amidst limited resources in advanced and developing economies, coupled with rising healthcare expenditure, the financial sustainability of the health systems in the future may be doubtful.

Other works, such as Bahuli and Bala (2020) and Ma, Hu and Zafar (2022) considered how public debt and other variables affect health outcomes. In a panel study of seven emerging Asian economies (Bangladesh, Malaysia, The Philippines, Thailand, Sri Lanka, China, and India), Ma et al.

(2022) examined the importance of FDI for how external debt affects health, using panel ARDL while Bahuli and Bala (2020) assessed the influence of external debt servicing on health outcomes in Nigeria between 1995 and 2017.

The above reviewed papers on sustainability and health issues differ considerably from the present study on the grounds of issues, empirics, methodologies and estimation techniques, which further strengthen the justification for the current paper.

3. Theoretical Framework and Methodology

The study hinges on the Grossman (1972) health production theoretical function, which relates health with some inputs, covering socioeconomic, biological and demographic variables. Thus, for this study, health outcomes depend on fiscal sustainability, socioeconomic, environmental, and demographic variables. Therefore:

$$HOC = f(FSB, SEV, ENV, DGV) \quad (1)$$

where:

HOC = health outcome variables
FSB = fiscal sustainability variables
SEV = socioeconomic variables
ENV = environmental variables
DGV = demographic variables

3.1 Model specification and estimation technique

The function in Eq. (1) can be transformed into an econometric model as follows:

$$HOC_t = \omega_0 + \omega_1 FSB_t + \omega_2 SEV_t + \omega_3 ENV_t + \omega_4 DGV_t + \varepsilon_t \quad (2)$$

where: ω_1, ω_2, ω_3, and ω_4 denote the long run elasticities of health outcome indicators (life expectancy and infant mortality rate) with respect to fiscal sustainability indicators (debt to GDP, debt service-to-revenue ratio and

debt to exports), economic growth, school enrolment, CO2 emissions, and population growth respectively, and ω_0 stands for the constant term. ε_t and *t* represent the stochastic error term and time, respectively.

In this study, the Autoregressive Distributed Lag Model (ARDL) proposed by Pesaran, Shin and Smith (2001) was utilized to examine the interconnection between fiscal sustainability and health outcomes. The ARDL approach is notable for being applicable irrespective of the integrating order of the variables between I(0) and I(1) (Ouattara, 2004). The technique also provides the estimation of short-run and long-run dynamics in a single framework. Furthermore, the ARDL is free from the issue of endogeneity and serial correlation, and provides consistent estimation even with small observation sizes. Thus, Equation (2) is formulated in the ARDL model as follows:

$$\begin{aligned}\Delta HOC_t = \ & \omega_0 + \sum_{i=1}^{t} \omega_1 \Delta HOC_{t-i} + \sum_{i=1}^{t} \omega_2 \Delta FSB_{t-i} + \sum_{i=1}^{t} \omega_3 \Delta SEV_{t-i} + \\ & \sum_{i=1}^{t} \omega_4 \Delta ENV_{t-i} + \sum_{i=1}^{t} \omega_5 \Delta DGV_{t-i} + \varphi_1 HOC_{t-i} + \varphi_2 FSB_{t-i} + \\ & \varphi_3 SEV_{t-i} + \varphi_4 ENV_{t-i} + \varphi_5 DGV_{t-i} + \varepsilon_t\end{aligned} \tag{3}$$

where: Δ denotes the first difference operator, *t* is the lag length, short-run coefficients are represented by $\omega_{1 \ldots} \omega_5$ and long-run coefficients captured by $\varphi_{1 \ldots} \varphi_5$

Prior to the estimation of the ARDL technique, after the stationarity status, the existence of a long-run cointegration relationship among the variables was verified using the ARDL bounds test proposed by Pesaran et al. (2001). Inference on the presence of long-run equilibrium is established by comparing the *F*-test with the two critical values generated by Pesaran et al. (2001). The existence of long-run cointegration is confirmed when the *F*-test value exceeds both critical values. To account for the short-run deviation from the long-run equilibrium, Eq. (3) is re-specified into the error correction version as:

$$\Delta HOC_t = \omega_0 + \sum_{i=1}^{t} \omega_1 \Delta HOC_{t-i} + \sum_{i=1}^{t} \omega_2 \Delta FSB_{t-i} + \sum_{i=1}^{t} \omega_3 \Delta SEV_{t-i} + \sum_{i=1}^{t} \omega_4 \Delta ENV_{t-i} + \sum_{i=1}^{t} \omega_5 \Delta DGV + \vartheta ECT_{t-1} + \varepsilon_t \quad (4)$$

where ϑ denotes the speed of adjustment of short run to long run equilibrium and ECM_{t-1} is the error correction term.

The paper further utilized the Fully Modified Ordinary Least Squares (FMOLS) and the Dynamic Ordinary Least Squares (DOLS) as robustness and sensitivity checks for this investigation. The techniques have been regarded as not being constrained to a single order of integration of the variables. In other words, they accommodate a mixed order of integration of variables. Furthermore, the FMOLS and DOLS approaches have been adjudged to be consistent estimators that take into account the potential endogeneity and serial correlation issues. Specifically, the DOLS is notable for circumventing the issue of multicollinearity and serial correlation by including the lead and first-lag difference in the cointegration regression. The argument that the leads and the lags of the distinct terms are incorporated shows that the white noise is orthogonalized (Raihan & Tuspekova, 2022).

3.2 Variables and measurements

The paper employed annual time series dataset spanning 1980-2020 to examine the nexus between fiscal sustainability and health outcomes in Nigeria. Health outcome variable (HOC) was measured using average life expectancy (LIF) and infant mortality rate (INF) while fiscal sustainability variable (FSB) was captured with debt-to-GDP (DEBTG), debt service-to-revenue (DEBTR), and debt to-exports (DEBTX) ratios. Other variables used include: GDP per capita (GDP) and primary school enrolment rate (ENR) as proxies for SEV; CO2 emissions (C02) for ENV, and total population (POP) for DGV.

3.3 Data source

The data employed for analysis in the study were sourced from the World Bank (2022b) World Development Indicator Database.

4. Empirical Results

The empirical analysis begins with preliminary scrutiny of the statistical properties of the variables under consideration. Table 1 presents the descriptive statistics of the variables considered in this study.

Table 1: Descriptive Statistics

Variable	Mean	Median	Max	Min	Std. Dev	J. Bera
LIF	47.633	46.116	53.112	45.333	2.429	6.408
INF	108.194	118.900	126.200	79.300	17.664	4.336
DEBTG	1.167	1.006	3.630	0.062	0.979	4.870
DEBTR	2.899	2.685	6.521	0.102	2.190	3.056
DEBTX	12.953	11.850	3.038	0.494	6.539	3.006
GDP	1715.875	1548.288	2563.900	1324.297	389.461	4.077
ENR	94.301	93.548	113.078	78.663	8.557	1.968
CO2	774.170	721.126	131.685	336.813	298.894	1.932
POP	1.16E+08	1.09E+08	1.76E+08	713.114	320.544	2.489

Note: LIF = life expectancy, INF = infant mortality, DEBTG = debt to GDP, DEBTR = debt service-to-revenue ratio, DEBTX = debt to export, GDP = economic growth, ENR = school enrolment, CO2 = CO2 emission, and POP = population growth.
Source: Computed by Authors.

The analysis in Table 1 reveals that the average life expectancy and infant mortality rate were 47.633 and 108.194, respectively. This shows that average life expectancy in the country is very low in comparison with the global and African averages of 73 years and 64.5 in that order as reported in World Population Review (2022) while infant mortality rate remains high in the country. Regarding fiscal sustainability indicators, debt to exports as a measure of fiscal solvency stood at an average of 12.953, debt service-to-revenue ratio as a measure of fiscal liquidity averaged 2.899 while debt to GDP as a proxy for fiscal sustainability was 1.167. This indicates that fiscal

sustainability indicators in the country are still low, suggesting the weakness of external debt sustainability. The standard deviation shows that there is no wide variation among the series except for economic growth, CO2 emissions, and population growth. The Jarque-Bera statistics indicate that all the series are normally distributed.

The order of integration of the variables was determined using the Augmented Dickey-Fuller (ADF) and Phillips and Perron (1988) unit root tests. These are presented in Table 2.

Table 2: Unit Root Test (with Break and without Break)

Variable	Level		1st Diff		Level	1st Diff
	ADF	PP	ADF	PP	Zivot	Zivot
LIF	-0.451	-1.918	-3.854**	-4.098*	-2.526(1991)	-5.853(2000)*
INF	-1.745	-1.266	-4.497*	-4.213*	-2.912(2003)	-4.993(2016)*
DEBTG	-1.556	-1.623	-5.468*	-5.735*	-3.383(2007)	-6.438(2009)*
DEBTR	-1.970	-1.930	-7.994*	-8.286*	-7.626(1998)*	-9.531(2007)*
DEBTX	-2.058	-2.164	-8.119*	-8.288*	-3.100(2014)	-9.529(2016)*
GDP	-1.264	-1.308	-4.571*	-4.875*	-3.212(2003)	-8.842(2016)*
ENR	-2.322	-2.636	-5.204*	-5.578*	-2.291(1998)	-5.449(2013)*
CO2	-4.993*	-4.986*	-6.072*	-6.033*	-3.368(2000)	-7.766(2010)*
POP	-3.511**	-1.565**	-6.426*	-6.636*	-1.012(1990)	-9.717(2014)*

*Note: * and ** denote significance at the 1% and 5% levels respectively*

Source: Computed by Authors.

The results indicate that economic growth, life expectancy, infant mortality, debt to GDP, debt to exports, debt service-to-revenue, and school enrolment became stationary only at the first difference, while population growth and CO2 emissions were stationary at level. The results of these conventional unit root tests may be spurious if the chosen variables are susceptible to structural and macroeconomic events. To this end, the Zivot and Andrew (1992) unit root test was used to account for potential structural breaks among the chosen variables.

Table 2 presents the results of the Zivot-Andrew (1992) unit root test. As shown in the table, all the series were non-stationary at levels except for debt service-to-revenue. Nonetheless, all series were stationary at first difference

with the break years of 2000, 2016, 2009, 2007, 2016, 2016, 2013, 2010 and 2014, respectively to the variables as presented in Table 2.

Having confirmed the stationarity of the series, we proceeded further to examine the long-run cointegration among the series using the bounds test as presented in Table 3.

Table 3: ARDL Bounds Test Results

Estimated model		F-statistics	Inference
$LIF_t = f(debtg, gdp, enr, Co2, pop)$		9.320	Cointegration
$LIF_t = f(debtr, gdp, enr, Co2, pop)$		6.074	Cointegration
$LIF_t = f(debtx, gdp, enr, Co2, pop)$		5.713	Cointegration
$INF_t = f(debtg, gdp, enr, Co2, pop)$		4.943	Cointegration
$INF_t = f(debtr, gdp, enr, Co2, pop)$		4.245	Cointegration
$INF_t = f(debtx, gdp, enr, Co2, pop)$		7.946	Cointegration
Significance level	LCBI(0)	UCBI(1)	
1%	3.41	4.68	
5%	2.62	3.79	
10%	2.26	3.35	

Source: Computed by Authors.

From the table, which shows the results of the bounds test for six models in which fiscal sustainability and health outcome indicators were incorporated separately, the findings revealed that the computed F-statistics exceeded the upper and lower critical values, suggesting a long-run connection between health outcomes and explanatory variables.

Long-run and short-run results, showing relationship between fiscal sustainability and health outcomes in Nigeria

The results of the estimated models indicating the long-run and short-run relationships between fiscal sustainability and health outcomes variables are presented in Table 4 while Table 5 displays the robustness and sensitivity tests results, using FMOLS and DOLS, respectively. The findings were interpreted and discussed jointly.

Table 4: ARDL Results

Variable	1	2	3	4	5	6
Constant	-1.211(0.023)**	0.683(0.129)	-0.944(0.053)**	1.899(0.000)*	0.788(0.000)*	0.378(0.000)*
$DEBTG_t$	-0.320(0.007)*			0.177(0.036)		
$DEBTR_t$		-0.464(0.082)***			0.165(0.469)	
$DEBTX_t$			-0.197(0.038)*			0.217(0.000)*
GDP_t	0.130(0.000)*	0.118(0.000)*	0.482(0.000)*	-0.167(0.043)**	-0.101(0.019)*	-0.106(0.056)**
$CO2_t$	-0.220(0.000)*	-0.134(0.009)*	-0.020(0.015)*	0.110(0.019)*	0.789(0.012)*	0.885(0.041)**
POP_t	-0.160(0.482)	-0.148(0.578)	-0.153(0.219)	0.581(0.124)	0.517(0.190)	0.487(0.231)
ENR_t	0.124(0.020)**	0.152(0.000)*	0.136(0.000)*	-0.149(0.037)**	-0.206(0.014)*	-0.225(0.000) *
Short run						
$\Delta DEBTG_t$	-0.472(0.020)**			0.278(0.026)**		
$\Delta DEBTR_t$		-0.164(0.010)*			0.374(0.120)	
$\Delta DEBTX_t$			-0.296(0.045)**			0.472(0.007)*
ΔGDP_t	0.991(0.010)*	0.182(0.000)*	0.102(0.052)*	-0.211(0.014)*	-0.228(0.010)*	0.023(0.019)*
$\Delta CO2_t$	-0.330(0.009)*	-0.204(0.092)***	-0.139(0.018)*	0.172(0.038)**	0.187(0.028)**	0.185(0.012)*
ΔPOP_t	-1.580(0.155)	-1.304(0.122)	1.482(0.178)	0.909(0.341)	0.118(0.135)	0.105(0.144)
ENR_t	0.111(0.015)*	0.519(0.002)*	0.496(0.063)*	-0.564(0.024)*	-0.257(0.032)**	-0.726(0.002)*
ECT_t	-0.417(0.000)*	-0.549(0.000)*	-0.347(0.000)*	-0.732(0.000)*	-0.639(0.000)*	-0.829(0.000)*
Diagnostic results						
R^2	0.968	0.963	0.999	0.985	0.994	0.973
X^2_{SC}	0.774(0.143)	0.178(0.250)	0.212(0.529)	0.291(0.725)	0.230(0.694)	0.830(0.166)
X^2_H	0.347(0.239)	0.116(0.204)	0.289(0.148)	0.640(0.162)	0.472(0.121)	0.610(0.152)
X^2_{FF}	0.262(0.128)	0.467(0.114)	0.726(0.567)	0.137(0.503)	0.215(0.192)	0.137(0.725)
X^2_N	0.379(0.573)	0.325(0.402)	0.130(0.770)	0.446(0.189)	0.191(0.375)	0.172(0.195)

Note: *, ** and *** indicate significance levels for 1%,5% and 10% respectively. The values in parenthesis are p-values respectively. X^2_{SC}, X^2_H, X^2_{FF} and X^2_N represent LM test for serial correlation, heteroskedacticity, RAMSEY RESET test, and normality test, respectively.
Source: Computed by Authors.

Table 4 shows the long-run and short-run ARDL results, with models 1-3 and 4-6 illustrating the findings on life expectancy and infant mortality as the dependent variables, respectively. The results reveal that the estimated coefficient of per capita GDP had a significant positive effect on life expectancy (columns 1-3) but a significant negative impact on infant mortality (columns 4-6). This finding suggests that increasing economic growth provides the government with more resources to provide health care services, which improves health outcomes in the economy. This result aligns with the findings of McCarthy and Wolf (2001), Kennelly, O'Shea and Garvy (2003), Jiménez-Rubio (2011), Clayton, Liñares-Zegarra, and Wilson (2015), Dauda (2020) and Ma et al. (2022), who reported similar outcomes of GDP per capita improving life expectancy and reducing infant mortality.

The results further indicate that the estimated coefficient of school enrolment exerts a positive effect on life expectancy (columns 1-3) and a negative impact on infant mortality (columns 4-6) in all estimated models. This suggests that an increase in educational enrolment in the country contributes significantly to improved health outcomes. This finding is consistent with the results of Feinstein et al. (2006) and Raghupathi and Raghupathi (2020) who discovered that countries with higher educational levels are more likely to have better national health conditions. Moreover, Laaksonen et al. (2008) and Denney et al. (2010) found that highly educated people use their knowledge, information, and past experiences to avoid health-related risk factors and engage in health-enhancing behaviours, including quitting smoking, abstaining from alcohol, and exercising frequently.

Furthermore, CO_2 emissions have a significant negative effect on life expectancy (columns 1-3) but a significant positive impact on infant mortality. The import of this is that CO_2 emissions are capable of reducing life expectancy and at the same time bloating infant mortality. Continuous exposure to carbon emissions, primarily from non-renewable energy sources, could cause respiratory and immune complications, which subsequently is likely to worsen health outcomes. The result is in consonance with the findings of Onanuga and Onanuga (2014), Jerumeh, Ogunnubi and Yusuf (2015), and Erdoğan, Yıldırım and Gedikli (2019) which showed that environmental quality deterioration caused by increasing consumption of polluting energy sources adversely affects many health indicators.

Additionally, the estimated coefficient of population growth had negative and positive effects on life expectancy and infant mortality respectively, however, the coefficients were not significant. The negative and insignificant impact of population variable on life expectance is in consonant with Dauda (2020).

Debt-to-GDP and debt-to-exports ratios, which both measure fiscal sustainability had negative effects on life expectancy but positive effects on infant mortality, with the estimated coefficients being statistically significant for all models. Debt service-to-revenue had a significant negative effect on life expectancy but a positive insignificant impact on infant mortality. This suggests that rising government debt crowds out the healthcare expenditures necessary to improve the quality of life of individuals, thereby worsening the country's health outcomes. Thus, recurring high debt servicing in the nation results in a diversion of budgetary resources that would otherwise have been employed to improve the welfare of individuals and ultimately worsen their health outcomes. This finding is not surprising. as the government has been grappling with the sustainability of its fiscal space over time, affecting healthcare expenditure and thereby worsening the country's health indicators. This result is consistent with those of Gupta et al. (2002), Loko et al. (2003), Ubi and Effiiom (2015), Shabbir and Yasin (2015), Bahuli and Bala (2020), and Ma et al. (2022) which reported that countries that experienced increasing debt servicing were restricted from pursuing healthcare programmes and were likely to spend less on social services, thereby worsening health outcomes. Furthermore, Jacoby (2002) showed that debt accumulation limits access to forthcoming resources for health-related investments, resulting in a vicious cycle of debt accumulation, which further causes poor health outcomes.

The short-run results show that per capita GDP, school enrolment, CO2 emissions and population growth had a positive effect on life expectancy but a negative impact on infant mortality. Regarding fiscal sustainability indicators, the long-run findings correspond with the short-run outcomes. The estimated coefficient of ECT is negative and significant for all estimated models, indicating that the speed of convergence to the long-run equilibrium is corrected at different time periods.

To verify the robustness of the long-run ARDL results, we utilized FMOLS and DOLS methods, with the results presented in Table 5.

Table 5: FMOLS and DOLS Results

FMOLS						
Variable	1	2	3	4	5	6
C	0.464(0.000)*	0.129(0.103)***	0.492(0.184)	0.249(0.123)	-0.383(0.145)	-0.932(0.270)
$DEBTG_t$	-0.583(0.002)*			0.240(0.061)***		
$DEBTR_t$		-0.442(0.055)**			0.824(0.012)*	
$DEBTX_t$			-0.583(0.003)*			0.824(0.012)*
GDP_t	0.301(0.013)*	0.242(0.000)*	0.183(0.012)*	-0.235(0.000)*	-0.205(0.000)*	-0.372(0.000)*
$CO2_t$	-0.240(0.000)*	-0.207(0.127)*	-0.720(0.000)*	0.158(0.000)*	0.162(0.000)*	0.138(0.000)*
POP_t	-0.114(0.116)	-0.124(0.479)	-0.874(0.162)	0.997(0.121)	0.431(0.248)	0.129(0.617)
ENR_t	0.489(0.007)*	0.457(0.030)**	0.917(0.000)*	-0.583(0.016)*	-0.396(0.024)**	-0.236(0.012)*
R^2	0.984	0.947	0.981	0.988	0.943	0.972
DOLS	1	2	3	4	5	6
C	-0.748(0.242)	0.722(0.000)*	0.190(0.032)**	0.960(0.044)**	0.660(0.135)	0.894(0.000)*
$DEBTG_t$	-0.171(0.037)**			0.788(0.013)*		
$DEBTR_t$		-0.739(0.009)*			0.127(0.005)*	
$DEBTX_t$			-0.667(0.014)*			-0.101(0.006)*
GDP_t	0.247(0.030)**	0.474(0.000)*	0.557(0.000)*	-0.786(0.000)*	-0.230(0.059)**	-0.527(0.000)*
$CO2_t$	-0.609(0.000)*	-0.550(0.024)**	-0.176(0.013)*	0.631(0.000)*	0.586(0.000)	-0.567(0.012)*
POP_t	-0.169(0.315)	-0.197(0.231)	-0.242(0.299)	0.934(0.121)	0.857(0.154)	0.468(0.110)
ENR_t	0.761(0.014)*	0.239(0.002)*	0.496(0.000)*	-0.189(0.013)*	-0.992(0.000)*	-0.130(0.006)*
R^2	0.993	0.972	0.981	0.947	0.999	0.995

Note: *, ** and *** indicate significance levels for 1%,5% and 10% respectively. The values in parenthesis are p-values respectively.
Source: Computed by the Authors.

As evident in Table 5, economic growth, school enrolment, CO2 emissions, and population growth have a positive impact on life expectancy while a negative relationship is reported for infant mortality. Fiscal sustainability indicators including debt-to-GDP, debt-to-export and debt-to-service revenue, have a negative effect on life expectancy (columns 1-6). Conversely, fiscal sustainability indicators exhibit a significant positive effect on infant mortality. Overall, the findings of the FMOLS and DOLS techniques corroborate the results of the ARDL approach presented in Table 4.

Various diagnostic tests were conducted to verify the consistency of the estimated models. The results in the lower panel of Table 4 reveal the absence of serial correlation, misspecification, and heteroskedasticity, while the residuals were normally distributed, given the non-significance of the diagnostic tests. The CUSUM and CUSUMsq tests show that all estimated models (long-run and short-run parameters) were stable and consistent. This is reflected in the results presented in Figures 1 and 2, in which the graphs lie within the 5% critical bounds, which validates the stability of the parameters.

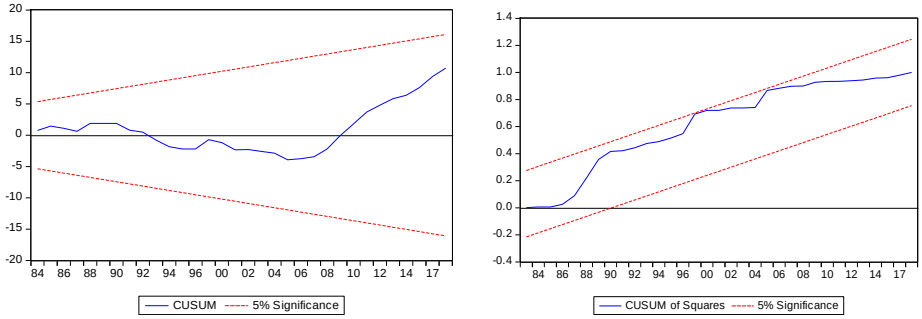

Figure 1: CUSUM and CUSUMsq for Life Expectancy Model.

Source: Generated by Authors.

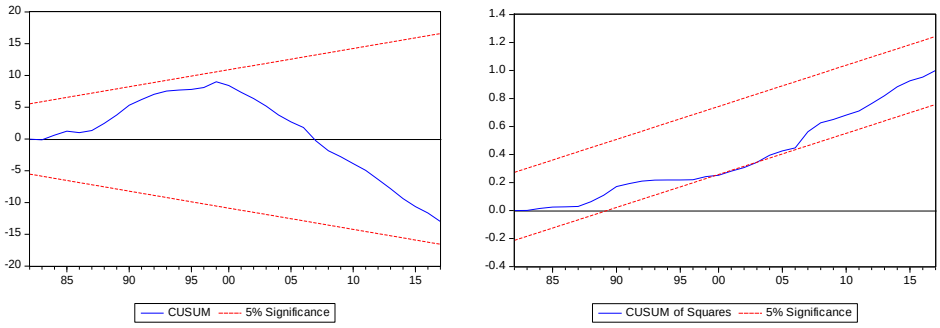

Figure 2: CUSUM and CUSUMsq for Infant Mortality Model.
Source: Generated by Authors.

5. Conclusion and Policy Implications

This paper analysed the effect of fiscal sustainability on health outcomes in Nigeria, covering the period 1980-2020. It employed two health outcome variables (life expectancy and infant mortality rate) and three fiscal sustainability indicators (debt-to-GDP, debt-to-exports and debt service-to-revenue ratios). The Autoregressive Distributed Lag (ARDL) modelling approach, which derived from the Grossman health production theory was used for analysis. For the purpose of robustness and sensitivity checks, the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) techniques respectively, were employed,

The variables were subjected to unit root tests to determine the order of their integration. To do this, we utilized the Augmented Dickey-Fuller (ADF) and Phillips and Perron (1988) unit root tests, with a mixed integration order of I(0) and I(1). However, because the results of these conventional unit root tests could be spurious if the chosen variables are susceptible to structural and macroeconomic events, we carried out the Zivot and Andrew unit root test to account for potential structural breaks among the chosen variables. The result showed that all the series were non-stationary at levels except debt service to revenue; however, they all became stationary at first difference, with the break years of 2000, 2016, 2009, 2007, 2016, 2016, 2013, 2010 and 2014.

The ARDL bounds test was conducted with the results confirming the presence of long-run cointegration among the variables, which necessitated estimation of both the short-run and long-run models. The findings therefore, revealed overwhelmingly that fiscal sustainability (fiscal deficit) is a threat to

health outcomes in Nigeria. Policies aimed at addressing the problem should target reducing government's borrowing, boosting economic growth, investing in human capital, and ensuring moderate population growth.

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