International Journal of Economics and Development Policy (IJEDP)
Vol. 5 No. 1, June, 2022
Print - ISSN: 2651-5644
Online - ISSN: 2811-2288

The Dynamic Nexus between Health and Economic Growth in Nigeria

[1] **Mohammed I. Dauda,** [2]**Muhammed D. Usman,** [3] **Shehu G. Saleh,** [4]**Bello Ibrahim &** [5]**Ibrahim Yaro**

[1 - 5] Department of Economics and Development Studies,
Faculty of Social Sciences, Federal University of Kashere, Gombe State – Nigeria
Corresponding Author's E-mail: migonidauda@gmail.com

Abstract

This study examined the dynamic causal relationship between health and economic growth in Nigeria from 1961 to 2017 using annual time series data sourced from the World Bank World Development Indicators. Autoregressive Distributed lag (ARDL) bounds cointegration test was used to analyze the data. The findings revealed a strong evidence of an existence of long run equilibrium relationship between health (as proxied by life expectancy at birth and infant mortality) and economic growth in Nigeria. The long run estimates revealed that health proxied by infant mortality rate and life expectancy at birth has negative and statistically significant impact on economic growth at 5% level of significance. But economic growth has no any significant influence on any of the health proxies. The study recommends among others that for health to have the desired impact on economic growth and to be an engine of growth in the country, there is an urgent need to come-up with sound economic policies coupled with sound health sector policies such as free medical care for all citizens, access to improve water and sanitation facilities, access to quality health care facilities, and myriad of factors that can enhance the life expectancy at birth and reduce infant mortality rate thereby improving the life of the citizens and make them be relatively more productive.

Keywords: *Health, Infant Mortality Rate, Life Expectancy at Birth, Economic Growth, Autoregressive Distributed lag (ARDL), Nigeria*
JEL Classification:I12, I31, J13, I10, J24, O15, P34

Contribution to/Originality Knowledge: This paper contributes to the existing ocean of knowledge in myriad of ways. First, it contributes to investigate the long run dynamic causal relationship between health (as proxied by life expectancy at birth and infant mortality rate) and economic growth in Nigeria from 1961 to 2017 using Autoregressive Distributed Lag (ARDL) Bounds cointegration test. To the best of our knowledge no any previous study was carried out in Nigeria on health and economic growth that used these variables and methods. Second, it has contributed to the literature of long term debates on relationship between health and economic growth most especially in developing countries, like Nigeria. Third, this study has come-up with empirical evidences and policy implications that will aid policy makers and stakeholders in formulating policies and strategies that can improve health and enhance economic growth of the country

1.0 Introduction

Health level of a country determines to a large extent its economic growth and development. Also economic growth which makes available the resources required in the health sector and better quality of life influences the health outcomes of a country. It is evident in literature that there is a positive relationship between health and economic growth. Pritchett and Summers (1996) in a study of the causal relationship between health and wealth, revealed that, wealthier nations are healthier nations. Also wealthier nations are in a stronger position to provide better

to their citizens, whereas better health increases labour productivity, hence improving wealth of the nations. It has been established countries with better health status tend to have higher incomes than countries with worse health status (see Bloom, Kuhn, & Prettner, 2018). And poor health outcomes are associated with low-income countries, where they have the lowest health personnel (medical doctors and midwifery) per 10,000 populations. Hence the low-income countries having the highest mortality rates and lower life expectancy at birth averaged 62.7 years which is 18.1 years lower than the average of high-income countries' life expectancy of 80.8 years (World Health Organization, 2019).

The health outcomes condition of country can influence income and economic growth through different mechanism. The first mechanism is the impact of health on labour productivity, where healthier workers lose less time from work due to ill health and are therefore more productive when working than sick workers. The second mechanism is the impact of population health on education, where childhood health outcomes can have a direct effect on cognitive development and the ability to learn as well as school attendance. Furthermore, because adult mortality and morbidity (sickness) can lower the prospective returns to investments in schooling, improving adult health can raise the incentives to invest in education (and training). The third mechanism is the effect of health on savings. A longer prospective lifespan can increase the individual's incentive to save for retirement, which will generate higher level of savings and wealth a healthy workforce can boost the incentives for business investments. Also cost of healthcare can force families to sell their productive asset, leading them into long-term poverty (because of catastrophic health expenditure). The fourth mechanism of the impact of health on income/economic growth is the impact of population health outcomes on population size and age structure; (Bloom and Canning (2000); Bloom and Canning (2008), also see Ruger, Jamison & Bloom, (2001)).

Furthermore, economic growth also influences health by increasing the capacity and ability of individuals to demand and consume better health care, housing, nutrition etc. More so, it increases the capacity of governments and other key players in health sector to supply more and better health care and to improve access to health care through better infrastructure (Lorentzen, Mcmillan & Wacziarg, 2008). Furthermore, the effect of economic growth on health can be viewed from the fact that, health expenditure is a function of income or resources available both in private and public sectors of an economy. Where the higher income (as a result of economic improvement) means that there is more money to spend on health and by implications more resources for the health sector (Mehrara & Musai, 2011).

According to Olaniyan (2010), better health and nutrition has been established to pay-off in terms of economic growth and equity concerns. The improvement of child health and nutrition of poor children has been regarded as an efficient means of improving school attendance and boost economic growth because learning translates to long run productivity. In addition, it has been argued by Olaniyan and Lawanson, (2010), that health status of people has implication on their ability to generate income. Individual productivity is significantly influenced by the state of his/her health. Worsening health condition can lead to poor economic status. It has been

argued that, the poor health status observed in the Northern region of Nigeria is found to be associated with greater incidence of poverty in the region.

Nigeria is greatly endowed with rich human and natural resources. It is the largest country in Africa with a population of about 200 million people and the second largest economy in the continent after South Africa. It is expected that, Nigeria as one of the relatively wealthier countries in the world supposed to be a healthier nation. According to Weil (2006), people in poor countries are on average much less healthy than their counterparts in rich countries. The significant role of health in growth process has been pictured in the argument by Bloom, Finlay, Humair, Mason, Olaniyan & Soyibo (2010) that, for Nigeria to realize its demographic dividend it require increasing human capital that can only be achieved with strong investments in health, education, gender parity and parity. However, despite its economic growth rate and the supposed corresponding vast resources, the health of the country continues to be one of the lowest in the world. Nigeria has one of the worst health outcomes in form of low life expectancy at birth and high infant mortality rate (World Bank, 2021). Why the paradox? What is then the nature of the dynamic causal relationship between health and economic growth in Nigeria from 1961-2017? Based on that it is vital to examine the link between health (proxied by life expectancy at birth and infant mortality rate) and economic growth, in an effort to see whether there is a causal relationship between health and economic growth Nigeria within this study period.

Although there are various studies on health and economic growth, most of these studies are panel in nature or concentrated on other regions of the world (such as Rocco, Fumagalli, Mirelman & Suhrcke, 2021; Ogunleye, 2011; Jamison, Lau &Wang, 2004; Day & Tousignant, 2005), while the studies in Nigeria are short term in nature compared to this study (such as Ogunjimi & Adebayo, 2018; Dauda & Yerima, 2008; Dauda, 2009a; Dauda, 2009b). To our knowledge none of these studies consider the long run dynamic causal relationship between health (as proxied by life expectancy at birth and infant mortality rate) and economic growth in Nigeria from 1961 to 2017 using Autoregressive Distributed Lag (ARDL) Bounds cointegration test. Hence, this study, in order to come-up with results and policy implications which will aid policy makers and stakeholders in formulating policies and strategies that can improve health and enhance economic growth of the country.

The remaining part of this study has been organized as follows: Section 2 provides literature review and theoretical framework. Section 3 highlights data sources, model specification and econometric techniques. Section 4 presents estimation results and discussion. Section 5 contains conclusion and recommendations

2.0 Literature Review and Theoretical Framework

Rocco, Fumagalli, Mirelman and Suhrcke, (2021) investigated effect of health proxied by mortality and morbidity on economic growth from 1990 to 2014 in 135 countries. They analyzed the data using Ordinary least squares (OLS) and instrumental variables (IV) techniques. Their study revealed that both mortality and morbidity rates have a negative effect on GDP per capita growth, that is decreasing mortality and morbidity rates have favourable

impact on long run economic growth; where reducing mortality by 10 percent increases the GDP per capita growth rate in over a quarter century by *at least* 9.6 percent. The effects of mortality and morbidity rates are heterogeneous across countries studied, with the low and the high income countries exhibiting a stronger effect compared to the middle income.

In how income/economic growth of countries influenced their health outcomes, World Health Organization (2019) has revealed that from 2013 to 2018, birth attended by skilled health personnel in low income countries was only 60% compared with 100% in upper-middle-income and high-income countries. Whereas in 2015, low-income countries have the highest maternal mortality ratio per 100,000 live births, where one woman dies for every 202 children born compare to one woman in 5,900 in high income countries. In addition, between 2015 to 2020 low-income countries have highest adolescent fertility rates of 97 per 1,000 women aged 15-19 years which is eight times higher than in high-income countries with only 12 per 1,000 women. While in 2017 low-income countries have lower vaccine coverage rates, hepatitis B prevalence rate, under-five and neonatal mortality rates that are 13 times, 14 times and 7 times higher than in high-income countries respectively. Yet, from 2000 to 2018 the rates of under-five years stunted children in low-income countries are more than 10 times higher than in high-income countries, and they have the highest incidence rates of new HIV, tuberculosis infections and malaria. Also in 2018, prevalence of wasting in children under-five was highest in low-income and lower-middle-income countries than in high-income countries.

Ogunjimi and Adebayo (2018) studied the link among health expenditure, health outcomes and economic growth in Nigeria from 1981 to 2017 using Toda-Yamamoto causality framework. Autoregressive Distributed Lag (ARDL) Bounds test approach to cointegration was used to analyzed the data. Their study revealed that there a long-run relationship among health expenditure, infant mortality, life expectancy, maternal mortality rate and economic growth, a unidirectional causality from health expenditure to infant mortality, a unidirectional causality from health expenditure and economic growth to life expectancy and maternal mortality; and a unidirectional causality from economic growth to health expenditure. But there is no causality relationship between economic growth and infant mortality.

Jamison, Lau and Wang (2004) in a panel study to capture the effects of improved health on gross domestic product per capita of 53 countries from1965 to 1990, using Hierarchical Linear variant of Cobb-Douglas model and multi-level modelling techniques/maximum likelihood methods were used for estimation. They have revealed that health has accounted for 0.23 percent of income growth per year and that countries with initially higher levels of adult survival rates had realized a much more modest contribution to their growth rates from health improvement than did countries with initially lower adult survival rates. Increase in physical capital stocks had accounted for 67 percent to total growth, education improvement and health improvement accounted for 14 percent and11 percent respectively. This study had the advantage of using 53 countries with data from 1963 to 1990 and the use of health outcomes in form of male survival rate which is rare in the literature. The study did not used life expectancy at birth which is the most important health outcomes in the literature. In addition, they did not consider the endogeneity bias of the variables involve.

Dauda and Yerima (2008) examined the determinants of health status in Nigeria from 1981 to 2005, using both descriptive and Ordinary Least Square regression. It was found that economic growth proxied by per capita income is not statistically significant in determining health proxied by life expectancy at birth and infant mortality rate in the country. Dauda and Yerima (2008) study was a single equation framework, they did not examine unit root properties of the variables, therefore they failed to carry out cointegration test and the error correction mechanism. Also they did not consider the possibility of reverse causality between health and economic growth or the endogeneity bias, hence Impulse response function (IRFs) and forecast error variance decomposition (VED) are absent coupled with the fact that their study covered short term (1981 to 2005) period compared to this study.

In a study of trend and socio-economic determinants of life expectancy in Nigeria from 1991 – 2005 by Dauda, (2009a), , using both descriptive and OLS regression analysis, it was revealed that GDP per capita, health expenditures, literacy rate, population doctor and childhood immunization are statistically not significant in influencing life expectancy at 5% level of significance. Though it was one of the few studies in Nigeria, but the possibility of reverse causality or endogeneity bias is not considered by Dauda (2009a).

In a study that considered reverse causality or endogeneity within a Vector Autoregressive (VAR) frame work by Day and Tousignant (2005), analyzing the relationship between health expenditures, health outcomes and economic growth proxied by per capita GDP, using time series data from Canada, they carried out cointegration tests and pair wise granger causality tests. Their findings showed evidence of a statistically weak relationship between per capita health spending, health outcomes (infant mortality rate, the age standardized mortality rate and a composite of a group of health constructed using principal component analysis) and per capita GDP. But unlike our study Day and Tousignant (2005), used time series data from one country (Canada) and does not consider life expectancy at birth and growth rate of GDP which are proxies for health and economic growth respectively.

Yet, Hartwig, (2009), in a study of health human capital accumulation and economic growth of 21 OECD countries using panel granger causality consisting of 147 observations where per capita GDP proxying economic growth and per capital health care expenditure proxying health capital formation using VAR model with OLS, Arellano-Bond one-step system GMM estimator and Arellano-Bond two-step system GMM estimator, he found that there is a negative causality from per capita health expenditure to per capita GDP growth and a positive causality from per capita GDP to per capita health expenditures. This implies that health capital formation does not foster long term economic growth in the OECD area. Hartwig, (2009), used health expenditures instead of life expectancy at birth as a proxy for health and he failed carry out cointegration test to see their long term relationship of health and economic growth.

In addition, Dauda (2009b), had investigated the impact of health expenditure and health status on economic growth in Nigeria, using both descriptive and OLS regression analysis on time series data. The result showed that, health expenditure (total, recurrent and capital health expenditures) is not statistically significant in explaining economic growth. But in the equation where health status in form of life expectancy, infant mortality and literacy rate were used, all

except life expectancy are statistically significant in influencing economic growth. Though, Dauda (2009b), used time series on Nigeria, he failed to carry out unit root test and did not carry out his estimation within the VAR model framework, hence failed to consider reverse causality or endogeneity of health and economic growth.

Ogunleye (2011) examined the determinants of health outcomes and the impact of health outcomes in 40 Sub-Saharan African countries economic growth. He used life expectancy at birth and child mortality rate to proxy health outcomes and per capita GDP growth proxy economic growth. Other covariates are health infrastructure, education, lifestyle, and carbon emission. Arrellano-Bond dynamic GMM estimation technique was utilized. The result revealed that none of the health outcomes indicators significantly influence economic growth in Sub-Saharan Africa. Ogunleye (2011), utilized GMM estimation techniques; we intend to use vector autoregressive (VAR) model.

2.1 Theoretical framework

There are myriad of theories of provided valuable insights on factors influence economic growth of country, the major dominant economic growth theories are classical, Neoclassical and endogenous growth theories. However, since this study is on relationship between health and economic growth, endogenous growth theory is used as a rider. This is because the theoretical basis of the impact of health human capital on productivity growth is rooted in the endogenous growth theory (see Adamu, 2003; Becker, 1962; Howitt, 2005; WHO, 2003; and Otu and Adenuga, 2006, for the role of human capital in growth), which maintained that enhancement in productivity of an economy can be obtained through faster pace of innovation and investment in human capital (see Romer, 2001). That real GDP per capita grows because of choices that individuals make in the pursuit of profit and that growth can persist indefinitely. Health is incorporated into the endogenous growth model because it is perceived to be an investment in human capital that enhances health outcomes, productivity and hence promotes economic growth. Endogenous growth theory have treated technological changes and human capital as endogenous in the growth process of countries (Martin and Sunley, 1996), which is in divergence to neoclassical (Solow) model which contends that technological progression and other external factors as the leading sources of economic growth. Endogenous growth model, in particular notes that the enhancement of nation's human capital will generate economic growth by way of the development of new forms of technology and efficient and effective means of production (see Barro, 1991).

3.0 Methodology

This section explained the sources of data, model specification and techniques of estimation used in the study.

3.1 Data Sources and Measurement

This study used secondary data, sourced from the World Bank's World Development Indicators. Health proxied by life expectancy at birth (total) refers to the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. Another proxy for health is Infant mortality rate which is the

number of infants dying before reaching one year of age, per 1,000 live births in a given year. Whereas economic growth is proxied by Growth rate of Gross Domestic Product (GDP) which is the annual percentage growth rate of GDP at market prices based on constant 2005 US Dollars (The World Bank, 2021).

Life expectancy at birth was used as a proxy for health because it has been argued that health outcomes in form of life expectancy have been a powerful predictor of income levels and subsequent economic growth rates (Ruger, Jamison & Bloom, 2001). That was why in macroeconomic models, life expectancy is one of the best measure of population health. Therefore, there is the tendency that country with higher initial levels of life expectancy to experience more rapid economic growth (Bloom & Canning, 2008).

3.2 Model Specification

In this study, health and economic growth are treated as jointly determined or interrelated. We assumed that Nigerian health proxied by life expectancy at birth is perceived as one of the forms of human capital that influences economic growth of a nation as evident in endogenous growth model. Infant mortality on the other hand is another variable that indicates state of health and economic growth in a country. Also economic growth determines the health status (life expectancy at birth), because, government health expenditures and myriad of factors which influences health are also dependent on economic growth, leading to a reverse causality or link between health and economic growth. The endogeneity of the variables can be gleaned from the argument by Weil (2006), that people who are richer can better afford better food, shelter and medical treatment. Again, richer countries can afford higher expenditures on public health, which may lead to better health status.

The dynamic relationship between health proxied by life expectancy at birth, infant mortality and economic growth in Nigeria has been using Autoregressive Distributed lag (ARDL) bounds testing method to cointegration test, the unrestricted/unconstrained empirical model of is as follows:-

$$\Delta LEX_t = \beta_{0t} + \beta_{1j} LEX_{t-j} + \beta_2 GDPG_{t-j} + \beta_3 INF_{t-j} + \sum_{t=0}^{m} \delta_k \Delta LEX_{t-j} + \sum_{l=0}^{n} \xi_p \Delta GDPG_{t-j} + \sum_{w=0}^{o} \vartheta_{\varpi} \Delta INF_{t-j} + \mu_{1t} \quad (1)$$

$$\Delta GDPG_t = \alpha_{0t} + \alpha_{1j} GDPG_{t-j} + \alpha_2 LEX_{t-j} + \alpha_3 INF_{t-j} + \sum_{t=0}^{m} \chi_k \Delta GDPG_{t-j} + \sum_{l=0}^{n} \kappa_p \Delta LEX_{t-j} + \sum_{w=0}^{o} \rho_{\varpi} \Delta INF_{t-j} + \mu_{1t} \quad (2)$$

$$\Delta INF_t = \psi_0 + \psi_1 INF_{t-j} + \psi_2 LEX_{t-j} + \psi_3 GDPG_{t-j} + \sum_{t=0}^{m} \psi_k \Delta INF_{t-j} + \sum_{l=0}^{n} \pi_p \Delta LEX_{t-j} + \sum_{w=0}^{o} \varphi_{\varpi} \Delta GDPG_{t-j} + \mu_{1t} \quad (3)$$

The study tested the null hypothesis of no cointegration of the ARDL models for model one, two and three respectively are:- H_0: $\beta_1 = \beta_2 = \beta_3 = 0$; $\alpha_1 = \alpha_2 = \alpha_3 = 0$ and $\psi_1 = \psi_2 = \psi_3 = 0$. While the

alternative hypothesis of the ARDL cointegration among the variables are H_1: $\beta_1 \neq \beta_2 \neq \beta_3 \neq 0$; $\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq 0$ and $\psi_1 \neq \psi_2 \neq \psi_3 \neq 0$ implying presence of cointegration. To confirm the existence or otherwise of cointegration (long run equilibrium) relationships among the variables, the F- test statistic calculated was compared with the critical value which comprises of lower critical bound and upper critical bound values of Pesaran and Pesaran (1997) and Pesaran, Shin and Smith (2001). If it is established that none of the variables is I(2), the lower bound shall be based on the assumption that all the variables in the study are I(0), and the upper bound shall be based on the assumption that all the variables are I(1). The null hypothesis of no cointegrating relationship among the variables will be rejected if the computed F- test statistic falls above the upper bound. But if the calculated F- test statistic falls below the lower bound, the null hypothesis of no cointegration among the variables cannot be rejected. However, if the calculated F-test statistic falls between the lower and the upper bounds, the result of the cointegration test is inconclusive.

Where;

LEX= Life expectancy at birth Proxied health

INF= Infant Mortality rate proxied health

GDPG= Gross Domestic Product growth rate proxy economic growth

t = is the year index.

Δ= is the first difference

$\beta_1, \beta_2, \beta_3; \alpha_1, \alpha_2, \alpha_3; \psi_1, \psi_2, \psi_3$= are coefficients of the respective variables.

μ= is an error term

Since the cointegration has been established, the long run models for LEX, GDPG and INF that has been estimated are as follows:

$$LEX_t = C_0 + \sum_{t=0}^{m} \delta_k LEX_{t-j} + \sum_{l=0}^{n} \xi_p GDPG_{t-j} + \sum_{w=0}^{o} \vartheta_{\varpi} INF_{t-j} + \mu_{1t} \quad (4)$$

$$GDPG_t = \varpi_0 + \sum_{t=0}^{m} \chi_k GDPG_{t-j} + \sum_{l=0}^{n} \kappa_p LEX_{t-j} + \sum_{w=0}^{o} \rho_{\varpi} INF_{t-j} + \mu_{1t} \quad (5)$$

$$INF_t = \delta_0 + \sum_{t=0}^{m} \psi_k INF_{t-j} + \sum_{l=0}^{n} \pi_p LEX_{t-j} + \sum_{w=0}^{o} \varphi_{\varpi} GDPG_{t-j} + \mu_{1t} \quad (6)$$

In order to determine the speed of adjustment to the equilibrium relationship, the short run dynamics estimate using error correction model (ECM) version of the ARDL have the following representations:-

$$\Delta LEX_t = \beta_{0t} + \sum_{t=0}^{m} \delta_k \Delta LEX_{t-j} + \sum_{l=0}^{n} \xi_p \Delta GDPG_{t-j} + \sum_{w=0}^{o} \vartheta_{\varpi} \Delta INF_{t-j} + \rho ECM_{t-j} + \varepsilon_{1t} \quad (7)$$

$$\Delta GDPG_t = \alpha_{0t} + \sum_{t=0}^{m} \chi_k \Delta GDPG_{t-j} + \sum_{l=0}^{n} \kappa_p \Delta LEX_{t-j} + \sum_{w=0}^{o} \sigma_{\varpi} \Delta INF_{t-j} + \gamma ECM_{t-j} + \varepsilon_{1t} \quad (8)$$

$$\Delta INF_t = \psi_{01t} + \sum_{t=0}^{m} \psi_k \Delta INF_{t-j} + \sum_{l=0}^{n} \pi_p \Delta LEX_{t-j} + \sum_{w=0}^{o} \varphi_{\varpi} \Delta GDPG_{t-j} + \theta ECM_{t-j} + \varepsilon_{1t} \quad (9)$$

And

$$ECM_t = y_t - \sum_{i=1}^{k} \hat{\theta}_i x_{it} - \psi' w_t \quad (10)$$

Where δ, ξ, ϑ, χ, κ, σ, ψ, π, and ϕ are the short run dynamic coefficients of the models convergence to equilibrium and ρ, γ, and θ are the speeds of adjustment in the respective models. ECM_t reflects extent to any short run disequilibrium in the previous period is being corrected or adjusted in y_t

4.0 Estimation Results and Discussion

4.1 Unit Root Test

Augmented Dickey Fuller (ADF) was used in testing the possible order of integration of the variables at both constant; and constant and trend. The results of the unit root tests in the table 1 depicts that economic growth proxied by Growth rate of Gross Domestic product (GDP) is stationarity at levels. Also health proxied by life expectancy at birth (LEX) and infant mortality rate (INF) are stationary at levels. Hence, all variables are integrated of order zero I (0).

Table: 1: Augmented Dickey Fuller (ADF) Unit Root tests

Variables	*Augmented Dickey Fuller (ADF) test*	*5 % Critical values*	*Order of Integration*
LEX	-4.9523	-3.4970	I(0)
GDPG	-4.6279	-3.4953	I(0)
INF	-4.4107	-3.5005	I(0)

Source: Author's Computation using Eviews 10

Results of ARDL Bound-Co-integration Test

Having established that all the variables are integrated of order zero I(0), the study proceeded to examine the possible long run equilibrium cointegrating relationship between health (proxied as life expectancy and infant mortality) and economic growth in Nigeria using ARDL long run form and bounds test of cointegration as proposed by Pesaran, Shin and Smith (2001). Because unlike with other cointegration techniques that required all the variables in a study to be integrated of the same order, Autoregressive Distributed lag (ARDL) bounds test approach can be used when variables are of different orders of integration, that is even if the variables are purely integrated of order one [I(1)] and or integrated of order zero [I(0)] or combination of both integrated of order one [I(1)] and zero [I(0)].

In the estimation of cointegration test selection of optimal lag length cannot be over emphasized, since the estimation of ARDL F-Statistic is sensitive to the selection of lag order in the model which also necessary for having reliable and unbiased results. Based on the optimal lag length from Zero to 5 was examined, lag length of one as suggested by SIC and Final Prediction Error (FPE) was used.

4.2 Results of ARDL Bound-Co-integration Test

The results of the ARDL bound cointegration tests results for the three models as presented in table 2 show a high calculated F-Statistic values of 4.330077, 10.21419 and 5.050884 which are greater than the upper critical bounds of 3.87, 3.87 and 3.87 for models with life expectancy at birth (LEX), economic growth (GDPG) and infant mortality rate (INF) as dependent variables respectively at 5% level of significance. Therefore the ARDL bound F-statistic values have signified the rejection of the null hypothesis of no cointegration at 5% level of significance and the existence of long run equilibrium relationship between health (as proxied by life expectancy at birth and infant mortality) and economic growth in Nigeria. Hence, there is a stable equilibrium relationship amongst the variables. These findings are in accord Ogunjimi and Adebayo (2018) where they established a long-run relationship among health expenditure, infant mortality, life expectancy, maternal mortality rate and economic growth in Nigeria. But in disagreement with the study by Day and Tousignant (2005) that finds evidence of a statistically weak relationship between per capita health spending, health outcomes (infant mortality rate, and per capita GDP. It is also in variance with the findings by Ogunleye, (2011) where none of the health outcomes indicators significantly influence economic growth in Sub-Saharan Africa.

Table 2: Results of the ARDL F- Bounds test for Co-integration

S/n.	*Model*	*Dependent Variable*	*Independent Variable*	*F-Statistic*	*Lower Bound I(0)*	*Upper Bound I(1)*
1.	One	Life expectancy at birth (LEX)	Economic growth (GDPG), Infant Mortality Rate (INF)	4.330077	3.1	3.87
2.	Two	Economic growth(GDPG),	Life expectancy at birth (LEX), Infant Mortality Rate (INF)	10.21419	3.1	3.87
3.	Three	Infant Mortality Rate (INF)	Economic growth (GDPG), Life expectancy at birth (LEX)	5.050884	3.1	3.87

Source: *Authors computation using EViews 10*

The results of the long run estimates as reflected in table 3 revealed that economic growth (GDPG) has a negative and not statistically significant at any level of significance in influencing life expectancy at birth (LEX). But infant mortality rate (INF) has a negative and statistically significant impact on life expectancy at birth at 5% level of significance, which suggests that as infant mortality rate increases by 1 %, it tend to reduces life expectancy at birth

by 15.8 %. This is may be the reason the life expectancy at birth is Nigeria is relatively low due to the high rate of infant mortality in the country. However, infant mortality rate as expected has a negative and statistically significant effect on economic growth at 5% level of significance. A 1 % increase in infant mortality rate lead reduces economic growth by 64%. The findings of this study agreed with that of Rocco, et al., (2021) where they found out mortality rate having a negative effect on GDP per capita growth in 135 countries. Contrary to the a priori expectations, life expectancy at birth turns out negative and statistically significant in its impact on economic growth. This denotes that as life expectancy increases, it lead to decline in economic growth. This may not be unconnected with the fact that increases in years that are spent unproductively may not have positive impact on economic growth of the country.

Furthermore, life expectancy at birth has a negative and statistically significant effect on infant mortality rate at 5% level of significance. An increase in life expectancy at birth decreases infant mortality rate in the country. Though, economic growth turned negative in line with the a priori expectations, it is nevertheless not statistically significant. One important findings of the long term coefficients portrayed economic growth not having any significant influence on any of the health proxies.

Table 3: Results of Long Run Coefficients Estimate

Dependent Variable : Life expectancy at birth (LEX)	
Independent Variables	Coefficients
GDPG	-0.0593
	(-1.1428)
INF	-0.1583
	(-3.6431)**
Constant	64.4935
	(13.5673)*
Dependent Variable : Economic Growth (GDPG)	
Independent Variables	Coefficients
INF	-0.6351
	(-2.0481)**
LEX	-6.0779
	(-2.1518)**
Constant	356.4183
	(2.1363)**
Dependent Variable : Infant Mortality Rate (INF)	
Independent Variables	Coefficients
LEX	-7.5612
	(-8.9276)**
GDPG	-0.9307
	(-1.3909)
Constant	458.8884*
	(10.3800)

Source: *Authors computation using EViews 10*

Since a stable long run equilibrium relationship has been recognized between health (as proxied by life expectancy at birth and infant mortality rate) and economic growth, we cannot proceed with the estimation of the Error Correction Mechanism because the need to ascertain the short run dynamics of the variables (short run model) does not arise.

4.3 Diagnostic Analysis

The consistency of the coefficients in the model was examined with the null hypotheses of the respective diagnostic tests that all the residuals have no serial correlation, normally distributed and homoscedastic. The diagnostic tests in table 5 have indicated that the null hypotheses for all the test statistics cannot be rejected at both 1%, 5% and 10% level of significance. Therefore, this implies that there are no evidences of serial correlation, no issues of non-normality of the residuals as the models have passed the tests for normality which signifies that the errors are normally distributed and no proof of heteroscedasticity. Hence, the diagnostic test results have suggested that all the coefficients of the model estimated are efficient and consistent.

Table 4: Diagnostic Test Results

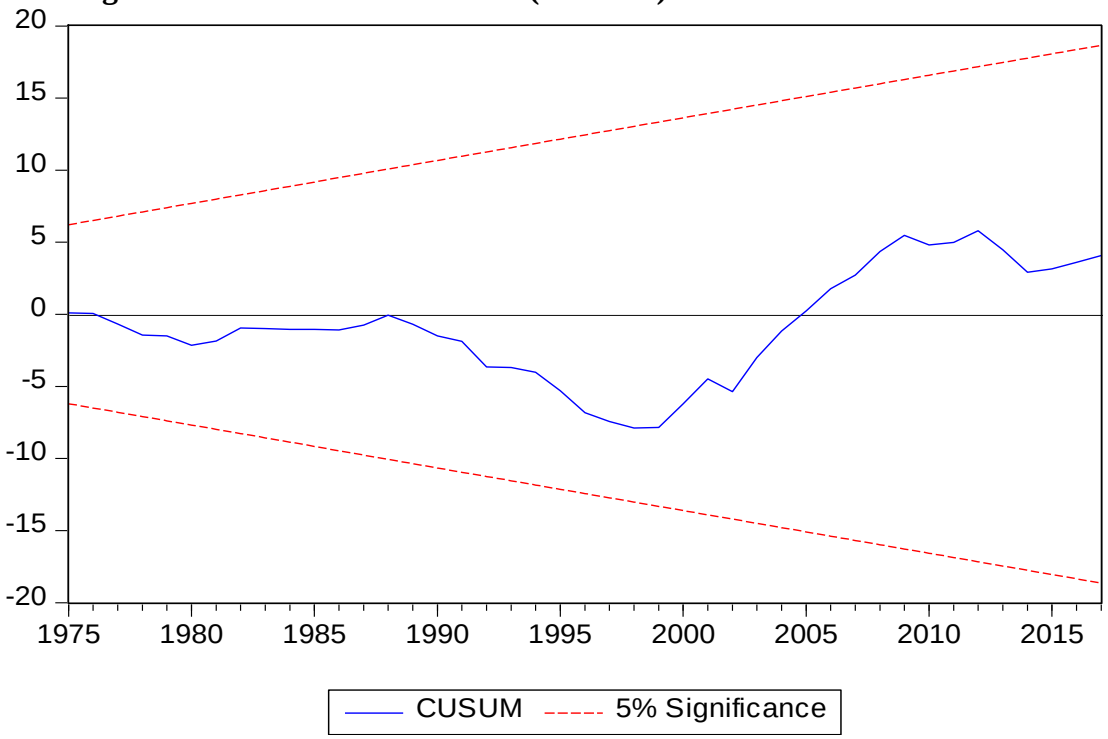
Test Statistics	Chi-Square/LM Test	Probability Value
Serial Correlation	6.7734	0.6607
Normality	1.8456	0.6051
Heteroscedasticity	235.6903	0.1079

Source: Author's Computation using Eviews 10

4.4 Stability Tests

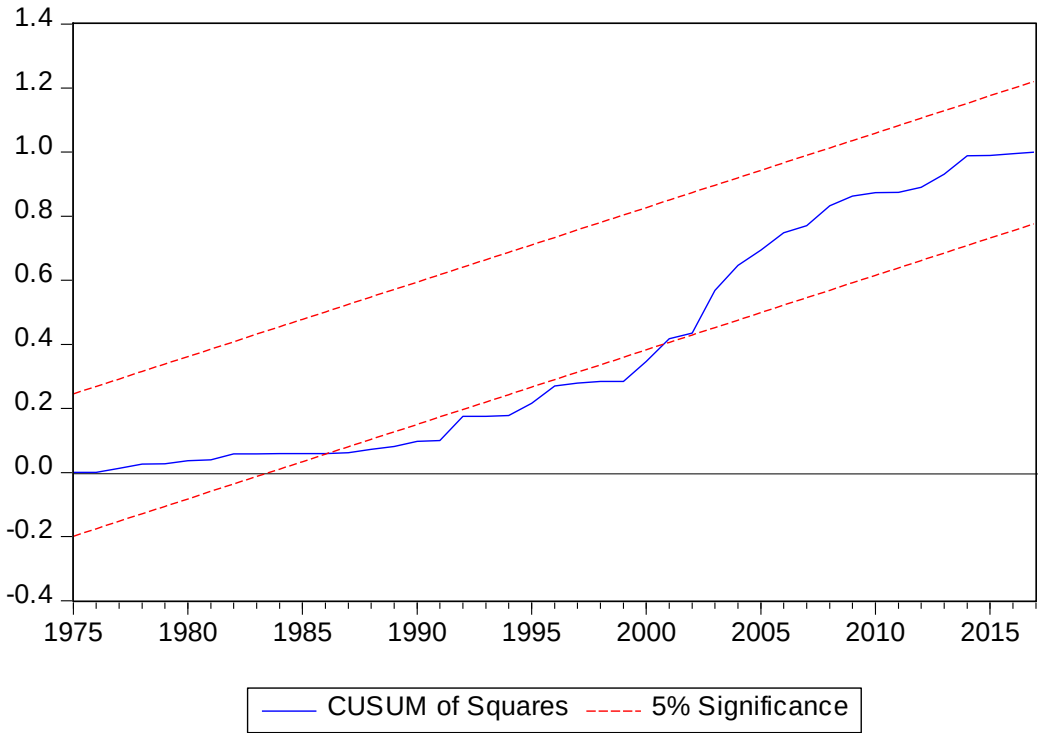
The cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests were used to examined the stability of the long run coefficients of the ARDL model of the long run equilibrium relationship between health (proxied by life expectancy at birth and infant mortality) and economic growth as mirrored in figures 1 and 2 respectively. Both the plots of the CUSUM and CUSUMSQ statistics which are based on the recursive residuals method are well within the 5% Critical bound of the confidence interval of the parameter stability. These revealed the absence of any instability of the coefficients suggesting that the null hypotheses that the regression equations are all correctly specified cannot be rejected. Hence, the stability, appropriateness and suitability of the coefficients in the long run model at 5% levels of significance.

Figure 1: Plot of cumulative sum (CUSUM) of the Recursive Residuals



Source: Author's computation using EViews 10

Figure 2: Plot of Cumulative Sum of squares (CUSUMSQ) of the Recursive Residuals



Source: Author's computation using EViews 10

5.0 Conclusion and Recommendations

This study has explored the dynamic causal relationship between health and economic growth in Nigeria from 1961 to 2017. The study utilized Autoregressive Distributed Lag (ARDL) bounds testing method to cointegration test to analyze the data. The findings revealed that a strong evidence of an existence of long run equilibrium relationship between health (as proxied by life expectancy at birth and infant mortality) and economic growth in Nigeria. The long run estimates revealed that health proxied by infant mortality rate has a negative and statistically significant effect on economic growth at 5% level of significance. Also life expectancy another proxy of health at birth turns out negative and statistically significant in its impact on economic growth which contrary to the a priori expectations. But economic growth has no any significant influence on any of the health proxies. However, both the two health proxies in form of life expectancy at birth and infant mortality rate (INF) have a negative and statistically significant on each other at 5% level of significance.

The implications of the above findings are that, Nigerian governments and policy makers should pay much attention to the established long term equilibrium relationship between health and economic growth in their macroeconomic policies. Therefore this study recommends that, for health to have the desire impact on economic growth and to be an engine of growth in the country, there is an urgent need to come-up with sound and strong economy coupled with sound health sector policies such as free medical care for all citizens, access to improve water and sanitation facilities, access to quality health care facilities, and myriad of factors that can enhance the life expectancy at birth and reduce infant mortality rate thereby improving the life of the citizens and make them be relatively more productive.

References

Adamu, P.A. (2003). The impact of human capital formation on economic development in Nigeria: An error correction approach." *Human Resources development in Africa*. Selected papers for 2002 Nigeria Economic Society (NES) Annual conference, Ibadan NES, pp.53-78.

Adebiyi, M.A. & Dauda, R.O.S. (2004). Trade liberalization policy and industrial growth performance in Nigeria: An error correction mechanism (ECM) technique. *Selected papers presented at the 2004 Annual Conference of the Nigerian Economic Society, p.119-145.*

Barro R.J. (1991). Economic growth in a cross-section of countries: *Quarterly Journal of Economics 106, May, 407-443.*

Becker, G.S. (1962). Investment in human capital: a theoretical analysis: *Journal of Political Economy*, 70, 9-49.

Bloom, D.E. & Canning, D. (2000). The health and wealth of nations: *Science, 287:1207-8.*

Bloom, D.E. & Canning, D. (2008). Population, health and economic growth: *Working Paper No.24*, Commission on Growth and Development, *The World Bank, Washington DC.*

Bloom D., Finlay, J., Humair, S., Mason, A., Olaniyan, O., & Soyibo, A. (2010). Prospects for economic growth in Nigeria: A Demographic Perspective. Paper presented at the IUSSP Seminar on Demographics and Macroeconomic Performance held at Novotel, gare de Lyon, Paris, France 4-5 June.

Bloom, D. E., Kuhn, M. & Prettner, K. (2018). Health and economic growth: IZA Institute of Labour Economics, Discussion Paper Series, November, IZA DP No. 111939. Retrieved on 10th September, 2021, from https://ftp.iza.org/dp11939.pdf

Dauda, M.I. (2009a). An empirical analysis of trend and socio-economic determinants of life expectancy in Nigeria: *ADSU Journal of Social and Development studies, 3, (1), 9-20.*

Dauda, M.I. (2009b). Impact of health expenditure and health status on economic growth in Nigeria: *ADSU Journal of Social and Development studies, 3,(2), 57-66.*

Dauda, M.I. & Yerima, W.M. (2008). Determinants of health status in Nigeria: *In Sahel Analyst, 10, (1), 10-20.*

Day, K., & Tousignant, J. (2005). Health spending, health outcomes and per capita income in Canada: A dynamic analysis. *Working Paper 2005-07*, Department of Finance, University of Ottawa, Canada.

Hartwig, J., (2009). Is health capital formation good for long term economic growth?- Panel granger-causality evidence for OECD countries." *Journal of Macroeconomics,* Elsevier, Inc

Howitt, P. (2005). Health, Human Capital and Economic Development: *A Schumpeterian perspective.* Paper Prepared for the Pan American Health Organization which is presented at the PAHO Senior Policy Seminar on Health Capital and Economic Growth in Washington, October, 4th, 2002.

Jamison, D.T., Lau, L.J. & Wang, J. (2004). Health contribution to economic growth in an environment of partially endogenous technical progress: *Working paper NO. 10.* Disease control priorities Project, Bethesda: *Fogartly International Center, national Institute, February.*

Lorentzen, P., McMillan, J., & Wacziarg, R., (2008). Death and development: *Springer, 13(2), 81-124.*

Martin, R. & Sunley, P. (1996). Slow convergence, post-neoclassical endogenous growth theory and regional development: *Working Paper No.44.* ESRC centre for Business Research, University of Cambridge.

Mehrara, M. & Musai, M. (2011). The causality between health expenditure and economic growth in Iran: *International Journal of Economic Research, 2(4), 13-19.*

Ogunjimi, J. & Adebayo, A. (2018). Health expenditure, health outcomes and economic growth in Nigeria: MPRA Paper No. 94989. https://mpra.ub.uni-muenchen.de/94989/1/MPRA_paper_94989.pdf

Ogunleye, E. K. (2011). Health and economic growth in sub-saharan African countries: A Production Function Approach. http://www.csae.ox.ac.uk/conferences/2011-EdiA/papers/319-Ogunleye.pdf

Olaniyan, O. (2010). The effects of household resources and community factors on child health: Evidence from Nigeria: *Paper Presented at the 2010 CSAE Conference held at St Catherine College, University of Oxford, Oxford, UK, March, 18/19*

Olaniyan, O. & Lawanson, A.O. (2010). Health expenditure and health status in northern and southern Nigeria: A comparative analysis using NHA Framework. *Paper Presented at the 2010 CSAE Conference held at St Catherine College, University of Oxford, Oxford, UK, March.*

Otu, M.F. and Adenuga, A.O. (2006). Economic growth and human capital development: the case of Nigeria. *Economic and Financial Review, 44 (3), 1-127.* Abuja, Central Bank of Nigeria.

Pesaran, H.M. & Pesaran, B. (1997). Working with microfit 4.0*:* Interactive Econometric Analysis. *Oxford University Press*.

Pesaran, H.M, Shin,Y. & Smith, R. (2001). Bounds testing approaches to the analysis of level relationships: *Journal of Applied Econometrics, 16:289-326.*

Pritchet, L. & Summers L.H. (1996). Wealthier is healthier: *Journal of Human Resources*, 30(4), 841-68.

Rocco, L., Fumagalli, E., Mirelman, A.J. & Suhrcke, M. (2021). Mortality, morbidity and economic growth: *PLoS ONE 16(5): e0251424.* https://doi.org/10.1371/journal.pone.0251424

Romer, P. (2001). Advanced Macroeconomics: (2nd ed.*)*. New York, *MC-Graw Hill*

Ruger, J.P., Jamison, D.T., & Bloom, D.E. (2001). Health and the economy in Merson, M., Black R., and Mills, A. (Eds): *International Public Health: Diseases, Programs, Systems and Policies*, Gaithersburg, MD: Aspen Publishers, Inc. pp.617-66

Weil, D.N. (2006). Accounting for the effect of health on economic growth: (revised) *National Bureau of Economic Research (NBER) Working Paper 11455, July. http://www,nber.org/papers/w11455*

World Bank (2021). World Development Indicators: Washington, D.C., *The World Bank.*

World Health Organization (2019). World health statistics, 2019*:* Monitoring health for the SDGs, sustainable development goals. Geneva. *World Health Organization*. https://apps.who.int/iris/bitstream/handle/10665/324835/9789241565707-eng.pdf

World Health Organization (2003). Macroeconomics and health: A report of a regional consultation. SEARO, New Delhi, India, 18-19, August, 2003