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DETERMINANTS OF LIFE EXPECTANCY IN NIGERIA: A MACROECONOMIC ANALYSIS

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ABSTRACT

This study investigated the macroeconomic determinants of life expectancy in Nigeria. Variables such as income per capita, unemployment, inflation, income inequality, health investment; health system measured by physician per 1,000 population and the environment measured by the carbon dioxide emission index were assessed. Time series data on these variables from 1980-2015 were estimated using the Ordinary Least Squares technique. Of the macroeconomic variables included in the model, income inequality was the largest predictor of life expectancy. The other macroeconomic variables significant in explaining life expectancy are income per capita and government capital expenditure on health. Also, carbon dioxide emission and physician per 1,000 population were found to be significant in explaining life expectancy in Nigeria. The study underscores the need for income redistribution, higher income levels in Nigeria and the employment of skilled health personnel to man the health system a top priority in order to improve life expectancy.

Keywords: Life expectancy, income per capita, unemployment, OLS

1. INTRODUCTION

Statistics unveiled at the World Health Organisation in 2018, showed that life expectancy at birth in Nigeria for the year 2016 was estimated as 55 years, with Nigeria ranking 178th out of the 194 WHO member states in terms of life expectancy globally. Also, maternal mortality ratio in Nigeria for year 2015 was reported as 814 per 100,000 live births, while under-five mortality rate was 104 per 1,000 life births [1]. Comparing regional estimates, Nigeria ranked 15th out of 17 countries in the West-African sub-region in terms of life expectancy, with Cape Verde having the highest life expectancy at birth (73 years) and Sierra Leone having the lowest life expectancy

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at birth (53 years). The Millennium Development Goals Endpoint-report for Nigeria indicates that the country did not met the goals for reducing child mortality and combating HIV & AIDS, malaria and other diseases [2]. It can be deduced from the foregoing, that Nigeria has not recorded significant improvements in her health outcomes despite being one of the signatories to the MDGs. Influenza & pneumonia, tuberculosis, diarrhoeal disease, stroke and HIV/AIDS are the first five causes of death in Nigeria. Just recently, a study by the Brookings Institute in 2018 suggested Nigeria as the poverty capital of the world and this has serious implications for the health of its citizen and the health sector in general, given the nexus that exits between poverty, ill health and low life expectancy. The predominant strategy adopted by Nigeria and other low- and medium-income countries (LMICs) for the attainment of better health, seems to be centered on increasing government's expenditure in the healthcare sector. This strategy is in line with that of most developed countries that spend a high proportion of their gross domestic product on healthcare. These increases notwithstanding, the health outlook of the country has not improved significantly and remains below the country targets and internationally set benchmarks. These poor health indices for Nigeria may portend that increasing government's expenditure on health alone may not be sufficient for improving health outcomes including life expectancy. Pertinent issues around the socioeconomic determinants of heath persist including inequality, poverty and other conditions individuals are born and raised in.

Health is said to be determined by a host of socioeconomic, biological, cultural and environmental factors [3]. At the macro level, population health is believed to be correlated with the levels of national income, per capita income, health expenditures by government, investment in health, availability of infrastructure, resource allocation, poverty to mention a few. On the other hand, factors such as household income, assets holdings, education, social class, gender, race, behavioural and biological factors, psychosocial factors and environmental conditions including sanitation, urbanization and access to clean water determine individual health at a micro level [3,4,5,6,7,8].

Good health and access to healthcare, have been articulated as a right and not a mere privilege in various declarations and publications of the United Nations (Universal Declaration of Human Rights Article 25, Article 12 of the International Covenant on Economic, Social and Cultural Rights (ICESCR) and Millennium Declaration (Sept. 2000). This has placed the responsibility for citizen's health on the government. Governments are therefore, expected to ensure that all their citizens have access to optimum healthcare, so that they can enjoy the highest attainable standard of physical and mental wellbeing. It is on these grounds that; the Federal Government of Nigeria has taken various steps to provide healthcare for her citizens. The first amongst these steps, a comprehensive national health policy in Nigeria, called The National Health Policy and Strategy to Achieve Health for All Nigerians, was promulgated in 1988. It was the operational

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policy document, until there was a general consensus for the review of the policy to accommodate the challenges and peculiarities of the Nigerian health system that had evolved over time. Consequently, the Health Sector Reform Programme (HSRP) was flagged off in 2004. The HSRP had in its purview seven strategic objectives, aimed at facilitating the role of government in making healthcare available. The objectives included: "management of the national health system, the burden of disease, mobilization and utilization of health resources, health service delivery, consumer awareness and community involvement, partnerships, collaboration and coordination" [9]. The HSRP which was operational from 2004-2007 is believed to have recorded some legislative and policy milestones including "the national health policy review, the national health bill and strengthening, the national health insurance scheme" [10]. The National Health Insurance Scheme (NHIS), which is a form of social insurance programme, was established by law in 1999, but was formally instituted and its operations kicked off in year 2005. The scheme is funded by the government, and aims to provide basic health coverage for all Nigerians at affordable costs [11]. The NHIS is at present mostly accessed by Nigerians employed in the public sector and some employees in the organized private sector (OPS), while those in the informal sector, like market women, rural dwellers, the urban poor, other vulnerable population groups and the unorganized private sector are yet to be incorporated into the current structure of the NHIS. These groups alluded to above, are presently not deriving any benefit from the scheme, as they have to foot their medical bills. In 2009, in a bid to tackle some persisting challenges in health care delivery, the Federal Ministry of Health articulated the "National Strategic Health Development Plan (NSHDP) Framework (2009-2015)". This framework was anchored on the "principles of the four ones" which included: "one health policy, one national plan, one budget, and one monitoring and evaluation framework for all levels of government" [12]. The NSHDP resulted from the synchronization of the federal, states and local governments' health strategy, in a bid to promote national ownership, resource mobilization/allocation and mutual accountability by all stakeholders – government, development partners, civil society, private sector communities, amongst others [13]. This framework served as a platform for attaining the MDGs through its attendant strengthening of the National Health Systems. The unimpressive health indices is believed to be accounted for by "lack of effective stewardship role of government, disjointed healthcare service delivery, insufficient and inefficient financing, inadequate health infrastructure, skewed distribution of health workforce and poor coordination amongst key players"[12]. Recently, the Federal Government of Nigeria launched the Economic Recovery and Growth Plan 2017-2020. It is anticipated that the implementation of this plan will set the country on a path to attaining a higher life expectancy. This is because it stipulates the achievement of macroeconomic stability and investing in the Nigerian citizen (through investing in health, education, job creation and environmental sustainability) amongst its broad objectives and key execution strategies [38].

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With life expectancy in Nigeria hovering around 52-55 years from 2011-2016, and health care service delivery and standard of living below par, it becomes imperative to improve macroeconomic performance, which may influence life expectancy and make for improved health and well-being in Nigeria. It is against this backdrop that this study investigated the macroeconomic variables that are dominant in determining life expectancy in Nigeria.This is necessary so as to set the country on a path to achieving the targets of the SDGs by 2030 given that the SDGs build on the MDGs, and has good health and well-being as the third goal on its 17-goals agenda by 2030 [2, 40]. The macroeconomic variables examined include income per capita, income inequality, unemployment, inflation, and health investment. We also included two control variables representing the health system and the environment. The rest of the paper is divided into five sections with, section two discussing the literature review and theoretical issues, sections three, four and five present the methods, result, discussion and conclusion respectively.

2. LITERATURE REVIEW AND THEORETICAL ISSUES

2.1 Determinants of health

The World Health Organization [3, 39] lists the determinants of health to include: the social and economic environment, the physical environment, and the person's individual characteristics and behaviours.

In the study of the determinants of health, some macroeconomic variables are believed to influence health outcomes through sundry pathways. The health of a population is usually assessed using indicators of health status, generally known as health outcomes; which refer to changes in health that result from measures or specific healthcare investments or interventions [14]. Health outcomes include indicators such as life expectancy, maternal mortality rate, and under-five mortality rate amongst others.

Although health care can be financed from a combination of different sources including public expenditures (government spending and public insurance schemes) and private expenditure (out-of-pocket payments by individuals and households, expenditure by non-governmental organizations, and expenditure by other private organizations), public health financing demonstrates the commitment of government to make healthcare available and affordable for its citizenry through the amount of resources allocated to the healthcare sector for the production of health. Health financing by government is usually measured by government's expenditure on health, and can be disaggregated into recurrent and capital expenditures on health. Health financing by the government has been widely used in literature to explain health outcomes [15, 16, 17,18, 19]. This is because, it provides an avenue for improving healthcare by providing wider access to healthcare, development of health infrastructure, technology acquisition,

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provision of health insurance, provision of drug subsidies, provision of essential drugs, human capital investment and the provision of vital health services like family planning activities and emergency aid services; thereby reducing morbidity, preventing avoidable death and ultimately reducing mortality. Health financing is of particular interest in the context of this study considering the Abuja Declaration of 2001 where heads of states of Africa Union countries made a commitment to allocate at least 15% of their yearly budget to improvement of the health sector. Ten years after, the World Health Organization reports that only Rwanda and South Africa lived up to this commitment.

The income of individual or household is believed to affect health outcomes since higher levels of income permit increased expenditure in health optimizing activities, improved standards of living and housing conditions, adequate nutrition, access to, and consumption of high-quality goods and services which influence health positively. Per capita income has been used in studies like [15,16, 17] to explain variations in health outcomes.

Unemployment limits access to health services due to the inability to pay for healthcare services needed by individuals, infants, children, and pregnant women. Also, the situation of unemployment impacts the quality of life, nutrition and the psychological health of individuals. This contributes to high suicide rates, which reduces life expectancy. Empirical studies like [15, 17, 20, 21, 22] found associations between health and unemployment. Unemployment can be measured by unemployment rates or the claimant count. However, the most widely used measure of unemployment is the unemployment rate.

The Inflation phenomenon is typically accompanied by increase in the general price level, which decreases the purchasing power of money. Consequently, inflation affects health outcomes through the cost of health services. A high rate of inflation leads to high cost of healthcare services, drugs and other health inputs which in turn hampers the use of these services due to inability to pay for these services. This results in low utilization of available health facilities and services, increased patronage of quacks, low standard of living and poor nutrition, amongst others, which contribute to high death rates. Inflation can be measured by consumer price index (CPI), producer price index, retail price index, commodity price index, core price indices, GDP deflator amongst others. Inflation has been used in studies like [21, 22, 23, 24] to explain variations in health outcomes.

Income inequality affects health, since the income inequality hypothesis holds that health outcomes for a community worsen as the gap between rich and poor individuals in the community increases [25, 26, 27]. Thus, the higher the income inequality, the more negative the health outcomes. Income inequality has been used in empirical studies like [16, 28, 29] to investigate variations in health outcomes. The measures of income inequality include, but are not

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limited to, the Theil's statistic, Gini coefficient, Coefficient of variation, McLoone Index, and Range ratio.

The health system is regarded as an important determinant of health outcomes. It is because it shows how effectively the resources made available to the health sector are put into use for the attainment of better health outcomes [16,21]. The health system can be measured by the coverage rate of immunisation, number of hospital beds, number of physicians per 1,000 people, availability of skilled birth attendants and other categories of health personnel, to mention but a few.

The environment has been considered to be a major determinant of health. Environmental conditions like increased emission of greenhouse gases, poor air quality and air pollution, congestion, poor sanitation, lack of basic amenities, amongst others exert a considerable impact on health outcomes [26]. Carbon dioxide emissions from the burning of fossil fuels, manufacture of cement, gas flaring, consumption of solid, liquid and gas fuels, cause air pollution, which constitutes health hazards and may lead to respiratory tract diseases, lung infection as well as lead poisoning. The environment has been measured by level of urbanization, carbon dioxide emissions, and sanitation conditions amongst others. Environmental variables have been used in empirical studies like [15, 16, 19], to explore the determinants of health outcomes. Other variables believed to influence health outcomes include poverty, food availability, education, crime rate, population, fertility rates, amongst others.

[19] using the Grossman (1972) theoretical model, and the Two-way random effect regression technique found a negative relationship between health expenditure and life expectancy in sub-Saharan Africa. On the other hand, food availability per capita, literacy rate, a decrease in alcohol consumption, an increase in urbanization and a decrease in Carbon dioxide emissions had a positive relationship with life expectancy. They recommended the inclusion of policies that enforce the marginal efficiency of health services for the improvement of health status.

[15] using GDP per capita, health expenditure, food production index, employment ratio, education index, measles immunization coverage rate, urbanization, and carbon dioxide emission as explanatory variables, explored the determinants of life expectancy in the Eastern Mediterranean Region (EMR). Estimating a Health Production Function using a fixed effect model and panel data for 21 EMR countries, their findings showed that GDP per capita, food availability, employment ratio, education, and urbanization had a positive effect on life expectancy, while health expenditure, measles, immunization coverage rate, and carbon dioxide emission showed no significant relationship with life expectancy.

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The study by [18], investigated the determinants of public health outcomes (life expectancy at birth) using data sourced from 80 countries including Argentina, Canada, Germany and Kenya from years 1961 to 1995, and taking into consideration explanatory variables including Physician per thousand, adult illiteracy rate, sanitation, GDP per capita, tertiary education enrolment rate, primary and higher education attainment rate. They employed the instrumental variable and ordinary least squares estimation techniques. Their results showed that, public health inputs such as sanitation, have positive impact on health outcomes, and that, education was important for determining health outcomes. [30] in their empirical study, explored the factors affecting the production of health (life expectancy) in Iran. They used per capita income, immunization rate and share of expenditure on education (as percent of GDP) as explanatory variables. Following the estimation of their model using the Johansen-Juselius cointegration and error correction model, their result showed that all the explanatory variables included in the model had positive and significant effect on life expectancy with immunization having the largest magnitude of effect.

2.2 Theoretical framework

Production theory and the health production function

The production theory describes the relationship between factors of production and the output of goods and services for the derivation of utility. [31] holds that "a production function is purely a technical relationship, which connects factor inputs and outputs". [32] sheds more light on this, by explaining that, it is usual in Economics to speak of firms "producing" their output by combining "factor inputs"; the correlation linking these inputs to the final output is known as the "production function". The theoretical household health production function developed by [5] draws from this concept, and thrives on the basis that health is contingent on a range of factors, some of which can be induced by the individual; implying that health can be produced. Secondly, health is considered a consumption good due to its entering the utility function of individuals, since utility increases in optimum health conditions; and as an investment commodity, since it is a determinant of the total amount of time available for productive activities, which yield income or wealth. Thus, the theoretical household health production function was developed to account for the gap between health as an output and medical care as one of many inputs into its production. The health production function is defined by [33] as, "a function that describes the relationship between combinations of medical and non-medical inputs and the resulting output", and depicts a scenario where an individual/government produces his/its health (outcome/output) by combining health inputs, which could include various medical and non-medical variables [32]. Furthermore, the health production function links these inputs to outputs, and shows how much health can be acquired "from a given quantity of health input, for

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a given state of technical knowledge" [32]. The health production function has been criticized by [34] on the grounds of being instinctive, since it is a truism that, "people contribute to their longevity through health maintenance activities. Also, the additions that people make to their longevity (through these health maintenance activities) are limited by resource availability and by the technology available to produce health"

3.0 METHOD

The study investigated the extent to which variations in these macroeconomic variables affect the life expectancy in Nigeria using the ex post study design given that the macroeconomic variables that affect life expectancy had already occurred before the study was undertaken.

3.1 Data/Variables

This study utilized annual time series data from 1980-2015 extracted from secondary sources such as, the Central Bank of Nigeria (CBN) Statistical Bulletin, Abstracts of Statistics, World Health Organization, World bank world development indicators, academic publications from the Internet, and publications from health institutions in Nigeria. Information obtained from these sources were used in the data analyses. Data analyses were performed using the EViews 9 statistical software.

3.2 Description of variables

a. Income per capita

Individual and household income, have implications on the health outcomes of individuals. Higher individual/household incomes promote better health, through ability to afford healthy lifestyle and adequate nutrition, improved housing conditions, improved environmental and sanitation conditions, access to clean water, the ability to pay for health services and other social amenities, just to mention a few. This implies that health outcomes improve with increases in household income. Income per capita is measured in this study by per capita GDP.

b. Unemployment rate

Unemployment rate is an indicator of how well the economy is faring, relative to its productive potential. Employment opportunities in an economy provide individuals with windows to earn income. This has direct consequences on the quality of life led by individuals and their dependents, their ability to afford basic health services and good nutrition, which have considerable effects on the health of individuals. This implies that health outcomes worsen with high unemployment rates. In this study, unemployment is measured by the unemployment rate.

c. Inflation

The rate of inflation in an economy is believed to affect the prices of healthcare services and cost of drugs. A high rate of inflation leads to high cost of healthcare services, drugs and other health inputs which in turn hampers the use of these services due to inability to pay for them. This results in low utilization of available health facilities and services, increased patronage of quacks, low standard of living and poor nutrition, amongst others, which contribute to high death rates. This implies that health outcomes worsen with high inflation rates. Inflation is measured in this study by the consumer price index.

d. **Income inequality**

Income inequality affects health outcomes, because according to the income inequality hypothesis, health outcomes for a community worsen as the gap between rich and poor individuals in the community increases. Thus, the higher the income inequality, the more negative the health outcomes implying that health outcomes worsen with high levels of income inequality. Income inequality is measured in this study by the Gini coefficient. The Gini coefficient was chosen because it is generally considered as a gold standard amongst other measures of income inequality. It is also easy to interpret.

e. Health investments

Health investments undertaken by government is indicative of the government's commitment to the development of the health sector in the form of the share of GDP spent on health as well as the availability of resources and inputs for the production of health. This includes costs of building hospitals, health insurance, acquisition of medical technology and equipment, amongst others. Health investment is measured in this study by government's capital expenditure on health. This is because, capital expenditures mainly comprise of the costs of acquiring and maintaining fixed assets like, hospital buildings and other infrastructure needed for the efficient functioning of the health system. This implies that health outcomes improve, if an increased proportion of the country's GDP is spent on healthcare.

f. Health service delivery

Health service delivery through the health system is important for health outcomes, and is reflective of the effectiveness of the health sector. In this study, the health system is proxied by physician per 1,000 population. This is because, physician per 1,000 population is one of the indicators of the manpower capacity of the health sector and shows the ratio of the population

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that have access to skilled medical personnel for their health needs. This implies that health outcomes improve with increases in the number of physicians per 1,000 population.

g. **The environment**

Environmental conditions like sanitation, air pollution, have considerable impact on the health of the populace. This implies that health outcomes worsen with high rates of environmental pollution. The environment is proxied in this study by carbon dioxide emission, because this gives a measure of the exposure of individuals to health hazards, especially due to air pollution, which is a serious problem in Nigeria.

h. Education

Education is believed to influence health outcomes, since it enhances knowledge and improves the health-seeking behaviour of the populace. This makes them more informed on the need to adopt healthy lifestyles; makes them amenable to embracing practices and lifestyles that improve health, and causes them to patronize the available health services; which invariably improve health outcomes. This implies that health outcomes improve with higher literacy rates.

3.3 Model specification

The econometric model deployed in this study, is founded on the Theory of Production, and structured after the Health Production Function developed by [5]. The Health Production Function was chosen because it makes for the modelling of health (health outcomes) as a product of macroeconomic variables (inputs), linking these inputs to outputs, and showing the quantity of health can be acquired from a given quantity of health inputs. It is also preferred on the basis that, it has been widely used in empirical studies to investigate the determinants of health outcomes at regional, cross-country and national levels [15, 16, 17, 19, 21, 35].

The mathematical form of the general model specified in this study is:

$$H = f\,(GDPPC, UMPR, INF, GI, GCHEXP, PHP, CO, ALR) \ldots\ldots\ldots\ldots\ldots \quad (3.2)$$

The empirical form of the model is specified as:

$$H = a_0 + a_1\,GDPPC + a_2\,UMPR + a_3\,INF + a_4\,GI + a_5\,GCHEXP + a_6\,PHP + a_7\,CO + a_8 ALR + u) \ldots\ldots\ldots\ldots\ldots \quad (3.3)$$

Using the log-linear regression model to express the variables in order to generate elasticities, the model is specified as:

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$LogH = a_0 + a1logGDPPC + a_2UMPR + a_3INF + a_4logGI + a_5logGCHEXP + a6logPHP + a_7logCO + a_8ALR + u)$……………………………..……. (3.4)

where:

H = health outcome (life expectancy)

GDPPC = income per capita in Naira

UMPR = unemployment rate in percentage

INF = consumer price index in percentage, used as proxy for inflation

GI = Gini coefficient, used as proxy for income inequality

GCHEXP = government's capital health expenditure in millions of Naira, used as proxy for health investment

PHP = physician per 1,000 population, used as proxy for health system

CO = carbon dioxide emission index in metric tons per capita, used as a proxy for measuring the extent to which the environment is pollution-free

ALR = adult literacy rate in percentage, used as a proxy for education

a_0 = the intercept

a_1 to a_8 = coefficients of the independent variables (unknown parameter) slopes

Log = natural logarithm

u = error term.

In the equations specified above, H is the dependent variable and was proxied in subsequent models by life expectancy (LE) in years. Life expectancy rate measures the general health outlook across gender.

The life expectancy equation estimated in this study is specified as:

$LogLE = b_0 + b1logGDPPC + b_2UMPR + b_3INF + b_4logGI + b_5logGCHEXP + b6logPHP + b_7logCO + b_8ALR + u)$…………………….……………. (3.5)

In line with economic theory, literature reviewed in this study, and the explanation of the variables above, GDPPC, GCHEXP, PHP and ALR are expected to have positive coefficients,

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because life expectancy increases with increases in GDPPC, GCHEXP, PHP and ALR, while UMPR, INF, GI, and CO are expected to have negative coefficients because life expectancy decreases with increases in UMPR, INF, GI, and CO. Thus the *a priori* expectations notation is given as:

$b_1>0; b_2<0; b_3<0; b_4<0; b_5>0; b_6>0; b_7<0; b_8>0$

3.4 Stationarity test

The Augmented Dickey Fuller (ADF) and Philips Perron (PP) test for unit root was be used to test for stationarity, in order to ascertain if the mean value and variance of the stochastic error term are constant over time.

The hypotheses tested include:

H_0: $\theta <0$ i.e there is a unit root (time series is non-stationary)

H_1: $\theta <0$ i.e there is no unit root (time series is stationary)

Decision rule: if the absolute value of the test statistic is greater than the MacKinnon's critical values, then the null hypothesis (H_o) is rejected in favour of the alternative hypothesis (H_1).

3.5 Co-integration test

A co-integration test was undertaken to test whether the variables have a long-run relationship or are stable over time, as a result of their different order of integration. The Johansen and Juselius (1990) co-integration technique was used to confirm if a long-run relationship exists among the variables. The hypotheses to tested for the co-integration include:

H_0: $\theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$ i.e there is no long-run relationship (no co-integration)

H_1: $\theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq 0$ i.e there is a long-run relationship, (co-integration exists)

Decision rule: if the calculated TRACE and maximum Eigen values are greater than the critical values then the null hypothesis (H_o) is rejected in favour of the alternative hypothesis (H_1) that co-integration exists amongst the variables.

3.6 Error Correction Mechanism

The Error Correction Mechanism (ECM) was deployed to detect the short-term and long-term dynamics of the variables around their stationary equilibrium value. The ECM was utilized in determining the speed of adjustment from short-run to long-run equilibrium. The higher the coefficient of the error correcting factor, the faster the speed of adjustment of the model, from

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short-run disequilibrium to long-run equilibrium. However, the decision rule requires that the error correcting factor be negative and statistically significant.

The ECM for the general health outcomes model (life expectancy) was specified as:

$$\Delta LogH_t = a_0 + \sum_{i=1}^{n} a1i\Delta Log\ LE_{t-i} + \sum_{i=1}^{n} a2i\Delta LogGDPPC_{t-i} + \sum_{i=1}^{n} a3i\Delta UMPR_{t-i} + \sum_{i=1}^{n} a4i\Delta INF_{t-i} + \sum_{i=1}^{n} a5i\Delta Log\ GI_{t-i} + \sum_{i=1}^{n} a6i\Delta Log\ GCHEXP_{t-i} + \sum_{i=1}^{n} a7i\Delta LogPHP_{t-I} + \sum_{i=1}^{n} a8\Delta Log\ CO_{t-i} + \sum_{i=1}^{n} a9\Delta LogALR_{t-i} + \theta ECM_{t-1} + u_{1t} \ldots\ldots (3.8)$$

Given that life expectancy is the measure of health in this study, the ECM is thus given as:

$$\Delta LogLE_t = b_0 + \sum_{i=1}^{n} b1i\Delta Log\ LE_{t-i} + \sum_{i=1}^{n} b2i\Delta LogGDPPC_{t-i} + \sum_{i=1}^{n} b3i\Delta UMPR_{t-i} + \sum_{i=1}^{n} b4i\Delta INF_{t-i} + \sum_{i=1}^{n} b5i\Delta Log\ GI_{t-i} + \sum_{i=1}^{n} b6i\Delta Log\ GCHEXP_{t-i} + \sum_{i=1}^{n} b7i\Delta LogPHP_{t-i} + \sum_{i=1}^{n} b8\Delta Log\ CO_{t-i} + \sum_{i=1}^{n} b9\Delta LogALR_{t-i} + \theta ECM_{t-1} + u_{1t} \ldots\ldots (3.8A)$$

3.7 Estimation technique

The estimation technique adopted in this study is the Ordinary Least Squares (OLS) regression technique, introduced by Carl Friedrich Gauss (1795). This technique was used to undertake a multiple regression analysis. The predilection of this technique is that it is easy to understand, easy to use, simple in its computational procedure, and possesses the BLUE properties of best, linear and unbiased estimator, which are consistent and sufficient.

The OLS regression technique is readily available for use in user-friendly software packages like Eviews, Microsoft Excel, PcGive, and SPSS. Besides, it is easy to understand by non-experts in Econometrics. Also, data requirements for the OLS technique are minimal. The results of this study were evaluated based on the economic *apriori* expectations, statistical tests of significance, and econometric tests.

4.0 RESULTS

4.1 Test for stationarity

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TABLE 1: Results of Unit Root Tests Based on Phillips-Perron (PP) test statistic

Variables	Level	1st difference	Order of Integration
GDPPC	0.222673	-5.592549*	I(1)
UMPR	-1.962080	-6.782529*	I(1)
INF	-2.746546***	-	I(0)
GI	-1.278853	-5.691633*	I(1)
GCHEXP	0.161047	-9.142736*	I(1)
PHP	-1.701855	-4.973391*	I(1)
CO	-1.346433	-8.116336*	I(1)
ALR	-0.137268	-8.936713*	I(1)
LE	-2.513470	3.849720*	I(1)
U5	2.113163	-6.255738*	I(1)
MMR	-1.601072	-5.295476*	I(1)

Test critical value at level: 1%= -3.632900, 5% = -2.948404, 10% = -2.612874
Test critical value at 1st difference: 1% = -3.639407, 5% = -2.951125, 10% = -2.614300

* stationary at 1%
** stationary at 5%
*** stationary at 10%

Source: Author's computation, 2018.

Unit root tests were performed on the variables to determine their time series properties, such as level of stationarity, and to ascertain if the variables have a stable long-run relationship with one another. The results of the Phillip-Perron (PP) unit root test presented in TABLE 1 show that all variables are stationary after first difference, indicating that they are I(1) variables. The stationarity of the variables at the one per cent and five per cent level of significance is indicated by the absolute value of Phillips-Perron test statistic being greater than the absolute critical values; and implies that, a long-run relationship exists between the variables. Thus, the null hypotheses are rejected at one per cent level of significance. The stationarity of inflation rate is also worthy of note since in calculating inflation rate, the consumer price index is differenced to give us the rate of inflation. Thus, the stationarity of inflation rate at level may in reality imply that it is stationarity at first differencing.

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4.2 Cointegration test

The Johansen co-integration test results contained in TABLE 2 shows the existence of long-run relationship between life expectancy, income per capita, unemployment, inflation, income inequality, health investment, physician per 1,000 population, carbon dioxide emission index and adult literacy rate as indicated by the TRACE- Statistic and Maximum Eigen value.

The TRACE-Statistic results revealed that there are five (5) co-integrating equations at the five per cent level of significance i.e., the TRACE-Statistic (loglikelihood) value of the first hypothesized number of co-integrating equations for which the null hypothesis is not rejected, 45.40002 is lower than the critical value 47.85613. Also, the Maximum Eigen value indicates that there are two co-integrating equations at the five per cent level of significance. Therefore, there exists a long run relationship between the variables since there is at least one co-integrating equation. This shows that the regression is not spurious.

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TABLE 2: Johansen Cointegration Test – life expectancy equation

Series: LE GDPPC UMPR INF GI GCHEXP PHP CO ALR

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.981176	364.3152	197.3709	0.0000
At most 1 *	0.904485	229.2462	159.5297	0.0000
At most 2 *	0.723551	149.3982	125.6154	0.0008
At most 3 *	0.632899	105.6834	95.75366	0.0087
At most 4 *	0.537414	71.61138	69.81889	0.0357
At most 5	0.497435	45.40002	47.85613	0.0835
At most 6	0.304422	22.00697	29.79707	0.2981
At most 7	0.206029	9.664553	15.49471	0.3074
At most 8	0.052135	1.820458	3.841466	0.1773

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.981176	135.0690	58.43354	0.0000
At most 1 *	0.904485	79.84799	52.36261	0.0000
At most 2	0.723551	43.71480	46.23142	0.0909
At most 3	0.632899	34.07204	40.07757	0.2031
At most 4	0.537414	26.21136	33.87687	0.3080
At most 5	0.497435	23.39306	27.58434	0.1573
At most 6	0.304422	12.34241	21.13162	0.5142
At most 7	0.206029	7.844095	14.26460	0.3947
At most 8	0.052135	1.820458	3.841466	0.1773

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's computation 2018

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4.3 Presentation and analysis of Error Correction Mechanism results: lag order selection criteria

The lag selection criteria shown in appendix 1 suggested two as the maximum lag period for the variables in the three respective models at the five per cent level of significance. This is as indicated by the LR, FPE, AIC, SC, and HQ criteria selected in each of the models. The study used a maximum lag length of two.

4.4 Presentation and analysis of Error Correction Mechanism results: life expectancy equation

From the over-parameterised regression results for life expectancy model in appendix 2A, the current value and one period logged lag of income per capita (DLOGGDPPC) and (DLOGGDPPC-1), income inequality (DLOGGI), the current value, one period logged lag and two period logged lag of carbon dioxide emissions (DLOGCO, DLOGCO-1, DLOGCO-2), the one period logged lag of government capital health expenditure (DLOGGCHEXP-1) and the one period logged lag of physician per 1,000 population (DLOGPHP-1) were

TABLE 3: Parsimonous Error correction model: life expectancy equation

Dependent variable: D(LOG(LE))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.063925	0.007586	-8.426862	0.0000
D(LOG(CO))	-0.015174	0.003395	-4.470002	0.0002
D(LOG(GDPPC))	0.006214	0.001199	5.183589	0.0000
D(LOG(GI))	0.037138	0.008067	4.603614	0.0001
D(LOG(GDPPC(-1)))	-0.012719	0.003448	-3.689178	0.0012
D(LOG(GCHEXP(-1)))	0.003324	0.001427	2.329542	0.0290
D(LOG(PHP(-1)))	0.017157	0.003110	5.516455	0.0000
D(LOG(CO(-1)))	-0.013941	0.003176	-4.389197	0.0002
D(LOG(CO(-2)))	-0.014424	0.002703	-5.335399	0.0000
ECM(-1)	-0.262431	0.074003	-3.546215	0.0017

R-squared	0.830494	Mean dependent var	0.005083
Adjusted R-squared	0.764166	S.D. dependent var	0.006635
S.E. of regression	0.003222	Akaike info criterion	-8.392642

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Sum squared resid	0.000239	Schwarz criterion	-7.939155
Log likelihood	148.4786	Hannan-Quinn criter.	-8.240058
F-statistic	12.52095	Durbin-Watson stat	1.894357
Prob(F-statistic)	0.000001		

Source: Author's computation, 2018.

significant in explaining life expectancy in Nigeria. We then proceeded to run the parsimonious error correction model including only the significant variables. The result of the parsimonious error correction model is presented in TABLE 3. The results revealed that the coefficient of the ECM bears a negative sign and is statistically significant. This is in line with *a priori* expectation and indicates that it is well behaved. However, the speed of adjustment from short-run disequilibrium to long-run equilibrium is slow as shown by the coefficient of 0.2624. This implies that about 26 per cent of the deviations of life expectancy from equilibrium is corrected in each period. The Adjusted R^2 (Adjusted Co-efficient of determination) of the regression remained high after adjusting for the degree of freedom as shown by the value of the adjusted R^2 = 0.7641 (~76 per cent). This indicates that 76 percent of the total variation in life expectancy can be explained by changes in the independent variables. This signifies that the model has a good fit and high explanatory power. The F-Statistic value of 12.52095 is statistically significant at the 5 percent level of significance as indicated by the corresponding probability value 0.000. This probability suggests that there is no chance at all that the coefficients of the right-hand side variables are all equal to zero, meaning all the independent variables can jointly explain or influence life expectancy. The Durbin Watson statistic (1.89), which is below 2, suggests the existence of positive autocorrelation among the variables. The effect of this autocorrelation may however be described as minimal, since 1.89 is closer to 2 than 0. Also, the value of the Durbin Watson (DW) statistic is greater than the adjusted R^2 value of 0.76, indicating that the model is not spurious.

The results of Akaike and Schwarz criterion (-8.3926 and -7.9391), respectively indicate that the model is a good one, as the lower the value of these criteria, the better the model. The significance of the model using these criteria reveals that the model is not spurious.

Additionally, the results of the Parsimonious ECM also show that a positive relationship exists between life expectancy, and income per capita of the current period (DLOGGDPPC). This is consistent with the *a priori* expectations since a higher income leads to greater access and higher consumption of high-quality goods and services, improved housing conditions as well as better socio-economic conditions which can influence life expectancy positively. On the other hand, the results show a negative relationship between life expectancy and income per capita in the

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immediate past period (DLOGGDPPC-1). This may suggest that income per capita of the previous year may have been inadequate and exerted a dampening effect on life expectancy in Nigeria. The results imply that a 1 per cent increase in the income per capita of the current period will lead to an increase in life expectancy by about 0.0062 percent, while that of the immediate past period led to a decrease in life expectancy by 0.0127. Interestingly, the relationship between income per capita and life expectancy, and the relationship between the one period logged lag of income per capita and life expectancy were statistically significant at the five per cent level of significance, given their probability values of 0.0000 and 0.0012 respectively. Consequently, we reject the null hypothesis in favour of the alternative hypothesis that, income per capita is significant in explaining life expectancy in Nigeria. Hence, income per capita influences life expectancy and is significant in explaining life expectancy in Nigeria within the period of study. This result (current value of income per capita) is similar to the findings of [15, 18, 19, 30, 36], but contrary to the findings of [17, 37].

The positive sign of the proxy for income inequality (gini coefficient (GI)) shows that, a direct relationship exists between life expectancy and income inequality. The results indicate that a 1 per cent increase in the income inequality will result in an increase in life expectancy by 0.0371 per cent. This is inconsistent with the *a priori* expectations since the income inequality hypothesis holds that life expectancy (health outcome) worsens as the gap between rich and poor individuals in a community increases. This inconsistency with the *a priori* expectations may indicate that, despite the high inequality, people were still seeking and getting treatment due to various health interventions. It is believed that various intervention programmes by the government and non-governmental organizations who intervene in healthcare by providing free or subsidized treatment, and other health services for diverse health conditions have helped to ameliorate the health implications of the widening gap between the rich and poor in Nigeria. For instance, the National health insurance scheme (NHIS) has dampened the high out-of-pocket expenditure on health by government employees, the free eye care and surgeries offered by NGOs have contributed to improving the quality of life of individuals that are unable to afford the costs of these services, the free screening and early detection services offered by various NGOs for different forms of cancers have served as a booster for preventive healthcare, to mention but a few. Income inequality was however statistically significant at the five per cent level of significance, given its probability value of 0.0001. Consequently, we reject the null hypothesis that, there is no significant relationship between income inequality and life expectancy in Nigeria. Hence, income inequality is relevant in explaining life expectancy in Nigeria. This finding is contrary to that of [29] who reported a negative and significant relationship albeit on the Health Human Development Index used as a measure of health in their study.

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A negative relationship was found to exist between life expectancy, the current value carbon dioxide emission (DLOGCO- proxy for the environment), between life expectancy and the one period logged lag of carbon dioxide emission (DLOGCO-1) and between the logged value of carbon dioxide emission in the immediate past two periods (DLOGCO-2). The results indicate that at the 5 per cent significance level, a 1 per cent increase in the carbon dioxide emission index will lead to a decrease in life expectancy by about 0.015 per cent in the current period; 0.0139 per cent and 0.0144 per cent after a period of one and two years respectively other variables remaining constant. This is consistent with the *a priori* expectations, since carbon dioxide emissions cause air pollution which constitutes health hazard, and may lead to lead poisoning, lung infection and other respiratory tract diseases inimical to optimum health and well-being. The current value, the one period lagged value and the two period lagged values of carbon dioxide emission were also statistically significant at the five per cent level of significance, given their probability values of 0.0002, 0.0002 and 0.0000 respectively. Consequently, we reject the null hypothesis that, there is no significant relationship between carbon dioxide emission and life expectancy in Nigeria. Therefore, carbon dioxide emission is important in explaining life expectancy in Nigeria. This result negates the findings of [15, 19, 36] who all report positive and insignificant effects.

The one period logged lag of government capital health expenditure (proxy for health investment) has a positive and significant relationship with life expectancy. This means that a one per cent increase in government capital health expenditure will yield a 0.0033 per cent increase in life expectancy after a period of one year. This is consistent with the *a priori* expectations since government's capital expenditure on health is an avenue for improving healthcare by providing wider access to healthcare services, developing health infrastructure, providing subsidies for certain disease conditions, increasing the man power capacity and promoting technology acquisition in the health sector. Government capital health expenditure was also statistically significant at the five per cent level of significance, given its probability value of 0.0290. Consequently, we reject the null hypothesis that, there is no significant relationship between government capital health expenditure and life expectancy in Nigeria. Therefore, government capital health expenditure is relevant in explaining life expectancy in Nigeria within the period of study.

The one period logged lag of physician per 1,000 population (proxy for the health system) has a positive and significant relationship with life expectancy. This is consistent with the *a priori* expectations since having a high physician density is an avenue for improving healthcare by providing broader access to skilled medical personnel and specialized care thereby reducing the patronage of quacks and self-medication, as well as improving general survival rates. The results suggest that a one per cent increase in physician per 1,000 population led to a 0.0171 per cent

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increase in life expectancy after a period of one year. Physician per 1,000 population was also statistically significant at the five per cent level of significance, given its probability value of 0.0000. Consequently, we reject the null hypothesis that, there is no significant relationship between physician per 1,000 population and life expectancy in Nigeria. Therefore, physician per 1,000 population is relevant in explaining life expectancy in Nigeria within the period of study.

5.0 SUMMARY AND CONCLUSION

This study investigated the macroeconomic variables that determine life expectancy in Nigeria. The macroeconomic variables assessed were income per capita, unemployment, inflation, income inequality, health investment. We also introduced two control variables, which included the health system measured by physician per 1,000 population and the environment measured by the carbon dioxide emission index. The null hypotheses that there is no significant relationship between life expectancy and these explanatory variables were tested. Time series data on these variables from 1980-2015 were estimated using the Ordinary Least Squares technique, Error Correction Mechanism and other statistical methods.

Of the macroeconomic variables included in the life expectancy model, income inequality was the largest predictor of life expectancy and accounted for about four per cent of the variations in life expectancy. This highlights the need for income redistribution in the country in other to reduce the disadvantages that arise from inequality gaps. The government could take measures such as progressive taxation, provision of social welfare and transfers, increasing minimum wage, building assets for low-income earners and investing in education, amongst other strategies. The other macroeconomic variables significant in explaining life expectancy are income per capita and government capital expenditure on health. The study therefore underscores the need to raise income levels in Nigeria since higher per capita income is necessary for improving life expectancy. This can be undertaken by diversifying the economy, strengthening the agriculture and manufacturing sectors and creating a conducive macroeconomic environment for small and medium scale enterprises to thrive. This will boost economic growth and expand the income earning opportunities of the country and by extension, the individual longevity in the country. In addition, investing in education and taking measures to control population growth may be beneficial for boosting income levels. There is also need for increased, continuous, and sustained capital investment in health by the government. This capital expenditure could assume the form of development of health infrastructure including health facility and state-of-the-art equipment, provision of free or subsidized health services, expenditure on capacity development of health personnel and expansion of the health workforce. This will provide wider coverage of health care services, improve the quality of health care services rendered, reduce cost of health care services, and curtail the high levels of brain drain in

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the medical sector. In addition, the problem of corruption should be tackled and adequate sanctions placed on individuals and organizations involved in corrupt practices.

We found two non-economic variables viz the environment (proxied by carbon dioxide emission) and the health system (proxied by physician per 1,000 population) to be significant in explaining life expectancy in Nigeria. Given that atmospheric conditions exert negative impact on life expectancy, it is important that legislation that guard against environmental pollution be enacted and enforced. It is also imperative to invest in human resources for health. The employment of more skilled health personnel to man the health sector of the country should be made a top priority by the government in order to improve health outcomes. Regardless of the fact that inflation and unemployment were not significant in explaining life expectancy within the period of study, there is need for the engagement of macroeconomic stabilization policies in other to tame rising costs, create employment opportunities, and aid the establishment of small and medium scale businesses. This will allow individuals afford adequate nutrition, improve their living conditions, reduce the dependency ratio, meet their health care needs and widen the income earning windows of individuals. The findings of this study show that there are other macroeconomic variables that matter for improving life expectancy, and socioeconomic determinants of health be explored for improving life expectancy in Nigeria.

REFERENCES

[1] World Health Statistics (2016). http://www.who.int/gho/publications/world_health_statistics/2016/en/

[2] Nigeria Millennium Development Goals End Report, 2015. Abuja: Office of the Senior Special Assistant to the President. https://www.undp.org/content/dam/undp/library/MDG/english/MDG%20Country%20Reports/Nigeria/Nigeria_MDGs_Abridged_Sept30.pdf

[3] WHO (2016). The determinants of health. http://www.who.int/hia/evidence/doh/en/

[4] Commission on Macroeconomics and Health (CMH 2001). Macroeconomics and health: investing in health for economic development. Geneva: World Health Organization.

[5] Grossman, M. (1972). “On the Concept of Health Capital and the Demand for Health.” *Journal of Political Economy* 80: 223–55.

[6] Kelly, M. P., Commission de l'OMS sur les déterminants sociaux de la santé, & Bonnefoy, J. (2007). *The social determinants of health developing an evidence base for political action*. NHS.

[7] UNESCAP (2007). Achieving the Health Millennium Development Goals in Asia and the Pacific: Policies and Actions within Health Systems and Beyond. United Nations Economic and Social Commission for Asia and the Pacific.

[8] Anyanwu, J.C., & Erhijakpor, E.O. (2007). Health expenditure and health outcomes in Africa. *Economic Research Working Paper Series*. African Development Bank

[9] Federal Ministry of Health Nigeria (2004). National Policy on Health

[10] Bakare A.S., & Sanmi, O. (2011). Health care expenditure and economic growth in Nigeria: An empirical study. *Journal of Emerging Trends in Economics and Management Sciences (JETEMS) 2* (2): 83-87.

[11] National Health Insurance Scheme (NHIS) Report (2004).

[12] Federal Ministry of Health Nigeria (2009). The National Strategic Health Development Plan (NSHDP) Framework (2009-2015).

[13] Ichoku, H.E (2005). The redistributive Effect of Healthcare Financing in Nigeria. A Technical Report Submitted to Poverty and Economic Policy Research Network, University of Laval, Canada.

[14] CIHI (2016). Canadian Institute for Health Information https://www.cihi.ca/en/health-system-performance/quality-of-care-and-outcomes/outcomes

[15] Bayati, M., Akbarian, R., & Kavosi, Z. (2013). Determinants of life expectancy in eastern mediterranean region: a health production function.*International journal of health policy and management*, *1*(1), 65-71.

[16] Kamiya Y. (2010). Determinants of Health in Developing Countries: Cross-Country Evidence. OSIPP Discussion Paper : DP-2010-E-009.

[17] Sede, P., & Ohemeng, W. (2015). Socio-economic determinants of life expectancy in Nigeria (1980 – 2011). *Health Economics Review*, *5*(2).

[18] Ricci, F., & Zachariadis, M. (2006). Determinants of public health outcomes: A macroeconomic perspective. In *Computing in Economics and Finance*, 107.

[19] Fayissa, B. & Gutema, P. (2008). Estimating a health production function for Sub-Saharan Africa (SSA). Applied Economics, 37, 155 - 164.

ISSN: 2455-8834

Volume: 04, Issue: 04 "April 2019"

[20] Grobe, T., & Schwart,z F. W.(2003). Unemployment and Health. Gesundheitsberichterstattung des Bundes. Robert-Koch-Institut Berlin (13).

[21] Imoughele, L.E., Ighata, J.A. & Obasanmi, J.O. (2014). A quantitative analysis of determinants of health outcomes in Nigeria. *Elite Research Journal of Clinical Pharmacy, Medicine and Medical Sciences, 2*(3): 17 – 24.

[22] Williams, C., Gilbert, B. J., Zeltner, T., Watkins, J., Atun, R., & Maruthappu, M. (2016). Effects of economic crises on population health outcomes in Latin America, 1981–2010: an ecological study. *BMJ open*, *6*(1), e007546.

[23] Bourne, P. A. (2009). Inflation, public health care and utilization in Jamaica. *Australian Journal of Basic and Applied Sciences*, *3*(3), 3008-3024.

[24] Salatin P., & Bidari M. (2014). Effects of inflation on women's health in selected middle-income countries. *African journal of health economics xxx 2014 xxx*. E publication ahead of print.

[25] De Maio, F. G. (2014). Income Inequality Hypothesis. *The Wiley Blackwell Encyclopedia of Health, Illness, Behavior, and Society*.

[26] Georgieva, L., & Burazeri, G. (2005). Health determinants in the scope of new public health. *A handbook for teachers, researchers and health professionals. Lage: Hans Jacobs Publishing Company*.

[27] Idrovo, A. J., Ruiz-Rodríguez, M., & Manzano-Patiño, A. P. (2010). Beyond the income inequality hypothesis and human health: a worldwide exploration.*Revista de Saúde Pública*, *44*(4), 695-702.

[28] Olson, M. E., Diekema, D., Elliott, B. A., & Renier, C. M. (2010). Impact of income and income inequality on infant health outcomes in the United States. *Pediatrics*, *126*(6), 1165-1173.

[29] López-Casasnovas, G., & Soley-Bori, M. (2014). The socioeconomic determinants of health: economic growth and health in the OECD countries during the last three decades. *International journal of environmental research and public health*, *11*(1), 815-829.

[30] Agheli, L., & Emamgholipour, S. (2015). Determinants of Life Expectancy at Birth in Iran: A modified Grossman Health Production Function. *European Online Journal of Natural and Social Sciences*, *4*(2), pp-427.

ISSN: 2455-8834

Volume: 04, Issue: 04 "April 2019"

[31] Koutsoyiannis, A. (1979). *Modern Micro-Economics*. Macmillan Press London.

[32] Wagstaff, A. (1986). The demand for health: theory and applications. *Journal of Epidemiology and Community Health, 40*: 1-11.

[33] Smith, C. S. (Ed.). (1992). *Economics and Health: 1992: Proceedings of the Fourteenth Australian Conference of Health Economists*. Public Sector Management Institute, Faculty of Economics and Politics, Monash University.

[34] Mwabu, G. (2007). Health economics for low-income countries. Center discussion paper no. 955. Economic growth center Yale University.

[35] Or, Z. (2000). "Determinants of Health Outcomes in Industrialised Countries: A Pooled, Cross-country, Time-series Analysis". OECD Economic Studies No. 30, 2000/

[36] Delavari, S., Zandian, H., Rezaei, S., Moradinazar, M., Delavari, S., Saber, A., & Fallah, R. (2016). Life Expectancy and its Socioeconomic Determinants in Iran. *Electronic Physician*, *8*(10), 3062–3068. http://doi.org/10.19082/3062

[37] Yaqub, J.O., Ojapinwa, T. V., Yussuff, R.O. (2012). Public health expenditure and health outcome in Nigeria: the impact of governance. *European Scientific Journal. 8,* (13): 189-201.

[38] Federal Ministry of Budget and National Planning (2017). Economic Recovery and Growth Plan (2017-2020).

[39] World Health Organization (1992): *Basic Document*, 39th Edition, Geneva.

[40] UN (2016). Sustainable development goals. *Available online: http://www.un.org/sustainabledevelopment/*

Appendix 1: Lag selection criteria

VAR Lag Order Selection Criteria
Endogenous variables: LE GDPPC UMPR INF GI GCHEXP
PHP CO ALR
Exogenous variables: C
Date: 02/23/18 Time: 13:36
Sample: 1980 2015
Included observations: 34

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Lag	LogL	LR	FPE	AIC	SC	HQ
0	-963.2203	NA	5.56e+13	57.18943	57.59347	57.32722
1	-699.0935	372.8850	1.37e+09	46.41726	50.45763	47.79514
2	-545.8837	135.1851*	61226160*	42.16963*	49.84632*	44.78760*

* 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
HQ: Hannan-Quinn information criterion

Appendix 2: Error Correction Mechanism Results

A: Over-parameterised regression equation results: life expectancy model

Dependent Variable: D(LOG(LE))
Method: Least Squares
Date: 02/23/18 Time: 14:22
Sample (adjusted): 1983 2015
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.085930	0.030783	-2.791520	0.0235
D(LOG(GCHEXP))	0.004307	0.003120	1.380307	0.2048
D(LOG(PHP))	-0.005501	0.004458	-1.234111	0.2522
D(LOG(CO))	-0.021517*	0.008247	-2.609131	0.0312
D(LOG(UMPR))	-0.003019	0.002552	-1.182825	0.2708
D(LOG(GDPPC))	0.008746**	0.004270	2.047982	0.0747
D(LOG(GI))	0.038203*	0.014590	2.618499	0.0307
D(LOG(GDPPC(-1)))	-0.021072*	0.006460	-3.262204	0.0115
D(LOG(UMPR(-	-0.002340	0.002982	-0.784733	0.4552

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1)))				
D(INF(-1))	-3.83E-05	4.95E-05	-0.774940	0.4607
D(LOG(GI(-1)))	0.010353	0.035155	0.294486	0.7759
D(LOG(GCHEXP(-1)))	0.009359**	0.004244	2.205344	0.0585
D(LOG(PHP(-1)))	0.028054*	0.007629	3.677208	0.0062
D(LOG(CO(-1)))	-0.013702*	0.003869	-3.541108	0.0076
D(LOG(ALR(-1)))	-0.012454	0.008202	-1.518399	0.1674
D(LOG(LE(-1)))	-0.067575	0.565138	-0.119572	0.9078
D(LOG(GDPPC(-2)))	-0.003930	0.004856	-0.809305	0.4417
D(LOG(UMPR(-2)))	-0.002085	0.003353	-0.621751	0.5514
D(INF(-2))	-2.33E-05	4.53E-05	-0.513956	0.6212
D(LOG(GI(-2)))	-0.027523	0.018809	-1.463301	0.1815
D(LOG(GCHEXP(-2)))	0.006299	0.004528	1.390909	0.2017
D(LOG(PHP(-2)))	0.004301	0.007418	0.579847	0.5780
D(LOG(CO(-2)))	-0.021265*	0.006922	-3.072310	0.0153
D(LOG(ALR(-2)))	0.009759	0.008586	1.136499	0.2886
ECM(-1)	-0.429422	0.165336	-2.597272	0.0318

R-squared	0.949666	Mean dependent var	0.005083
Adjusted R-squared	0.798663	S.D. dependent var	0.006635
S.E. of regression	0.002977	Akaike info criterion	-8.697752
Sum squared resid	7.09E-05	Schwarz criterion	-7.564034
Log likelihood	168.5129	Hannan-Quinn criter.	-8.316290
F-statistic	6.289052	Durbin-Watson stat	2.460095
Prob(F-statistic)	0.005598		

* significant at 5 per cent

** significant at 10 per cent

Source: Author's computation, 2017

B: Parsimonous Error correction model: life expectancy equation

Dependent Variable: D(LOG(LE))
Method: Least Squares
Date: 02/23/18 Time: 14:29
Sample (adjusted): 1983 2015
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.063925	0.007586	-8.426862	0.0000
D(LOG(CO))	-0.015174	0.003395	-4.470002	0.0002
D(LOG(GDPPC))	0.006214	0.001199	5.183589	0.0000
D(LOG(GI))	0.037138	0.008067	4.603614	0.0001
D(LOG(GDPPC(-1)))	-0.012719	0.003448	-3.689178	0.0012
D(LOG(GCHEXP(-1)))	0.003324	0.001427	2.329542	0.0290
D(LOG(PHP(-1)))	0.017157	0.003110	5.516455	0.0000
D(LOG(CO(-1)))	-0.013941	0.003176	-4.389197	0.0002
D(LOG(CO(-2)))	-0.014424	0.002703	-5.335399	0.0000
ECM(-1)	-0.262431	0.074003	-3.546215	0.0017

R-squared	0.830494	Mean dependent var	0.005083
Adjusted R-squared	0.764166	S.D. dependent var	0.006635
S.E. of regression	0.003222	Akaike info criterion	-8.392642
Sum squared resid	0.000239	Schwarz criterion	-7.939155
Log likelihood	148.4786	Hannan-Quinn criter.	-8.240058
F-statistic	12.52095	Durbin-Watson stat	1.894357
Prob(F-statistic)	0.000001		

