Maternal Mortality, Child Mortality, Life Expectancy and Economic Growth: The Nigerian Experience

[1]LAWAL, Nurudeen Abiodun, PhD, [2]OSINUSI, Kunle Bankole, PhD & [3]BISIRIYU, Sodiq Olaide

[1,2&3]Department of Economics, College of Social and Management Sciences, Tai Solarin University of Education (TASUED), Ogun State
Email:naf_lawal@yahoo.com, bank_kunle77@yahoo.com & bisiriyusodiqolaide@gmail.com

Abstract

The study investigated the impact of maternal mortality, child mortality and life expectancy on the Nigerian economic growth covering a period of 30 years spanning 1990 to 2019. In addition, the study adopted a theoretical framework of Solow Growth Theory and its production function was later modified for the empirical analysis of this study. The Classical Least Square was used to estimates the relationship of the empirical model while the Granger Causality Test was used to test the direction of causality among the model parameters. Results of the analyses revealed that maternal health, infant mortality and population growth exerts positive impact on economic growth with infant mortality found to be statistically insignificant while under-five mortality and life expectancy exerts a negative impact on economic growth in Nigeria with life expectancy exhibiting a statistical significance. The Granger Causality test results revealed unidirectional causality from gross domestic product to life expectancy and maternal mortality, also unidirectional causality from population growth to gross domestic product and from under-five mortality to gross domestic product. The test also revealed there is no causality between infant mortality and gross domestic product over the study period in Nigeria. Therefore, the study recommended that government should formulate plans and strategies at reducing child mortality at all its level (federal, state and local) to ensure economic growth among others.

Keywords: Child Mortality, Classical Least Square, Economic Growth, Granger Causality, Life Expectancy, Maternal Health and Solow Growth Theory.

Introduction

Every economy desires growth and development, whereas in recent time the nature of connection between major health indicators (maternal health, under 5 mortality, infant mortality and life expectancy), health expenditure and economic growth have generated debate among economic researchers, policy makers and health economists. This was due to the fact that government expenditure has increased over time and such should be reflected on the country's health indicators (Byaro & Musonda, 2016; Farahani, Subramanian & Canning, 2010; Ude & Ekesiobi, 2014, Ogungbenle, Olawunmi &

Obasuyi, 2013; Klobodu, Dawson, Reed & Carpio, 2018). Economic growth literature clearly explained the importance of health in propelling productivity in any economy.

Grossman (1972) argued that good health is required for the production of optimal output. The popular notion *"health is wealth"* implies it is only a healthy labour force that can contribute efficiently and effectively to production and growth of a country's output. As postulated by Solow (1956), the output of a nation at any point in time depends on capital, labour and knowledge or effectiveness of labour. Thus, this make the health of the citizens of a country that constitute its labour force essential to the government that aspires growth for labour manage all other inputs and as such adequate provision, policies, programmes and frameworks should be made one of the primary objectives of every government as the result translates to economic growth which is one of their macroeconomic objectives. It is suggested that, healthier workers will be able to work longer, efficiently and effectively than their relatively less healthy counterparts (Meroyi, 2018). Health of the labour cannot be over-emphasized yet without good health status; the labour force cannot optimize the utility of available scarce resources.

Maternal and child mortality rate has generally reduced in Africa and Nigeria in particular as evidenced by their reduction between 1990 till date (Millennium Development Goal, 2013; UNICEF, 2016). Despite the efforts put in place and this significant achievement, maternal and child mortality rates per 100,000 lives are still higher than the estimate of MDG-5. As presented by Bello and Joseph (2014), in Nigeria, one woman dies in every ten minutes on the account of either pregnancy or child birth, amounting 53,000 per year. This figure is indeed high and saddening, it implies about 800 women die in every 100,000 live births while Nigeria's new born death rate (neonatal mortality) is considered one of the highest in the world with 528 per day (UNICEF/ WHO/ World Bank/UN, 2015).

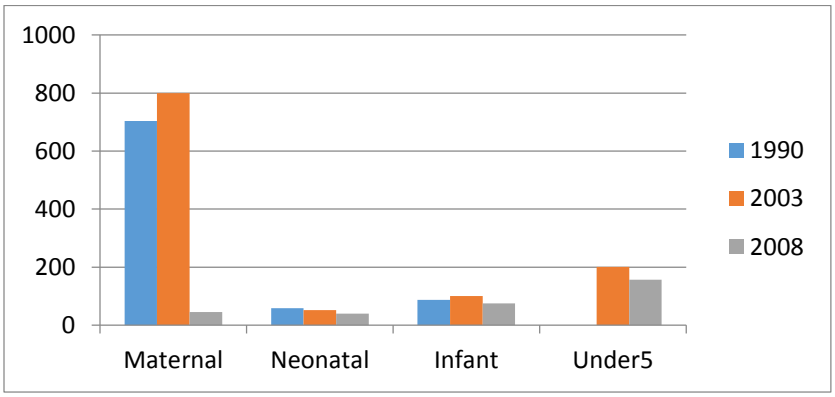

Fig. 1: Trends in Maternal and Child Mortality Rates in Nigeria (Per 100,000) 1990 - 2008

Source: MDG Acceleration Framework (2013)

Furthermore, inadequate/lack of health care facilities and equipment in hospitals/health centres, inadequate professional health personnel majorly as a result of brain drain, access to antenatal and postnatal health care facilities are major challenges confronting the provision of comprehensive and all-round health care for women and children (UNFPA, 2013). Also, there are problems with lack of education on antenatal and postnatal health care importance among pregnant women which cause complications on maternal and child health. Whereas, the Nigerian economy with population estimate of about 201 million according to United Nations (2020) had grown over the years in all its sectors since independence.

Against this background that major health indicators are positively related to economic growth; empirical exploration of literature reveals studies concentrated on health spending and health outcomes in Nigeria such as David, (2018), Nwankwo (2018), Ogunjimi and Adebayo (2019). Similar to this study are that of Klobodu *et al* (2018) who examined maternal and child health impact on economic growth but focused on some Sub-Saharan African countries. Also, the study of Ogungbule, Olawunmi and Obasuyi (2013) only considered life expectancy as health indicator variable in their research while the study of Ogunjimi and Adebayo (2019) only examine the causality between health expenditure, health outcomes and economic growth in Nigeria.

Conclusively, this study is of great distinction as its main objective is to examine the impact of maternal health, child mortality and life expectancy on economic growth in Nigeria for the period 1990 – 2019. It also attempts to check for the direction of causal relationship among the variables. The guiding hypotheses are: (i) maternal health, child mortality and life expectancy has no significant impact on economic growth in Nigeria (ii) maternal health, child mortality and life expectancy does not granger cause economic growth in Nigeria. The remaining sections of this paper are structured in the following manner: section 2 discusses the conceptual clarifications, trend analysis of variables and literature review. Section 3 contains the theoretical framework, model specification, data and estimation techniques. Section 4 comprises the empirical results and analysis; and section 5 concludes the study.

Conceptual Clarifications

Maternal Mortality

This simply means any loss or death that occurs to a woman's life after childbirth usually within 42days or as a result of pregnancy complications. As noted by Ibrahim (2016), such complications are issues emanating or linked to improper management of pregnancy and not from accident or incidental factors. Literature revealed that there are several medical and non-medical factors affecting maternal health in the broad context. Moughalu (2010) in his work noted that in Nigeria, maternal mortality is been influenced by several non-medical conditions. Such include social, economic and cultural factors among others; which impact directly on maternal mortality status. The most engrossing fact which calls

for attention on maternal mortality in Nigeria rural areas are the causes, these causes are factors that are non-medical which range from poverty to educational attainment, income level/earning, taboos or prohibitions as well as certain cultural practices and beliefs.

However, Nigeria maternal mortality reduction had recorded commendable progress especially between 1990 and 2015. Maternal mortality declined in 1990 from 1,100 per live births to 350 in 2012 whereas despite this appreciable trend of reduction, it is still considered then not sufficient for reducing maternal mortality ratio (MMR) to 250 maternal deaths per 100,000 live births as objectified by United Nations Millennium Development Goals for2015 (MDG, 2013). As reported by NDHS (2019) in their 2018 survey, Nigeria still failed to achieve the United Nation objective in reducing maternal mortality rate.

Child Mortality

Child mortality is a broad component which can be simplified into infant mortality and under-5 mortality. Infant mortality is the death of young children majorly those below age 2 and it is measured by infant mortality rate index (IMR), which is often computed using the number of deaths of children within the specified age per 100,000 live births at a particular period of time (Carpenter, n.d.). Under-5 mortality rate (U5MR) on the other hand can simply be defined as the probability a child given birth to in a specified year will die before the age of five. It can also be referred to as the sum total of deaths of infants (i.e. below age two) and that of children under the age of five, this is calculated per 100,000 live births (United Nations Children's Fund, 2012; UN Inter-agency Group for Child Mortality Estimation, 2013).

Past reports and studies on child mortality showed that despite the reduction in annual rate of U5M, Nigeria finds it challenging to attain the benchmark decline rate of 11% per annum as required by MDG goal 4 of the United Nations in West and Central Africa in 2015 (Rajaratnan et al, 2010; National Population Commission [Nigeria], 2004, 2009c; Lynken *et al*, 2009). Further investigations revealed that several efforts had been put in place in SSA countries (Nigeria inclusive) but child mortality rate still remains unacceptably high in the region. Smith (2010) reported that despite the region account for just one-fifth of the world's children population, about half of the world childhood deaths are from SSA countries.

Life Expectancy

According to World Health Organization (WHO)(2006) life expectancy at birth is defined as the average number of years that a new born is expected to live if the current mortality rates continue to prevail. Life expectancy at birth is a clear reflection or indication of the overall mortality level of a population or country at a period of time. It also gives the summary of mortality pattern that cut across all age structure – children and adolescents, adults and the aged of a population or country. It is evident from literature over the years

that Nigeria's life expectancy has increased as a result of reduction in infant and under-5 mortality (CBNSB, 2017 & NDI, 2018).

Economic Growth

Economic growth according to Jhingan (2006) is defined as an increase in output level of a country over a period of time. In this definition, it was explained further that economic growth is related to a quantifiable sustained increase in a country's per capita income or output accompanied by expansion in its labour force, consumption, capital and volume of trade. Similarly, Bisiriyu and Osinusi (2020) viewed economic growth as an increase in productivity of a country over a period of time which brings about better standard of living among the citizens through improvement in social and basic infrastructures such as health care, education and housing among others.

The significance of economic growth cannot be overemphasized as it serves as a catalyst for economic development which is a core objective of every economy.

Trend of Nigerian Economic Growth, Maternal Health, Child Mortality and Life Expectancy

Nigeria is characterised as a lower-middle income with mixed economy and emergent market with currently expanding financial, service, communication and entertainment sectors (World Economic Situation and Prospects, 2014). The country is ranked 30th in the world in terms of GDP as of 2011 and its emergent manufacturing sector is the third largest in Africa despite been considered underperforming. In addition, the GDP growth rate of the country grew steadily since its independence to 2019 except for some years (1982 – 1984 and 2016). The economy was growing until 1982 when it plunged into economic crisis that prevail to 1984and was later corrected with the adoption of Structural Adjustment Programme (SAP). Bisiriyu and Osinusi (2020) cited the study of Akeju and Olanipekun (2014) who revealed the country's GDP at purchasing power parity in 2005 increased more than doubled from $170.7 billion to $413.4 billion in 2011 while the actual figure was estimated to be approximately $520 billion with the inclusion of the informal sector. The GDP per capita increased by 116% from $1200 per person in 2005 to an estimated value of $2,600 per person in 2011.

The economy later fell into another recession recently in 2016 when her real GDP dropped. The study of Ogunjimi and Adebayo (2019) revealed the statistical figure that the GDP fell from ₦69023 billion in 2015 to ₦67931 billion in 2016. As of 2019, Nigeria's economy is the largest in the West Africa region, largest in Africa with nominal GDP of $496.12 billion with GDP per capita of $2407 and on track of becoming one of the 20 largest economies of the world whereas it presently stand as the 27th largest economy in the world according to the International Monetary Fund (IMF) World Economic Outlook Database, 2019.

Infant mortality rate as reported by Ogunjimi and Adebayo (2019) stood at 125.4 per 1,000 live births in 1981 but declined to 124 per 1,000 live births in 1983 and this increased

steadily to 126.2 in 1989 and 1990. However, according to the report of Ogunjimi and Adebayo (2019), this figure plummeted in 1991 to 126 per 1,000 live births and steadily decrease until it reached a double digit of 99.8 per 1,000 live births in 2004. The figure stood at 81.1 per 1,000 live births in 2010 and recently estimated as 66.9 per 1,000 live births in 2016. U5M was also reported to have an unstable pace in Nigeria over the years and this was faster in the 1960's and 1970's than in recent time (Adetunji, 2002). Ahmed *et al* (2000) also reported Nigeria was rated to have had a modest decline in U5M rate in the 1990's alongside some SSA countries (Madagascar, Mauritania & Lesotho).

Maternal mortality rate in Nigeria as at 1981 stood at 362.41 per 1,000 female adult and fluctuated for years until 1993 when it stood at 363.8 per 1,000 female adults. This increased steadily over the years and stood at 393.53 per 1,000 female adults in 2002 and later declined until it reached 359.82 and 333.03 per 1,000 female adults in 2010 and 2016 respectively (Ogunjimi & Adebayo, 2019). However, the country's life expectancy at birth stood at 45.62years in 1981 which later increased steadily in 1985 to 46.13. The figure declined in 1993 and 1994 to 45.84 but increased to 48.25 in the following year. Since 1995, the figure had maintained an upward trend, reaching 48.25years in 2005, 50.85years in 2010 and 53.43years in 2016 (CBNSB, 2017; WDI, 2018).

This indicates that measures and programmes by government and international organisations such as United Nations to combat maternal mortality yielded a significant result. Conclusively from the analysis, it is evident that economic growth, maternal health, child mortality and life expectancy had demonstrated commendable and interesting trends in Nigeria over the years.

Empirical Review

Exploration of literature showed there are lots of time-series and panel researches examining the connection between health outcomes (maternal mortality, child mortality, life expectancy), health expenditure and economic growth in several countries (developed and developing) and regions. Anyanwu and Erhijakpor (2007) investigated the relationship between government health expenditure and health outcomes in 47 African countries between 1994 and 2004 using Robust Least Square Model. Their results showed health expenditure have a statistically significant effect on infant mortality and under-five mortality. Further result from the study revealed both infant and under-five mortality are positively and significantly associated with SSA countries while inverse is true for North Africa countries. In the same vein, Kim and Lane (2013) analyzed the relationship between public health expenditure and public health outcomes nexus among 17 OECD countries between 1973 and 2000. The results of the study 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.

Novingon, Olakojo and Nowignon (2012) investigated the effects of public and private health care expenditure on health status in SSA countries from 1995 to 2010. The study adopted panel data regression and the results showed that health care expenditure significantly influence health status through improving life expectancy at birth, reducing death and infant mortality rates. Similarly, Nikoloski and Amendah (2017) examined health expenditure and better health outcomes among 14 African countries from 2000 – 2014. The result revealed public health expenditure reduces infant, neonatal and under-five mortality rate while increasing life expectancy at birth significantly. In the study of Shetty and Shetty (2014) on health expenditure and infant mortality rate among 34 Asia countries revealed a significant inverse relationship between health expenditure and infant mortality rate.

In Nigeria, David (2018) in his empirical explanation on the nexus between infant mortality and public health expenditure in Nigeria from 1980 to 2016, the empirical results indicated the presence of significant long-run relationship between infant mortality and government health expenditure. In the study of Edeme, Emecheta and Omeje (2017) on public health expenditure and health outcomes in Nigeria, it was found that an increase in public health expenditure improves life expectancy and reduces infant mortality rates. Also, Bashir (2016) assessed the impact of government health infrastructure on health sector performance from 2000 to 2013 and found a strong and significant inverse relationship between government health expenditure and infant mortality. The study also found a weak positive association between public health spending and life expectancy.

Linking economic growth to health outcomes, Bhalotra (2006) explored the extent to which the reduction in child mortality can be attributed to economic growth in 15 major states of India over a period of three decades. Malik (2006) in his study concluded infant mortality rate, life expectancy rate and crude health rate has significant effect on economic growth proxy by per capita gross national income (GNI). Also, Bloom, Kuhn and Prettner (2015) in their investigation on the contribution of female health to economic development noted that improved female health and health care facilities enhances demographic transition which results to sustained economic growth.

Similarly, Klobodu, Dawson, Reed and Carpio (2018) examined child health and economic development among six SSA countries (Burkina Faso, Togo, Ghana, Ivory Coast, Botswana and South Africa) between 1960 and 2012. The study concluded maternal and child healths are beneficial for long-term economic growth. The research further recommends that maternal health and child health care should be prioritized within the overall economic growth and development plans. In Nigeria, Ogungbenle, Olawunmi and Obasuyi (2013) in their study on life expectancy, public health spending and economic growth in Nigeria for the period 1997 to 2008 revealed there is no bi-directional causality between life expectancy and economic growth in Nigeria for the years under review.

Finally, Ogunjimi and Adebayo (2019) examined the relationship among health expenditure, health outcomes and economic growth in Nigeria between 1981 and 2017, the results from their analysis showed a unidirectional causality running from health expenditure to infant mortality and no causality between real GDP and infant mortality. Furthermore, the result showed 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.

Theoretical Framework

This study is guided by the Solow Growth Theory. This was chosen being the basic and fundamental reference point for almost all analyses of growth. The theory supports the fact that for an economy to produce certain output that will enhance growth, there must be some certain inputs which labour is one which must play a significant role. The Solow Growth Theory focuses on four variables: Output (Y), Capital (K), Labour (L) and "Knowledge" or the "Effectiveness of labour" (A); thus the production function takes the form:

$$Y = f(K, L, A) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

The above equation changes form to $Y = f(K, AL)$ …….. *(2)*

This is because knowledge is embedded in labour and it is explained by Solow noting there is a multiplicative relationship between labour (L) and knowledge (A). However, labour (L) ensures the utilization of capital (K) in production process. The multiplicative effective of A and L as explained by Solow is referred to as effective labour because acquisition of knowledge or skill makes labour more effective and productive.

The theory further argued that the production function has constant returns to scale in its two arguments – capital and effective labour. This simply means doubling labour and capital doubles the amount of output within the economy with A held constant. Multiplying both factors of production L and K by any non-negative constant c causes output to change by the same factor:

$$F(cK, cAL) = cF(K, AL) \quad \text{for all } c \geq 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Solow in his analysis proceeds to check equation (3) above of constant returns to scale using the popular Cobb Douglas production function which is specified as:

$$F(K, AL) = K^{\alpha}, AL^{1-\alpha} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

where $(0 < \alpha < 1)$, introducing the constant c;

$$\begin{aligned} F(K, AL) &= (cK)^{\alpha} (cAL)^{1-\alpha} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5) \\ &= c^{\alpha}K^{\alpha}. c^{1-\alpha} (AL)^{1-\alpha} \\ &= c^{\alpha} c^{1-\alpha}. K^{\alpha} (AL)^{1-\alpha} \\ &= cF(K, AL) \end{aligned}$$

From the foregone theoretical analysis, it is obvious that the role of labour is cogent to economic growth and as such, their health status is paramount to ensure increase in productivity. As the theory posit, doubling the amount of labour and capital doubles productivity; in the same vein decreasing the amount of labour decreases productivity ceteris paribus. However, increase in mortality rate, child mortality and decrease in life expectancy will decrease labour force which will surely in turn decrease productivity and retard economic growth of the nation.

Model Specification

The aforementioned Cobb Douglas production function as used by Solow in his analysis was adopted and modified for the study under investigation. The least square regression equation based on the functional relation is stated as follows:

$$GDP = a_0 + a_1MMR + a_2IMR + a_3U5M + a_4LE + a_5POP + U \quad \ldots\ldots\ldots\ldots (6)$$

Where:

a_0	=	Intercept
a_1, a_2, a_3, a_4&a_5	=	Regression Coefficients
GDP	=	Gross Domestic Product Growth Rate
MMR	=	Maternal Mortality Rate
IMR	=	Infant Mortality Rate
U5M	=	Under-5 Mortality Rate
LE	=	Life Expectancy
POP	=	Population Growth Rate
U	=	Error Term

Data and Estimation Techniques

This study employed time series data on maternal health given by maternal mortality rate, child mortality given by infant mortality rate and under5 mortality rate, life expectancy, population growth rate and economic growth given by gross domestic product growth rate for the period 1990 to 2019. The secondary data were collected from World Bank Data site while the sourced data were analyzed with the specified multiple regression model using the unrestricted Classical Least Square. The estimated parameters are subjected to evaluation using the F-statistics and t-statistics while the overall stability is tested using the adjusted $R^2$and Durbin Watson test. Furthermore, the Pairwise Granger Causality Test was employed to examine the direction of causality among the variables of the study.

Results of the Findings

Table 1 below shows the result of the Unit Root test for stationarity. The Augmented Dickey Fuller test was used to ascertain the time series properties of all variables employed in the model so as to avoid spurious regression which results from the inclusion of two or more non-stationary time series data in regression analysis.

Test of Stationarity: Augmented Dickey Fuller test

Table 1: Summary of the ADF Unit Root Test

Variables	Test Statistics	5% Critical value	Probability	Remarks
GDP	-3.261566	-2.967767	0.0264	Stationary at level
IMR	-3.783385	-2.976263	0.0082	Stationary at level
LE	-4.628087	-3.004861	0.0015	Stationary at level
MMR	-4.255702	-2.971853	0.0025	Stationary at first difference
POP	-4.603667	-2.976263	0.0011	Stationary at second difference
U5M	-3.164556	-3.004861	0.0362	Stationary at level

Source: Authors' Computation, 2020

Table 1 reveals GDP, IMR, LE and U5M were found to be integrated of order zero and this implies that the data were stationary at level form. MMR and POP were found to be integrated of order one and two at level form respectively and therefore, became stationary after differencing once and twice. Differencing was necessary so as to avoid the problem of spurious regression when series are used in their non-stationary form.

The results from the multiple parameters regression specified to investigate the impact of maternal health, child mortality and life expectancy on economic growth in Nigeria from 1990 to 2019 using E-Views version 9 is summarized below:

Table 2: Estimated Regression Results

Dependent Variable: GDP
Method: Least Squares
Date: 09/18/20 Time: 09:02
Sample: 1990 2019
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	151.0113	157.0965	0.961265	0.3460
IMR	5.206780	11.96325	0.435231	0.6673
LE	-6.326094	1.872581	-3.378276	0.0025
MMR	0.052717	0.026337	2.001672	0.0567
POP	60.02731	27.92223	2.149803	0.0419
U5M	-3.461846	6.546944	-0.528773	0.6018

R-squared	0.621604	Mean dependent var	4.401808
Adjusted R-squared	0.542772	S.D. dependent var	4.116132
S.E. of regression	2.783272	Akaike info criterion	5.061988
Sum squared resid	185.9185	Schwarz criterion	5.342228
Log likelihood	-69.92982	Hannan-Quinn criter.	5.151639
F-statistic	7.885137	Durbin-Watson stat	2.257023
Prob(F-statistic)	0.000164		

Source: Authors' Computation, 2020

The results of the regression analysis above revealed that infant mortality rate (IMR), maternal mortality rate (MMR) and population growth rate (POP) exert positive impact on economic growth in Nigeria from 1990 to 2019 in Nigeria. These do not conform to a-priori expectation base on expected signs expect population growth; it implies with a unit increase in infant mortality rate, maternal mortality rate and population growth, the Nigerian gross domestic product growth rate will increase by 5.2067, 0.0527 and 60.0273 respectively. On the other hand, the result also showed that life expectancy (LE) and under 5 mortality rate (U5MR) exert negative impact on Nigeria economic growth over the years of study. This implies that life expectancy and under5 mortality were growth retarding agents over the period of study. The magnitude indicates a unit increase in life expectancy and under5 mortality will deteriorate the growth of gross domestic product by 6.3261 and 3.4618 units respectively. The sign of under-five mortality rate conform to a-priori expectation while that of life expectancy does not.

Testing the partial significance of the estimated parameters of the model from table 2 above, the results show that the estimate parameters for life expectancy (LE) and population growth rate (POP) were found to be partially statistically significant at 5% critical level (p-values <0.05) while the estimated parameters for maternal mortality rate (MMR), infant mortality rate (IMR) and under-five mortality rate (U5M) were found to be statistically insignificant at 1% and 5% critical levels. The result is in line with that of Malik (2006) who examined the relationship between health and economic growth and concluded that life expectancy has significant effect on economic growth. Also, the result corroborate with the finding of Klobodu et. al. (2018) who concluded that child health is beneficial for long-term economic growth in his study on child health and economic development in some selected sub Saharan Africa countries.

The F-statistics which measures the overall significance of the model shows that all incorporated parameters in the model maternal mortality rate (MMR), infant mortality rate (IMR), under-five mortality rate (U5M), life expectancy (LE) and population growth rate (POP) have joint significant on economic growth in Nigeria at 1% and 5% critical levels. The value of the adjusted R^2 reveals about 54% of the total variation in economic growth is explained by the explanatory parameters of the model. Also, the Durbin Watson statistics reveals there is no presence of serial autocorrelation among the residuals because its value (2.2570) is very close to two. Therefore, parameters estimated from the model are stable, efficient and suitable for policy simulation.

Table 3: Summary of Pairwise Granger Causality Test

Variables		F - statistic	Probability	Remark
IMR	**GDP**	2.45457	0.1081	No Causality
GDP	**IMR**	1.20069	0.3192	No Causality
LE	**GDP**	1.23781	0.3086	No Causality
GDP	**LE**	4.11191	0.0297	Causality
MMR	**GDP**	0.12215	0.8856	No Causality
GDP	**MMR**	4.62894	0.0204	Causality
POP	**GDP**	3.02620	0.0681	Causality
GDP	**POP**	0.43632	0.6516	No Causality
U5M	**GDP**	2.83632	0.0792	Causality
GDP	**U5M**	1.03844	0.3700	No Causality

Source: Authors' Computation, 2020

Table 3 above presents the summary of the Granger Causality test, the test was carried out using an optimal lag length of two. The result indicates that there is unidirectional causality from gross domestic product to life expectancy and maternal mortality rate and from under-five mortality rate to gross domestic product. Also, unidirectional causality from infant mortality rate to maternal mortality rate, maternal mortality rate to life expectancy and under-five mortality rate to maternal mortality rate; all leading to the rejection of the null hypotheses (see table 2 in the appendix). Furthermore, the Granger Causality test results reveal there is bidirectional causality between life expectancy and infant mortality rate, population growth rate and infant mortality rate, under-five mortality rate and life expectancy, population growth rate and life expectancy and finally between under-five mortality and population growth rate leading to the rejection of null hypotheses. The results also indicate there was no causality between infant mortality rate and economic growth over the period under study.

The result of the study is in line with the result of Klobodu *et al* (2018) who found that child health granger cause economic growth in six SSA countries – (Burkina Faso, Togo, Ghana, Ivory Coast, Botswana and South Africa). Also, the result corroborate with that of Ogungbenle et. al. (2013) who revealed that there is no bidirectional causality between life expectancy and economic growth in Nigeria over their years of analysis. In addition, the study of Ogunjimi and Adebayo (2019) also supported result of the study that there is no causality between real GDP and infant mortality.

Conclusion

The study investigated maternal health, child mortality, life expectancy and economic growth in Nigeria for the period spanning from 1990 to 2019 to empirical data on parameters of the study. The classical least square method and granger causality test were adopted to analyze the specified model of the study. The results from the study empirical analyses found that maternal mortality, infant mortality and population growth exerts a positive impact on economic growth with only population growth rate found to be

statistically significant. The study also reveals life expectancy and under-five mortality exerts negative impact on economic growth in Nigeria over the years of study. The inverse relationship of life expectancy was found to be statistically significant. The finding on under-five mortality conformed to a-priori expectation, though not significant while that of population growth conformed and as well statistically significant; validating the Solow theory as reviewed that doubling labour will double the output level.

However, the granger causality test results reveal bidirectional causality from gross domestic product to life expectancy, from gross domestic product to maternal mortality, from population growth to gross domestic product, under-five mortality to gross domestic product and no causality between infant mortality and gross domestic product over the data period of analysis. A major implication of these results is that under-five mortality, infant mortality and population growth over the years are capable of influencing economic growth in Nigeria.

Recommendations

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

i. Government should formulate plans and strategies at reducing child mortality at all level (federal, state and local) to ensure economic growth.
ii. Governments and their agencies should work with United Nations towards reducing maternal mortality and child mortality and as well increasing life expectancy at birth as these contributes to population growth rate which spurs economic growth.
iii. Private sectors should also be encouraged by government to aid the attainment of reduced maternal mortality and child mortality to reap the gain of productivity needed for economic growth and development.

References

Adetunji, J.A. (2002). Levels, Trends and Regional Differentials in the Death rates of Nigerian Children: A Policy and Research Paper. Paper presented at the Annual Meeting of the American Public Health Association, Philadelphia PA.

Ahmed, O. B., Lopez, A. D & Inoue, M. (2000). The decline in child mortality: A reappraisal. Bulletin of the World Health Organization, 2000, 78(10).

Akeju, K.F. & Olanipekun, D.B. (2014). Unemployment and economic growth in Nigeria. *Journal of Economics and Sustainable Development*, 5(4); 138-144.

Anyanwu, J.C., & Erhijakpor, A.E.O. (2007). Health expenditures and health outcomes in Africa. *Economic Research Working Paper No 91 of African Development Bank.*

Bashir, Y. M. (2016). An Assessment of the Impact of Government Expenditure on Infrastructures: Evidence from Nigerian Health Sector Performance. *European Journal of Business and Management*, 18(14); 8-14.

Bello, R. A. & Joseph, A. I. (2014). Determinants of Child Mortality in Oyo State, Nigeria. *An International Multidisciplinary Journal*, Ethiopia 8(1); 32, 252-272.

Bhalotra, S. (2006). Spending to Save? State Health Expenditure and Infant Mortality in India. IZA Discussion papers, 2914.

Bisiriyu, S.O. & Osinusi, K.B. (2020). Foreign Direct Investment, Economic Growth and Unemployment in Nigeria. *Jalingo Journal of Social and Management Sciences,* 2(4); 51-61.

Bloom D.E., Kuhn M. and Prettner, K. (2015). The contribution of female health to economic development. National Bureau of Economic Research, 2015.

Byaro, M., & Musonda, P. (2016). Impact of public health expenditure on infant and underfive mortality in Tanzania (1995-2013): An Application of Bayesian Approach. *Journal of Economics and Sustainable Development*, 7(12); 178 -187.

Carpenter, K. (n.d.). What is infant mortality rate? – Definition, causes & history. *Study*. Retrieved from https://study.com/academy/lesson/what-is-infant-mortality ratedefinition-causes-history.html

Central Bank of Nigeria Statistical Bulletin, (CBNSB) (2017). Available from https://www.cbn.gov.ng/documents/Statbulletin.aspx.

David, J. (2018). Infant mortality and public health expenditure in Nigeria: empirical explanation of the nexus. *Timisoara Journal of Economics and Business,* 11(2); 149-164.

Edeme, R.K., Emecheta, C., & Omeje, M.O. (2017). Public health expenditure and health outcomes in Nigeria. *American Journal of Biomedical and Life Sciences*, 5(5); 96-102.doi: 10.11648/j.ajbls.20170505.13.

Farahani, M., Subramanian, S.V., & Canning, D. (2010). Effects of State-level public spending on health on the mortality probability in India. *Health Econ*., 19(11); 1361–1376. doi:10.1002/hec.1557

Grossman, M. (1972). On the concept of health capital and the demand for health. *The Journal of Political Economy*, 80(2); 223-255.

Ibrahim, D. O. (2016). Social-Economic Determinants of Maternal Mortality in Rural Communities of Oyo State, Nigeria. *International Journal of Scientific and Research Publications.* 6(9): 280-5.

International Monetary Fund (IMF) (2019). https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases

Jhingan, M. L. (2006). The Economics of Development and Planning, 38th Edition. *Virnda Publication (P) Ltd; Delhi.*

Kim, T.K., & Lane, S. R. (2013). Government health expenditure and public health outcomes: A comparative study among 17 countries and implications for US health care reform. *American International Journal of Contemporary Research*, 3(9); 8-13.

Klobodu, S.S., Dawson, J.A., Reed D.B. & Carpio, C.E. (2018). Do maternal and child health promote economic development? A case study of six sub-Saharan African countries. African Journal of Food, Agriculture, Nutrition and Development. 8(3); 13761-13775. DOI: 10.18697/ajfand.83.17395

Lykens, K., Singh, K. P., Ndukwe, E., and Bae, S. (2009). Social, economic, and political factors in progress towards improving child survival in developing nations. *Journal of Health Care for the Poor and Underserved* 20: 137-148.

Malik G. (2006). An examination of the relationship between health and economic growth. ICRIER, 2006.

Meroyi, Y. (2018). Determinants of Health Investment in Nigeria: A Case of Infant Mortality (2000-2014). *International Journal of Academic Research in Business and Social Sciences*, 8(9); 935–949.

Millennium Development Goals Acceleration Framework (2013). A commitment to improved maternal health. Federal republic of Nigeria, August, 2013.

Muoghalu, C.O. (2010). Socio-economic and Cultural Factors in Maternal Mortality in Nigeria: Ife Centre for Psychological Studies, 2010. Retrieved Jan.10, 2016, from http://www. Fags.org/teems.

National Population Commission [Nigeria] (2004). Nigeria Demographic and Health Survey 2003. National Population Commission and ORC Macro International, Calverton MD.

National Population Commission [Nigeria]. (2009c). Nigeria Demographic and Health Survey 2008. National Population Commission and ORC Macro International, Calverton MD. NDHS (2019). Nigeria Demographic and Health Survey Report.

Nikoloski, Z., & Amendah, D. (2017). Does a country's greater health care spending lead to better health outcomes for its population? -Evidence from African Health Accounts. Retrieved from https://afhea.org/docs/analysis-of-health-for-selectedcountries.pfd

Novignon, J., Olakojo, S.A., & Nonvignon, J. (2012). The effects of public and private health care expenditure on health status in sub-Saharan Africa: new evidence from panel data analysis. *Health Economics Review*, 2(22). doi:10.1186/2191-19912-22

Nwankwo, C.E. (2018). The Effects of Public Health Spending on Maternal Mortality in Nigeria. Journal of Economics and Sustainable Development. 9(2), 141-152.

Ogungbenle, S.; Olawumi, O.R. & Obasuyi, F.O. (2013). Life expectancy, public health spending and economic growth in Nigeria: A Vector Autoregressive (VAR) model. *European Scientific Journal*, 9(19); 210 – 235.

Ogunjimi, J.A. & Adebayo, A.O. (2019). Health Expenditure, Health Outcomes and Economic Growth in Nigeria. *Asian Journal of Economics and Empirical Research* 6(2); 130-139.

Rajaratnam, J. K., Marcus, J. R., Flaxman, A. D., Wang, H., Levin-Rector, A., Dwyer, L., Costa, M., Lopez, A. D., and Murray, C. J. (2010). Neonatal, post-neonatal, childhood, and under-5 mortality for 187 countries, 1970-2010: a systematic analysis of progress towards Millennium Development Goal 4. *Lancet* 375: 1988 – 2008.

Robert M. Solow (1956). "A Contribution to the Theory of Economic Growth" The Quarterly Journal of Economics, 70(1); 65-94.

Shetty, A., & Shetty, S. (2014). The correlation of health spending and infant mortality rate in Asian countries". *International Journal of Contemporary Pediatrics*, 1(2); 100-105.

Smith, E. G. (2010). Maternal Schooling and Child Mortality in Nigeria: The importance of the Actual curriculum [Online] Available: Princeton.edu/download.aspx? submissionld =100377 (February 18, 2011)

Ude, D.K. & Ekesiobi, C. S. (2014). Effect of per capita health spending on child mortality in Nigeria". *International Journal of Innovative Research and Development*, 3(9).

UNICEF (2016). Monitoring the Situation of Children and Women. UNICEF, New York City.

UNICEF/ WHO/ World Bank/UN Population Division. Levels & trends in child mortality: 2015 Report. United Nations Children's Fund, New York, 2015.

United Nations (2020). "*World Population Prospects: The 2019 revision".* Elabouration of data by United Nations, department of economic and social affairs, population division.

United Nations Children's Fund. (2012). *The state of the world's children 2015: Executive summary*. Retrieved from http:// www.unicef.org/publications/index_77928.html

United Nations Inter-agency Group for Child Mortality Estimation (2013). Levels & Trends in Child Mortality - Report 2013. UN Inter-agency Group for Child Mortality Estimation. United Nations, New York. 2013. http://www.mamaye.org.ng/evidence/levels-trends-child-mortality-report-2013.

United Nations Population Fund (UNFPA) (2013). UNFPA Annual Report, 2013.

WHO. (2006). Road Map for Accelerating the Attainment of the MDGs Related to Maternal and Newborn Health in Africa.

World Development Indicators, (2018). World Bank, Washington, D.C. Available from: https://data.worldbank.org/country/nigeria.World Economic Situation and Prospects [WESP] 2014, pp. 150.

Appendix

Table 1: Estimated Regression Result

Dependent Variable: GDP
Method: Least Squares
Date: 09/18/20 Time: 22:05
Sample: 1990 2019
Included observations: 30

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	151.0113	157.0965	0.961265	0.3460
IMR	5.206780	11.96325	0.435231	0.6673
LE	-6.326094	1.872581	-3.378276	0.0025
MMR	0.052717	0.026337	2.001672	0.0567
POP	60.02731	27.92223	2.149803	0.0419
U5M	-3.461846	6.546944	-0.528773	0.6018

R-squared	0.621604	Mean dependent var	4.401808
Adjusted R-squared	0.542772	S.D. dependent var	4.116132
S.E. of regression	2.783272	Akaike info criterion	5.061988
Sum squared resid	185.9185	Schwarz criterion	5.342228
Log likelihood	-69.92982	Hannan-Quinn criter.	5.151639
F-statistic	7.885137	Durbin-Watson stat	2.257023
Prob(F-statistic)	0.000164		

Source: Authors' Computation, 2020

Table 2: Pairwise Granger Causality Tests
Date: 09/18/20 Time: 21:52
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.	Inference/Conclusion
IMR does not Granger Cause GDP	28	2.45457	0.1081	No Causality
GDP does not Granger Cause IMR		1.20069	0.3192	No Causality
LE does not Granger Cause GDP	28	1.23781	0.3086	No Causality
GDP does not Granger Cause LE		4.11191	0.0297	Causality

MMR does not Granger Cause GDP	28	0.12215	0.8856	No Causality
GDP does not Granger Cause MMR		4.62894	0.0204	Causality
POP does not Granger Cause GDP	28	3.02620	0.0681	Causality
GDP does not Granger Cause POP		0.43632	0.6516	No Causality
U5M does not Granger Cause GDP	28	2.83632	0.0792	Causality
GDP does not Granger Cause U5M		1.03844	0.3700	No Causality
LE does not Granger Cause IMR	28	6.08322	0.0076	Causality
IMR does not Granger Cause LE		8.14456	0.0021	Causality
MMR does not Granger Cause IMR	28	1.51366	0.2412	No Causality
IMR does not Granger Cause MMR		2.67384	0.0903	Causality
POP does not Granger Cause IMR	28	5.76206	0.0094	Causality
IMR does not Granger Cause POP		3.09327	0.0646	Causality
U5M does not Granger Cause IMR	28	1.34012	0.2815	No Causality
IMR does not Granger Cause U5M		0.88018	0.4282	No Causality
MMR does not Granger Cause LE	28	9.05521	0.0013	Causality
LE does not Granger Cause MMR		2.38950	0.1141	No Causality
POP does not Granger Cause LE	28	7.05998	0.0041	Causality
LE does not Granger Cause POP		8.75606	0.0015	Causality
U5M does not Granger Cause LE	28	9.27989	0.0011	Causality
LE does not Granger Cause U5M		7.17019	0.0038	Causality
POP does not Granger Cause MMR	28	2.45909	0.1077	No Causality
MMR does not Granger Cause POP		1.85571	0.1790	No Causality
U5M does not Granger Cause MMR	28	3.08913	0.0648	Causality
MMR does not Granger Cause U5M		1.34172	0.2811	No Causality
U5M does not Granger Cause POP	28	3.30808	0.0546	Causality
POP does not Granger Cause U5M		5.69954	0.0098	Causality

Source: Authors' Computation, 2020