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University of Ibadan, University of Ibadan

2018

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Abstract

This study examined the relationship among health expenditure, health outcomes and economic growth in Nigeria for the period between 1981 and 2017. This study adopted the Toda-Yamamoto causality framework to examine these relationships. The Augmented Dickey Fuller unit root test was used to check for maximum order of integration of the variables used in the study and the result was one while the Autoregressive Distributed Lag (ARDL) Bounds test approach to cointegration was used to investigate if a long-run relationship exists among the macroeconomic variables used in the study and the result was in the affirmative. The results of the Toda-Yamamoto causality tests showed a unidirectional causality running from health expenditure to infant mortality while there is no causality between real GDP and infant mortality; a unidirectional causal relationship running from health expenditure and real GDP to life expectancy and maternal mortality; and a unidirectional causal relationship running from real GDP to health expenditure. This study therefore recommended that the Nigerian government should make concerted efforts geared towards increasing the health expenditure at least to meet up with the WHO's recommendation that all countries should allocate at least 13 per cent of their annual budget to the health sector for effective funding as this would bring desired health outcomes and employ the use of modern technology and the services of professional health personnel should be sought to combat the high incidence of maternal and infant mortality in the health sector in Nigeria.

Keywords: Health Expenditure, Life Expectancy, Infant Mortality, Maternal Mortality, Toda-Yamamoto Causality Test, Nigeria

1.0 Introduction

The state of health of the population of a country is a major factor driving productivity as only a healthy labour force can make meaningful contributions to production and growth of national output. As is the case in a typical production function, the quantity / level of inputs has a corresponding effect on the quantity / level of output depending on the scale of production and returns to scale. Hence, this make the health of the citizens of a country imperative and as such adequate provision for health should be one of the primary goals of government as it has a positive impact on economic growth, one of the macroeconomic goals of every government.

Similarly, the health of the population is influenced by both the type of health system and of their resources. The relationship between resources and outcomes helps one to effectively assess how functional the health system of a country is. A country has a health system with a better performance than another country, if, for the same level of resources, it generates better health outcomes, or if it generates the same outcomes but with fewer resources (Elola et al., 1995). Health systems are financed either through taxes, in the case of healthcare services owned by the state (national health services), or through income-related social contributions (social security systems) (Elola et al., 1995). The contribution of social security to the sustenance of the finance of the health system is phenomenal in countries with high income per capita.

It is one of the major duties of every government to provide funds for the provision of social welfare of which health care is an integral part. Thus, government devotes public fund to the provision of health care services in a bid to improving the health of the citizenry so as to enable them make significant contributions to economic growth and development in the country. It is believed that an increase in budgetary allocation to social services should enhance service delivery but this is not the case in Nigeria. In many developing countries, budget misappropriation and/or mismanagement is one of the primary causes of ineffective public spending (World Bank, 1998). For instance, many health indicators show that Nigeria ranks low in health status despite the increasing budgetary allocation to the health sector. UNAIDS, in 2016, ranked Nigeria as the second largest country with the prevalence of HIV/AIDS in the world. In 2017, Central Intelligence Agency (CIA) also ranked Nigeria as the eighth country with the highest infant mortality rate (69.8 per 1000 live birth) in the world. Furthermore, the United Nations Department of Economic and Social Affairs (UN DESA) says Nigeria's life expectancy stands at 52.29 years, the 194th in the world.

This statistics is indicative of the fact that the expenditure on health is not enough to develop the health system of Nigeria or appropriate policies are not put in place to improve the health system of the country. The cost of health is on the high side and in a bid to bridge the huge health funding gap by governments to its citizens, especially in developing and underdeveloped countries, the WHO recommended that countries should allocate at least 13 per cent of their annual budget to the health sector for effective funding. All member countries, including Nigeria signed towards the recommendation. Also, an Abuja Declaration, signed in 2001 by all member countries of the African Union, including Nigeria, who in fact was the host of the high powered meeting, recommended that for the continent to be at par with other nations of the world in terms of healthcare provision, 15 per cent of their annual budget, at the least, be allocated to the health sector. However, the budgetary allocation to the health sector (government health expenditure) has been below par over time implying that a large percentage of healthcare services will be funded from out-of-pocket which majority of Nigerians cannot afford.

The Nigerian economy is highly import-dependent not only on goods but also on services to the extent that her political office holders as well as the rich import medical services either by employing the services of foreign medical experts to Nigeria or travelling abroad for medical check-up and/or treatment thereby enriching foreign nations at the expense of the domestic economy. For instance, the present president of Nigeria, Muhammadu Buhari, went on medical vacation in early 2017 for over 50 days after which he went for another medical vacation for a staggering 103 days in May, 2017. This attitude by the president, other politicians and the rich alike shows that they do not believe in the services rendered by resident medical practitioners as most of the equipment and machines used in Nigerian are outdated and cannot measure up to what obtains in developed countries of the world. Consequently, there is an increase in brain-drain as competent medical personnel migrate to developed countries of the world, where sophisticated medical equipment and machines are available, to enhance their productivity and keep up with the pace of development in the medicine. Consequently, this reduces the labour force in the health sector thereby reducing the sector's contribution to GDP and the aggregate national output at large.

Several policies and institution frameworks have been instituted to improve the performance of the Nigerian health sector overtime. These policies include: National Population Policy of 1988, National Population Policy for Sustainable Development of 2004 and the National Population Policy of 2006. The institutional frameworks include: The National Population Commission (NPC), The National Planning Commission and the Federal Ministry of Health which comprises of four agencies whose activities directly or indirectly affect the demographic structure of Nigeria namely: the National Primary Health Care Development Agency (NPHCDA), the National Health Insurance Scheme (NHIS), the Nigerian Institute of Medical Research (NIMR) and the National Agency for Food and Drug Administration and Control (NAFDAC). However, these efforts of the government have not yielded the desired results given the maladies bedeviling the Nigerian health sector.

The literature is replete with studies on the issues relating to public health expenditure and health outcomes in different countries of the world [Kim and Lane, 2013 (17 OECD Countries); Novignon et al, 2012 (44 Sub-Sahara African Countries); Anyanwu and Erhijakpor, 2007 (47 African Countries); Elola et al, 1995 (17 Western European Countries); Novignon and Lawanson, 2016 (45 Sub-Saharan African Countries); Kulkarni, 2016 (BRICS Countries); Deluna and Peralta, 2014 (Philippines), Day and Tousignant, 2005 (Canada); Becchetti et al, 2015 (European countries); Jaba et al, 2014 (175 World Countries); Ogungbenle et al, 2013 (Nigeria); Edeme et al, 2017 (Nigeria); among other]. While some studies [Jaba et al (2014); and Ogungbenle et al, 2013] focused on the impact of health expenditure on life expectancy, some focused on the relationship between public health expenditure and mortality rate which are the only a small fraction of the overall health indicators/outcomes of an economy. Hence, the literature contains only a few studies on the empirical examination of the relationship between public health expenditure and health outcomes using only about two health indicator as a proxy for health outcome. This study will take a panoramic view of the health outcomes/indicators of an average household in the Nigerian economy by examining the relationship between public health expenditure and three major health outcomes (life expectancy, infant mortality, and maternal mortality) in Nigeria and also extend the analysis to investigating the impact of these health outcomes on the growth of the Nigerian economy. Another novelty of this study lies in the fact that it employs the use of the Toda-Yamamoto causality test to examine the relationship among health expenditure, health outcomes and economic growth, a technique that is particularly rare in the extant literature.

It is against this background that this study will empirically investigate the relationship between health expenditure and health outcomes as well as the impact of health outcomes on economic growth in Nigeria for the period between 1981 and 2016. It also checks for the direction of causal relationship of these macroeconomic variables. The rest of this paper is structured in the following manner: Section 2 discusses the trend analysis of key variables; Section 3 comprises the review of related studies; Section 4 contains the methodology, model specification and empirical analysis; and Section 5 concludes the study.

2.0 Health Expenditure, Health Outcomes and Real GDP Profile in Nigeria

Figure 2.1 presents the profile of government expenditure on health and the corresponding health outcomes as well as the real GDP of Nigeria. A cursory look at Figure 2.1 reveals that government expenditure on health fluctuated for most the period under review even though there was a significant increase in it during the period. It grew steadily from ₦0.80 billion in 1981 to ₦0.62 billion in 1991, plummeted the following year to ₦0.15 billion and grew sharply to ₦3.87 billion in 1993 after which it fluctuated but stood at ₦16.64 billion in 1999. However, it is noteworthy that it grew markedly by about 134 percent from ₦99.1 billion in 2010 to ₦231.8 billion in 2011 from when it plummeted and stood at ₦202.36 billion in 2016. On the other hand, the share of health expenditure in total government expenditure stabilized at 1.74 percent from 1981 to 1986 but fell sharply to 0.26 percent in 1987 from when it rose to stand between 2.3 – 3.7 percent from 1993 – 2000. Moreover, it grew to 4 and 5 percent in 2001 and 2002 respectively. The highest share of health expenditure in total government expenditure was in 2011 when it stood at 6.99 percent which falls short of the WHO recommendation as well as 2001 Abuja Declaration of the African Union that countries should allocate at least 13 per cent of their annual budget to the health sector for effective funding. This indicates that Nigeria falls below par in the expected expenditure on health.

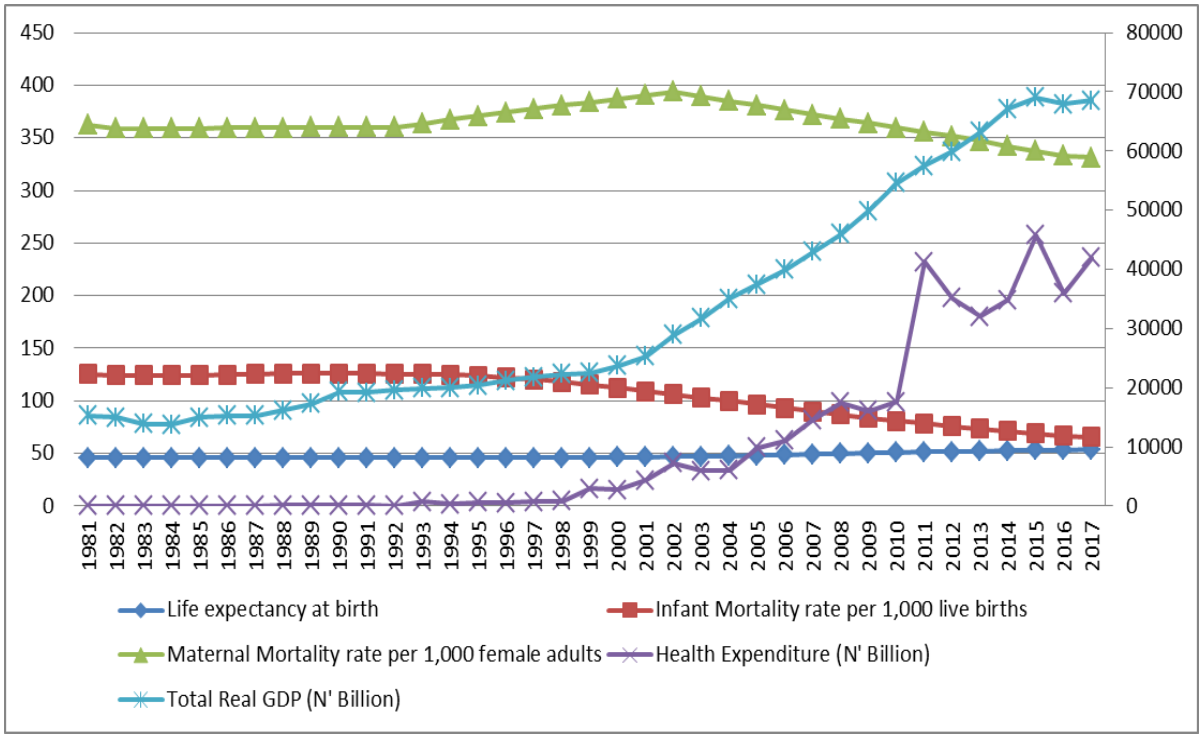
In addition, it is obvious that real GDP grew steadily almost throughout the period under review except for a few years (1982-1984 and 2016). The Nigerian economy plunged into economic crises during these periods and the Bretton Woods institutions, in a bid to salvage the Nigerian economy in the 1980s, introduced the Structural Adjustment Programmes (SAP) to Nigeria which later aggravated the economic crises it was meant to solve. Also, the Nigerian economy plunged into a recession in recently (2016) when her real GDP fell from ₦69023 billion in 2015 to ₦67931 billion in 2016.

Figure 2.1 also shows that infant mortality rate stood at 125.4 per 1,000 live births in 1981 but declined to 124 per 1,000 live births in 1983 and increased steadily to 126.2 in 1989 and 1990. However, it plummeted in 126 per 1,000 live births in 1991 from when it decreased steadily until it reached a double figure of 99.8 per 1,000 live births in 2004 and stood at 81.1 and 66.9 per 1,000 live births in 2010 and 2016 respectively. This downward trend could be linked to the advancement in medical science. In the same vein, maternal mortality rate stood at 362.41 per 1,000 female adults in 1981 and it fluctuated from then till 1993 when it stood at 363.8 per 1,000 female adults. It however increased steadily to 393.53 per 1,000 female adults in 2002 but declined from then until it reached 359.82 and 333.03 per 1,000 female adults in 2010 and 2016 respectively. This indicates that the effort of the Nigerian government in combating maternal mortality is yielding the desired fruit.

Additionally, life expectancy at birth in Nigeria stood at 45.62 years in 1981 increased steadily to 46.13 in 1985. It however declined to 45.84 years in 1993 and 1994 but increase in 1995 to 48.25 years and has since then maintained an upward trend till it reached 48.25 years,

50.85 years and 53.43 years in 2005, 2010 and 2016 respectively. Figure 2.1 reveals that life expectancy at birth is relatively stable throughout the period under review. It is also apparent that infant mortality as well as maternal mortality rose for some time but declined gradually for most part of the period under review. On the other hand, real GDP maintained an upward trend almost throughout the period under review while government health expenditure had some spikes and also grew for most part of the period under review but fell in 2016 when Nigeria plunged into a recession. This suggests that the recession in Nigeria in 2016 reduced government expenditure on health.

Figure 2.2: Trends of Health Expenditure, Health Outcomes and Real GDP in Nigeria



Source: Author's Computation from CBN Statistical Bulletin (2017) and WDI (2018)

3.0 Literature Review

There is a plethora of time-series and panel studies examining the nexus among health expenditure, health outcomes and economic growth. For instance, Dormont, Martins, Pelgrin and Suhrcke (2007) adopted the Pooled OLS, fixed effect and random effect models to examine the relationships between health spending, medical innovation, health status, growth and welfare and found that health spending triggers technological progress, which is a potential source of better outcomes in terms of longevity and quality of life, a direct source of growth for the bio-tech industries and an indirect source of growth through improved of human capital. The latter contributes to GDP per capita through two main channels: higher participation of the population in the labour force and higher labour productivity levels. In turn, income growth induces an increase in health expenditure, as richer countries tend to spend a higher share of their income on health.

Becchetti, Conzo and Salustri (2015) investigated the impact of health expenditure on health outcomes on a large sample of Europeans aged above 50 using individual and regional-level data. The results showed that health expenditure to GDP and health expenditure per capita

have a negative and significant impact on changes in the number of chronic diseases. It also showed that health expenditure produces heterogeneous effects on health outcomes, being more relevant for the elders, females, the overweight/obese, the below-median income group and for the less-educated vis-à-vis their complementary samples. After controlling for real per capita income, literacy level, and female participation in the labour market, Boachie and Ramu (2015) adopted the OLS and Newey-west estimation techniques and found evidence that the declining or falling infant mortality rate in Ghana has been influenced by public health spending among other factors.

Kulkarni (2016) used the panel data regression with fixed effects model to examine the differences in the health care systems of Brazil, India, China, Russian Federation and South Africa, the emerging economies of BRICS. The results show a positive relation between health outcome and the GDP per capita, adult literacy rate, and out-of-pocket expenditure; environmental pollution has a negative relation with health outcomes; and age dependency ratio and public health expenditure also show a positive elasticity with infant mortality rate. Kim and Lane (2013) analyzed the relationship between public health expenditure and national health outcomes among developed countries. The findings showed a negative relationship between government health expenditure and infant mortality rate, and a positive relationship between government health expenditure and life expectancy at birth. Jaba, Balana and Robu (2014) analyzed the relationship between the dynamics of the inputs and the outputs of health care systems and found that there is a significant relationship between health expenditures and life expectancy and that country effects are significant and show the existence of important differences among the countries.

In their study, Deluna and Peralta (2014) examined the relationship among public health expenditures, income and health outcomes in the Philippines. The results showed that infant mortality rate is inversely related to health expenditure per capita and GDP per capita. In their study on the dynamic analysis of the relationship among health spending, health outcomes and per capita income in Canada, Day and Tousignant (2005) employed the vector autoregression (VAR) model and the generalized impulse response function estimation technique and found evidence of a weak statistically significant relationship between per capita health spending, health outcomes, and per capita GDP. Gani (2009) examined the relationship between per capita public health expenditure and three measures of health outcomes for seven Pacific Island countries. The result provided strong evidence that per capita health expenditure is an important factor in determining health outcomes. The empirical results also provide strong evidence that per capita incomes and immunization are additional core factors that determine health outcomes.

Novignon and Lawanson (2016) sought to understand the relationship between child health outcomes and health spending while investigating lagged effects. The results show a positive and significant relationship between health expenditure and child health outcomes. Public health expenditure was found to be relatively more significant than private expenditure. Novignon, Olakojo and Novignon (2012) employed the fixed and random effects panel data regression model estimation techniques to assess the effect of health care expenditure on population health status and to examine the effect by public and private expenditure sources. The results show that health care expenditure significantly influences health status through improving life expectancy at birth, reducing death and infant mortality rates. Both public and private health care spending showed strong positive association with health status even though public health care spending had relatively higher impact. Edeme, Emecheta and Omeje (2017) investigated the effect of public health expenditure on health outcomes in

Nigeria and found that an increase in public health expenditure improves life expectancy and reduces infant mortality rates.

Anyanwu and Erhijakpor (2007) employed the Robust Ordinary Least Squares (ROLS) model and Robust Two-Stage Least Squares (R2SLS) techniques to provide econometric evidence linking African countries' per capita total as well as government health expenditures and per capita income to infant mortality and under-five mortality. Health expenditures have a statistically significant effect on infant mortality and under-five mortality. In addition, both infant and under-five mortality are positively and significantly associated with Sub-Saharan Africa while the reverse is true for North Africa. Piabuo and Tieguhong (2017) conducted a comparative analysis on the impact of health expenditure between countries in the CEMAC sub-region and five other African countries that achieved the Abuja declaration. The results showed that health expenditure has a positive and significant effect on economic growth in both samples. In addition, a long-run relationship also exists between health expenditure and economic growth for both groups of countries.

Matthew, Adegboye and Fasina (2015) adopted the vector error correction model to examine government spending on health and its effect on health outcomes in Nigeria and found that public spending on health has a significant relationship with health outcomes in Nigeria and that environmental factors such as carbon dioxide emissions affects individuals' health. Similarly, Nwanosike, Orji, Okafor and Umesiobi (2015) employed the ordinary least square estimation technique to investigate the progressive implication of malaria incidence and malaria spending on Nigeria health outcomes and found that increase in health expenditure and educational expenditure reduce malaria incidence. Yaqub, Ojapinwa and Yussuff (2012) used the Ordinary Least Squares and the Two-Stage Least Squares estimation techniques to investigate how the effectiveness of public health expenditure is affected by governance in Nigeria and found that public health expenditure has negative effect on infant mortality and under-5 mortalities when the governance indicators are included. Maduka, Madichie and Ekesiobi (2006) examined the relationship among government health expenditure, health outcomes and economic growth in Nigeria using the using Toda and Yamamoto causality approach. The results revealed that government health expenditures indirectly influence economic growth through health outcomes such as mortality rate and life expectancy.

In their empirical analysis of the relationship existing among life expectancy, public health spending and economic growth in Nigeria, Ogungbenle, Olawumi and Obasuyi (2013) found that there is no bi-directional causality between life expectancy and public health spending in Nigeria neither is a bi-directional causality between life expectancy and economic growth in Nigeria over the years. However, the study confirmed that there is bi-directional causality between public health spending and economic growth in Nigeria. Hooda (2014) examined the impact of different decentralized governance measures on infant and child mortality rates of rural India across states and in improving the efficacy of rural health spending. The result showed that states with high fiscal and political decentralisation have more significant impact in reducing the infant mortality compared to states having high fiscal but low political decentralisation, indicating efficacy of fiscal decentralisation increases with political decentralisation.

4.0 Methodology, Model Specification and Empirical Analysis

4.1 Methodology and Model Specification

This study assesses the relationship among health expenditure, health outcomes and economic growth in Nigeria for the period between 1981 and 2016 using the Toda-Yamamoto causality test. The aim is to examine how health expenditure influences health outcome and economic growth; how health outcomes influence health outcome and economic growth; and how economic growth influences health expenditure and health outcome. Whereas government expenditure on health is used as a proxy for health expenditure, real GDP growth is used as proxy for economic growth and the variables of health outcomes for this study include: life expectancy, infant mortality and maternal mortality. Data for the period between 1981 and 2017 on infant mortality, life expectancy and maternal mortality are sourced from World Development Indicators (2018) while data on health expenditure and real GDP are sourced from Central Bank of Nigeria (CBN) Statistical Bulletin (2017).

Following (Wolde-Rufael 2005) and Maduka, Madichie and Ekesiobi (2016), this study employs the Granger non-causality test, a Toda–Yamamoto procedure that is applicable regardless of whether a series is I(0), I(1), or I(2), non-cointegrated or cointegrated of any order. This implies that it avoids the potential bias associated with unit root and cointegration tests. As pointed out by Clarke and Mirza (2006), pre-tests for unit root and cointegration might suffer from size distortion, which often implies the use of an inaccurate model for the non-causality test. To obviate some of these problems, the Toda-Yamamoto test, based on augmented VAR modeling, introduced a Wald test statistic that asymptotically has a chi-square distribution irrespective of the order of integration or cointegration properties of the variables. The Toda–Yamamoto approach fits a standard vector autoregression and a vector error correction model on levels of the variables (not on their first differences) and therefore makes allowances for the long-run information often ignored in systems that require first differencing and pre-whitening (Clarke and Mirza, 2006). The approach employs a modified Wald test (MWALD) for restrictions on the parameters of the VAR (k), where k is the lag length of the system. The basic idea of the Toda-Yamamoto approach is to artificially augment the correct order, k, by the maximal order of integration, say d_{max}. Once this is done, a $(k + d_{max})$ the order of VAR is estimated and the coefficients of the last lagged d_{max} vectors are ignored.

Based on the foregoing and following the specification of Maduka, Madichie and Ekesiobi (2016), the relationship between health expenditure, health outcomes and economic growth are represented mathematically as follows:

$$LEXP = f(HEXP, RGDP) \quad (4.1)$$

$$IFM = f(HEXP, RGDP) \quad (4.2)$$

$$MMT = f(HEXP, RGDP) \quad (4.3)$$

$$RDGP = f(HEXP, LEXP, IFM, MMT, FTR) \quad (4.4)$$

$$HEXP = f(RGDP, LEXP, IFM, MMT, FTR) \quad (4.5)$$

The econometric representations of the above mathematical equations are as follow:

$$LEXP = \alpha_0 + \alpha_1 HEXP + \alpha_2 RGDP + \boldsymbol{\varepsilon}_1 \quad (4.6)$$

$$IFM = \beta_0 + \beta_1 HEXP + \beta_2 RGDP + \boldsymbol{\varepsilon}_2 \quad -- \quad -- \quad -- \quad -- \quad (4.7)$$

$$MMT = \delta_0 + \delta_1 HEXP + \delta_2 RGDP) + \boldsymbol{\varepsilon}_3 \quad -- \quad -- \quad -- \quad -- \quad (4.8)$$

$$RDGP = \vartheta_0 + \vartheta_1 HEXP + \vartheta_2 LEXP + \vartheta_3 IFM + \vartheta_4 MMT + \vartheta_5 FTR + \boldsymbol{\varepsilon}_5 \quad (4.9)$$

$$HEXP = \sigma_0 + \sigma_1 RGDP + \sigma_2 LEXP + \sigma_3 IFM + \sigma_4 MMT + \sigma_5 FTR + \boldsymbol{\varepsilon}_6 \quad (4.10)$$

The Toda and Yamamoto (1995) version of the above specified models representing the nexus among health expenditure, health outcomes and economic growth are in the following VAR system:

$$LEXP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} LEXP_{t-i} + \sum_{j=k+1}^{d_{max}} \alpha_{2i} LEXP_{t-j} + \sum_{i=1}^{k} \beta_{1i} HEXP_{t-i} + \sum_{j=k+1}^{d_{max}} \beta_{2i} HEXP_{t-j} + \sum_{i=1}^{k} \delta_{1i} RGDP_{t-i} + \sum_{j=k+1}^{d_{max}} \delta_{2i} RGDP_{t-j} + \gamma_{1t} \quad (4.11)$$

$$IFM_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} IFM_{t-i} + \sum_{j=k+1}^{d_{max}} \alpha_{2i} IFM_{t-j} + \sum_{i=1}^{k} \beta_{1i} HEXP_{t-i} + \sum_{j=k+1}^{d_{max}} \beta_{2i} HEXP_{t-j} + \sum_{i=1}^{k} \delta_{1i} RGDP_{t-i} + \sum_{j=k+1}^{d_{max}} \delta_{2i} RGDP_{t-j} + \gamma_{2t} \quad (4.12)$$

$$MMT_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} MMT_{t-i} + \sum_{j=k+1}^{d_{max}} \alpha_{2i} MMT_{t-j} + \sum_{i=1}^{k} \beta_{1i} HEXP_{t-i} + \sum_{j=k+1}^{d_{max}} \beta_{2i} HEXP_{t-j} + \sum_{i=1}^{k} \delta_{1i} RGDP_{t-i} + \sum_{j=k+1}^{d_{max}} \delta_{2i} RGDP_{t-j} + \gamma_{3t} \quad (4.13)$$

$$RGDP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} RGDP_{t-i} + \sum_{j=k+1}^{d_{max}} \alpha_{2i} RGDP_{t-j} + \sum_{i=1}^{k} \beta_{1i} HEXP_{t-i} + \sum_{j=k+1}^{d_{max}} \beta_{2i} HEXP_{t-j} + \sum_{i=1}^{k} \delta_{1i} LEXP_{t-i} + \sum_{j=k+1}^{d_{max}} \delta_{2i} LEXP_{t-j} + \sum_{i=1}^{k} \theta_{1i} IFM_{t-i} + \sum_{j=k+1}^{d_{max}} \theta_{2i} IFM_{t-j} + \sum_{i=1}^{k} \vartheta_{1i} MMT_{t-i} + \sum_{j=k+1}^{d_{max}} \vartheta_{2i} MMT_{t-j} + \sum_{i=1}^{k} \sigma_{1i} FTR_{t-i} + \sum_{j=k+1}^{d_{max}} \sigma_{2i} FTR_{t-j} + \gamma_{5t} \quad (4.14)$$

$$HEXP_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} HEXP_{t-i} + \sum_{j=k+1}^{d_{max}} \alpha_{2i} HEXP_{t-j} + \sum_{i=1}^{k} \beta_{1i} RGDP_{t-i} + \sum_{j=k+1}^{d_{max}} \beta_{2i} RGDP_{t-j} + \sum_{i=1}^{k} \delta_{1i} LEXP_{t-i} + \sum_{j=k+1}^{d_{max}} \delta_{2i} LEXP_{t-j} + \sum_{i=1}^{k} \theta_{1i} IFM_{t-i} + \sum_{j=k+1}^{d_{max}} \theta_{2i} IFM_{t-j} + \sum_{i=1}^{k} \vartheta_{1i} MMT_{t-i} + \sum_{j=k+1}^{d_{max}} \vartheta_{2i} MMT_{t-j} + \sum_{i=1}^{k} \sigma_{1i} FTR_{t-i} + \sum_{j=k+1}^{d_{max}} \sigma_{2i} FTR_{t-j} + \gamma_{6t} \quad (4.15)$$

Where:

LEXP = Life Expectancy

IFM = Infant Mortality

MMT = Maternal Mortality Rate

HEXP = Health Expenditure

RGDP = Real Gross Domestic Product (Proxy for Economic Growth)

α, β, δ, θ, ϑ and σ = Coefficients of the independent variables

γ_{it} = White Noise Stochastic Error Term

4.2 Empirical Analysis

4.2.1 Preliminary Analysis

4.2.1.1 Descriptive Statistics

Table 4.1 presents the descriptive characteristics of the macroeconomic variables used in this study. The average value of health expenditure, infant mortality, life expectancy, maternal mortality rate and real GDP are ₦58.85 billion, 105.78 per 1000 live births, 47.91 years, 364.95 per 1000 female adults and ₦32749.95 billion respectively. This suggests that maternal mortality rate is still very high in Nigeria and infant mortality is as well relatively high indicating that more women than children die in the course of child birth. This suggests that there is a dire need to upgrade the child delivery facilities in the country to lower the incidence of maternal and infant mortality. The mean values of health expenditure and real GDP also show that the percentage of government expenditure on health is extremely low and this could be the reason for the high maternal and infant mortality rate in Nigeria.

Furthermore, the probability values of the Jarque-Bera statistic of each variable show that the all the variables are normally distributed given the probability value of the Jarque-Bera statistic. In addition, for a series to be said to be normally distributed, the value of skewness should be zero or not be statistically different from zero. Accordingly, all the variables except health expenditure meet this condition thus giving further credence to the assertion of normal distribution. Further, all the variables employed in this study are platykurtic except health expenditure which is leptokurtic given its kurtosis value. The result also shows that all the variables have a very high standard deviation signifying a high deviation from their respective mean values.

Table 4.1: Descriptive Statistics

	HEXP	IFM	LEXP	MMT	RGDP
Mean	58.85	105.78	47.91	364.95	32749.95
Median	15.22	115.20	46.13	360.32	22449.41
Maximum	257.72	126.20	53.72	393.74	69023.93
Minimum	0.04	65.50	45.64	331.45	13779.26
Std. Dev.	82.51	21.58	2.67	15.54	18889.20
Skewness	1.26	0.61	0.97	0.14	0.80
Kurtosis	3.10	1.81	2.40	2.68	2.14
Jarque-Bera	9.79	4.46	6.37	0.27	5.10
Probability	0.1075	0.1074	0.1414	0.8749	0.1781
Sum	2177.54	3913.70	1772.74	13502.97	1211748.00
Observations	37	37	37	37	37

Where HEXP = Health Expenditure; IFM = Infant Mortality; LEXP = Life Expectancy; MMT = Maternal Mortality Rate; and RGDP = Real Gross Domestic Product

Source: Author's Computation from Eviews9

4.2.1.2 Unit Root Test

Routinely, the time-series properties of macroeconomic variables need to be ascertained when carrying out time-series analysis so as to guard against obtaining spurious results. The appropriate test for checking these time-series properties is unit root test. It tests the null hypothesis of the presence of unit root as against the alternative hypothesis of the absence of unit root. The decision rule is that the null hypothesis will be rejected and be alternative hypothesis accepted should the computed t-statistic be greater than the test critical values in absolute terms or the probability value be less than 0.1; it will be accepted and be alternative hypothesis rejected should the computed t-statistic be less than the test critical values in absolute terms or its probability value be greater than 0.1 or 10 per cent significance level.

This study employs the Augmented Dickey-Fuller (ADF) unit root test method to check the order of integration of the macroeconomic variables of this study and the results are presented in Table 4.2. The results show that infant mortality and life expectancy are stationary at level [I(0)] while health expenditure, maternal mortality rate and real GDP are stationary at first difference [I(1)]. This result shows that the macroeconomic variables employed in this study are a combination of I(0) and I(1) series or are integrated of different orders. This condition makes the ARDL Bounds test approach to cointegration appropriate for investigating the long-run relationship among these variable.

Table 4.2: Unit Root Test Results

	Augmented Dickey Fuller (ADF)		
	Level	**First Difference**	**I(d)**
HEXP	-1.27c	-2.94a**	I(1)
IFM	-4.58*b	-	I(0)
LEXP	-3.67*b	-	I(0)
MMT	-0.96a	-3.78b*	I(1)
RGDP	-1.86b	-5.45b*	I(1)

Note: *, ** and *** represent statistical significance at 1%, 5% and 10% level respectively; 'a' denotes model with constant and 'b' is for model with trend and constant and trend. I(0) and I(1) indicate stationarity at level and first difference respectively.

Source: Author's Computation from Eviews9

4.2.1.3 ARDL Bounds Test Approach to Cointegration

In line with the result of the unit root test, cointegration test will be carried out using ARDL Bounds Test approach to cointegration. The choice of this approach is premised on the fact that our variables are integrated of different orders [(I(0) and I(1)], thus negating the use of Engle-granger and Johansen Cointegration test approach. Pesaran and Shin (1999) and Pesaran et al (2001) developed the ARDL cointegration approach which has three major advantages over other traditional cointegration approaches. Firstly, the ARDL framework does not require that all the variables under study be of the same order of integration; it accommodates series which are I(0) or I(1) or both. Secondly, it is relatively more efficient using small sample sizes. Thirdly, the ARDL framework obtains unbiased estimates of the long-run model.

The rule of ARDL Bounds test of cointegration states that the null hypothesis should be rejected if the value of the computed F-statistic is greater than the upper bounds value and accepted if the F-statistic is less than the lower bounds value. The ARDL cointegration test will be said to be inconclusive should the computed F-statistic fall within the lower and upper bound. Accordingly, Table 4.3 shows that the computed F-statistic (4.54) falls above the upper bound critical value at 5 and 10 percent level of significance. This implies that there is a long-run relationship among health expenditure, infant mortality, life expectancy, maternal mortality rate and real GDP.

Table 4.3: ARDL Bounds Test Result

Significance Level	Critical Value		Computed F-Statistics
	Lower (I0) Bound	Upper (I0) Bound	
1%	3.74	5.06	4.54
5%	2.86	4.01	
10%	2.45	3.52	

The Bounds critical values for k=5are obtained from Narayan (2005) case III for 40 observations.
Source: Author's Computation from Eviews9

4.2.2 Result of Toda-Yamamoto Granger Causality Test

This study employs the Toda-Yamamoto Granger Causality approach examine the direction of causal relationship among health expenditure, health outcomes and economic growth in Nigeria. Before carrying out the Toda-Yamamoto granger causality test, it is needful to estimate the highest order of integration (d_{max}) in the system which is derived from the result of the unit root test. A cursory look at the unit root test result in Table 5.2 reveals that the maximum order of integration is one which implies that there will be an additional one lag to the VAR models. The next step after ascertaining the maximum order of integration is to determine the optimal lag length of the VAR model which is determined using the following criterions: sequential modified LR test statistic (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC) as well as the Hannan Quinn (HQ) Information Criterion. Accordingly, the result of the VAR optimal lag length selection criteria is presented in Table 5.4. It is obvious that the various information criteria unanimously suggested the selection of a maximum lag length of 3 for each variable thus, the VAR model with lag length 3 will be estimated.

Table 4.4: VAR Lag Length Selection Criteria

Endogenous variables: HEXP IFM LEXP MMT RDGP						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	106.1440	NA	1.01e-09	-6.525417	-6.294128	-6.450023
1	389.6865	457.3267	5.89e-17	-23.20558	-21.81785	-22.75322
2	451.8915	80.26451	6.13e-18	-25.60590	-23.06173	-24.77657
3	504.8231	51.22415*	1.49e-18*	-27.40794*	-23.70733*	-26.20164*
4	585.4645	52.02672	1.03e-19	-30.99771	-26.14066	-29.41443

Where * indicates lag order selected by the criterion, LR = sequential modified LR test statistic (each test at 5% level), FPE = Final prediction error, AIC = Akaike information criterion, SC = Schwarz information criterion and HQ = Hannan-Quinn information criterion

Source: Author's Computation from Eviews9

The results of Toda-Yamamoto causality estimated by the modified Wald test are presented in Table 4.5. The results show that the test follows the chi-square distribution with 3 degrees of freedom which is in accordance with optimal lag length. The results of the Toda-Yamamoto causality test reveal that the null hypothesis that health expenditure does not granger causes infant mortality is rejected thus, health expenditure granger causes infant mortality in Nigeria while infant mortality does not granger cause health expenditure suggesting that there is a unidirectional causal relationship running from health expenditure to infant mortality. This result is plausible and in line with a priori expectation. It suggests that the health expenditure in Nigeria has been able to achieve a desired result (reduction in infant mortality) and that the effort of government and other stakeholder in the heath sector have not been in vain. This result is also consistent with findings by Novignon, Olakojo and Nonvignon (2012), Kulkarni (2016), Edeme, Emecheta and Omeje (2017). Also, real GDP does not granger cause infant mortality neither does infant mortality granger cause real GDP indicating that there is no causality between real GDP and infant mortality in Nigeria.

Moreover, the result shows that health expenditure granger causes life expectancy while life expectancy does not granger cause health expenditure indicating that there is a unidirectional causality running from health expenditure to life expectancy. This suggests that health expenditure by the government has been able to improve the life expectancy at birth in Nigeria and that government's effort at improving the health sector of the Nigerian economy is yielding the desired result. This result in line with a priori expectation and parallels the findings of Maduka, Madichie and Ekesiobi (2006), Kim and Lane (2013), Jaba, Balana and Robu (2014) but negates the findings of Ogungbenle, Olawumi and Obasuyi (2013). Similarly, real GDP granger causes life expectancy while life expectancy does not granger cause real GDP thus, indicating that there is a unidirectional causal relationship running from real GDP to life expectancy. This result is against the findings of Ogungbenle, Olawumi and Obasuyi (2013) who found a bidirectional causality running from real GDP to life expectancy and vice versa.

Besides, there is a unidirectional causal relationship between health expenditure and maternal mortality rate in Nigeria as causality runs from health expenditure to maternal mortality rate but not the other way round. This result implies that health expenditure in Nigeria has been able to weakly combat maternal mortality given the probability value that is very close to 10 percent. Similarly, whereas real GDP granger causes maternal mortality, maternal mortality does not granger cause real GDP in Nigeria thus, suggesting a unidirectional causality running from real GDP to maternal mortality. This result is plausible and in line with a priori expectations as it implies that as the economy grows, maternal mortality rate reduces. This is the case in most developed economies and it can be attributed to the improvement in technology that has led to the invention of modern machines with which to preserve lives.

More so, health expenditure does not granger cause real GDP but real GDP granger causes health expenditure in Nigeria suggesting that a there is a unidirectional causality running from real GDP to health expenditure in Nigeria. This suggests that economic growth is capable of increasing health expenditure or economic growth is capable of influencing the amount the government will spend on the health sector in Nigeria. This result is plausible and is in line with theoretical expectation.

Summarily, health expenditure has a significant causal relationship with infant mortality, maternal mortality and life expectancy in Nigeria. In the same vein, real GDP has a significant causal relationship with maternal mortality and life expectancy in Nigeria. These results indicate that health expenditure has a significant causal relationship with health outcomes in Nigeria and the direction of relationship is unidirectional such that causality runs from health expenditure and health outcomes. This implies that the little efforts of the government in funding the health sector of the Nigerian economy are gradually yielding the desired fruit. On the other hand, real GDP causes/influences health outcomes in Nigeria and not the other way round. A unidirectional causality runs from real GDP to health outcomes in Nigeria. Finally, the result shows that it is real GDP that granger causes health expenditure and not the other way round.

Table 4.5: Toda-Yamamoto Causality (modified Wald) Test Results

Null Hypotheses	**Chi-sq**	**Df**	**Prob.**	**Direction of Causality**
HEXP does not granger cause IFM	1.59	3	0.0136	Unidirectional
IFM does not granger cause HEXP	0.81	3	0.8145	HEXP ➔ IFM
RGDP does not granger cause IFM	1.27	3	0.7358	No Causality
IFM does not granger cause RGDP	2.29	3	0.5147	
HEXP does not granger cause LEXP	7.53	3	0.0568	Unidirectional
LEXP does not granger cause HEXP	3.39	3	0.3353	HEXP ➔ LEXP
RGDP does not granger cause LEXP	20.16	3	0.0002	Unidirectional
LEXP does not granger cause RGDP	1.06	3	0.7860	RGDP ➔ LEXP
HEXP does not granger cause MMT	13.62	3	0.0035	Unidirectional
MMT does not granger cause HEXP	0.67	3	0.8797	HEXP ➔ MMT
RGDP does not granger cause MMT	5.03	3	0.0142	Unidirectional
MMT does not granger cause RGDP	0.10	3	0.9918	RDGP ➔ MMT
HEXP does not granger cause RGDP	2.40	3	0.4944	Unidirectional
RGDP does not granger cause HEXP	11.49	3	0.0093	RDGP ➔ HEXP

Source: Author's Computation from Eviews9

4.2.3 Diagnostic / Post-Estimation Test

Before this result can be appropriate for policy formulation and/or prescription, it is needful to verify that the estimates of the chosen multivariate model are reliable. This will require diagnostic checks / post-estimation tests. The most relevant post-estimation test for multivariate models is the serial correlation test (using the LM test). It is carried out to test

the presence of serial correlation in the estimated model thus, the null hypothesis of the serial correlation test is: "No Serial Correlation at Lag Order h." The null hypothesis will be accepted if the probability value is greater than 10 percent and rejected of the probability value is less than 10 percent. Accordingly, Table 4.6 presents the result of the Serial Correlation LM test and it shows that the probability values of the LM-Stat for each lag is greater than 10 percent thus, the null hypothesis of no serial correlation will be accepted indicating that the estimates of the model and its results are reliable for policy prescription.

Table 4.6: Diagnostic Test

VAR Residual Serial Correlation LM Tests		
Null Hypothesis: No Serial Correlation at Lag Order h		
Lags	LM-Stat	Prob
1	30.88705	0.2236
2	25.91344	0.4122
3	32.48781	0.1444
4	19.47508	0.7738
5	15.79846	0.8241

Source: Author's Computation from Eviews9

5.0 Conclusion and Policy Implications

The relationship between health expenditure, health outcomes and economic growth remains inconclusive in the extant literature hence, it is needful to ascertain these relationships so as to make evidence-based decision that would ameliorate the situation of the health sector of Nigeria. Given the high rate of infant and maternal mortality, the low life expectancy in Nigeria as well as the meagre budgetary allocation to the health sector of the Nigerian economy, it became imperative to examine the link between health expenditure, health outcomes and economic growth to actually see there is a causal relationship among these key macroeconomic variables in Nigeria.

Hence, this study was carried out to examine the causal relationship as well as the direction of causality among health expenditure, health outcomes (infant mortality, life expectancy and maternal mortality) and economic growth in Nigeria using the ARDL Bounds test approach to cointegration and the Toda-Yamamoto causality test. Sequel to the empirical findings of this study, this study concludes that health expenditure and economic growth play key roles in determining the health outcomes in Nigeria. Specifically, causality runs from health expenditure to infant mortality, maternal mortality and life expectancy while causality runs from economic growth to life expectancy and maternal mortality. On the other hand, this study concludes that a unidirectional causal relationship exists between economic growth and health outcomes in Nigeria indicating that causality runs from economic growth to health expenditure.

The implications of these findings for the Nigerian economy are hereby discussed. First, the non-causality between economic growth and infant mortality suggests that economic growth and infant mortality does not cause nor affect each other thus, that the government and the stakeholders in the health sector should endeavour to adopt technologies that would lower the incidence of infant mortality in Nigeria. Lastly, the unidirectional causality between health expenditure and economic growth as against the bidirectional causality found by Ogungbenle, Olawumi and Obasuyi (2013) suggests that the government need to formulate and implement policies that will stimulate economic growth which will in turn influence health expenditure,

thereby instigating the desired health outcomes. Second, the unidirectional causality running from economic growth to health expenditure suggests that health expenditure does not cause economic growth thus, downplaying the contribution of the health sector of the Nigerian economy to aggregate output. This implies that while government spends on health sector, it should focus on the impact of health expenditure on health outcomes rather than economic growth. It also suggests that health expenditure does not have a direct but indirect effect on economic growth as it goes through health outcomes to influence economic growth.

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