EXPLORING THE EFFECT OF HEALTH ON ECONOMIC GROWTH IN NIGERIA: A VECTOR ERROR CORRECTION MODEL APPROACH

Oladele O. Aluko ✉

Department of Economics, University of Abuja, Nigeria

alukooladele@yahoo.co.uk

Adeniji Sesan Oluseyi

Department of Economics, University of Abuja, Nigeria

adeniji.sesan@yahoo.com

Abstract

This paper seeks to investigate the effect of health on economic growth in Nigeria using secondary data from the period 1980 to 2013. Time series properties of the data was tested with ADF and PP unit root test which was followed by a test of the long run relationship among the variables using Johansen-Juselius cointegration test, VECM and granger causality test. The result of the unit root test revealed that all the variables were stationary at first difference i.e I(1) while Schwarz Information Criterion (SC) confirmed the appropriateness of two lag length and the trace statistic and the max-Eigen statistic Johansen cointegration test both revealed the existence of five cointegrating equation. The VECM result showed that all the explanatory variables were in line with the a priori expectation and the model satisfied the stability condition while the granger causality result depicts a uni-directional relationship between health indicators and economic growth in Nigeria. Therefore, it was suggested that government should increase the allocation of fund to the health sector and develop strategies for the monitoring of the disbursement of such fund as well as increase the awareness of the availability of various health services to the society.

Keywords: Public health, Economic Growth, Cointegration, VECM and Granger Causality

INTRODUCTION

Every economy (developed and developing) countries are guided by macroeconomic objectives such as; economic growth, full employment, price stability, balance of payments stability, care for the environment and an equitable (fair) distribution of income. Macroeconomic policy is aimed at achieving these objectives, with either of them usually selected as the main priority. However, irrespective of the priority taken up by the policy makers among these macroeconomic objectives, the achievement of the economic growth objective is still very fundamental while other objectives will therefore be directed to achieving it. In other words, if the prioritized macroeconomic objective(s) of the government could not at the end lead economic growth, it can simply be referred to as a failed pursuit or policy. Therefore, economic growth is an increase in a country's real level of national output which can be caused by an increase in the quality of resources such as education, health, technology etc. Put differently, it is an increase in the value of goods and services produced by every sector of the economy. Economic Growth can be measured by an increase in a country's gross domestic product (Todaro, M. P., 1999).

A Real economic growth only comes from increasing quality and quantity of the factors of production, which consist of four broad types: land, labour (human capital), capital and entrepreneurship. Hence, effective and efficient utilization of land labour and capital requires optimal combination of these factors by the human capital. Therefore, human capital plays a significant role in achieving economic growth through ensuring right combination of factors of production in the production process. Consequent to the significance of human capital in coordinating resources to achieve economic growth, it is pertinent to examine labour's health which, without reservation determines the level of productivity of the labour.

According to (Lilliard and Weiss, 1997), health is one of the most important assets a human being has. It permits us to fully develop our capacities. If this asset erodes or it is not developed completely, it can cause physical and emotional weakening, causing obstacles in the lives of people. In our time, it is possible to say every person could expect to live a long and healthy life which its economic value is huge and the health gains had the economic consequences of widespread economic growth, while an escape of ill-health traps in poverty (World Health Organization, 1999). But also, health problems could be reflected as reductions and obstacles for economic progress. In the account of the work of (David, E. B., et al, 2004), he maintained that, healthier workers are physically and mentally more energetic and robust. They are more productive and earn higher wages. They are also less likely to be absent from work because of illness (or illness in their family members). Illness and disability reduce hourly

wages substantially, with the effect being especially strong in developing countries, where a higher proportion of the work force is engaged in manual labour than in industrial countries.

In explaining the channel through which health affects the level of output in a country (David N. Weil, 2005) used a channel called the proximate or direct effect of health and explained that healthier people are better workers. They can work harder and longer, and also think more clearly. He also maintained that, beyond this proximate effect of health, there are a number of indirect channels through which health affects output. Improvements in health raise the incentive to acquire schooling, since investments in schooling can be amortized over a longer working life. Healthier students also have lower absenteeism and higher cognitive functioning, and thus receive a better education for a given level of schooling. Improvements in mortality may also lead people to save for retirement, thus raising the levels of investment and physical capital per worker. Physical capital per worker may also rise because the increase in labour input from healthier workers will increase capital's marginal product. The effect of better health on population growth is ambiguous. In the short run, higher child survival leads to more rapid population growth. The rate of economic growth, increase in social infrastructures and natural resources are far-reaching in population growth rate (Aluko and Areo, 2011). Over longer horizons, however, lower infant and child mortality may lead to a more-than-offsetting decline in fertility, so that the Net Rate of Reproduction falls (Bloom and Canning [2000], Kalemli-Ozcan, Ryder, and Weil [2000]). At a much longer horizon, (Acemoglu, Johnson, and Robinson, 2001) argue that the poor health environment in some parts of the world led European colonizers to put in place extractive institutions which in turn reduce the level of output today. However, it can be deduced that, both the direct and indirect channels of health uses human capital as a link to affect economic growth.

There are plethoras of studies on economic growth and which larger percentage of these studies had examined the relationship between macroeconomic fundamentals and economic growth, while other empirical studies identify human capital development as a link to economic growth narrowly with education. This practice ignores strong reasons for considering health to be a crucial aspect of human capital, and therefore a critical ingredient of economic growth (David, E. B., et al 2004). Hence, the consciousness of this fact is the birthplace of the passion for this study. However, analyses of the relationships between health and economic growth can be conducted at the individual level, at regional levels within a country, and at aggregate level for a country's aggregate data. Consequently, this study examines the impact of health on economic growth in Nigeria using some determinants of health for the period of 1980 – 2013. Therefore, the remains of this paper are organized as follows. Section II discusses previous literature that has examined the association between health and economic growth. Section III

presents a framework for analyzing how health affects economic growth, model specification as well as the various techniques of analysis. Section IV present and discuss results from the empirical, while section V concludes the paper.

LITERATURE REVIEW

Empirical evidence abounds on various channels through which health affects economic growth in the literatures. The major channels mostly considered are the inputs into health and health outcomes, while notable link between health and economic growth still results from the aftermath effect of health outcome on the human capital.

Inputs into health are the physical factors that influence an individual's health and these include nutrition at various points in life (in utero, in childhood, and in adulthood), exposure to pathogens, and the availability of medical care while, Health outcomes are characteristics that are determined both by an individual's health inputs and by his genetic endowment. Examples include life expectancy, height, the ability to work hard, and cognitive functioning. Human capital in the form of health represents how health affects ability to improve output (David N. W., 2005). Hence, we present the empirical evidences for this study in line with the above assertions as follows.

On the effect of health input on economic growth(Alderman, et. al, 2006) examined the long-run effects of childhood nutrition, using a variety of natural and manmade experiments that provide exogenous variation in nutrition and found that better nutrition leads to improvements in school completion, intelligent quotient (IQ), height, and wages. Similarly, Thomas et al. (2004) found positive effects of adult nutrition on labour input and wages.

Using different household survey indicators of adult nutrition and health, (Schultz, 2005) examines the impact of health on total factor productivity. Study finds that better health human capital have a significant and positive impact on wages and workers productivity. Study finds the developing countries often lack the resources for investment in health; on the other hand poor health status slows down the economic growth.

Developing countries seems to be in a vicious cycle resulting in persistent underdevelopment.

Fogel (1994) concludes that approximately one third of income growth in Britain during 1790-1980 may be credited to improvements in health facilities and better nutrition. Study also concludes that public health and medical care must be recognized as labour enhancing technological change.

Focusing on health outcomes rather than health inputs, (Barro, 1996; Bhargava et. al. 2001; Bloom, et al. (2000), Bloom and Malaney (1998), Bloom et al. (1999) present regressions

of GDP per capita, GDP growth, or TFP on some measure of health outcomes, as well as a standard set of controls. Some of the studies reached similar quantitative results. Growth effect of increasing life expectancy by 5 years from the studies ranged between 0.006 (Sachs and Warner, 1997) to 0.58 (Barro and Lee, 1994).

By using the adult survival rate as an indicator of health status, Bhargava, et al. (2001) finds positive relationship between adult survival rate and economic growth. Results remain similar when adult survival rate is replaced by life expectancy.

Mayer (2001) also used the probability of adult survival by gender and age group as a measure of health status. By using Granger-type, causality test study concludes that health status causes economic growth in Latin America generally, and specifically in Brazil and Mexico. Improvements in adult health are associated with 0.8–1.5 percent increase in annual income. Moreover, the growth impact is higher for improvements in health of female compared with health of male.

Bloom, et al. (2004) by using 2SLS technique finds that life expectancy and schooling have a positive and significant effect on GDP. Improvements in health increase the output not only through labour productivity, but also through the Capital accumulation. Study also finds that improvement of one year in a population's life expectancy resulted into an increase of 4 percent in output.

By using the average height adult survival rate and life expectancy as an indicator of health status (Weil, 2005) found that health is an important determinant of income variations in different countries. Approximately 17-20 percent of the cross country variation in income can be explained by cross-country differences in status of health.

Arora, (2001) uses the life expectancy at birth, at ages; five, ten, fifteen, twenty, and structure of adulthood as health indicators for 10 industrial countries. Study concludes that improvement in health status has increased the pace of long-term economic growth by 30-40 percent. It also concludes that high rate of disease prevalence and deaths are among the main reasons for poor long-term growth in developing countries.

Lorentzen, *et al.* (2005) analyzed the impacts of adult mortality rate on economic growth. Study finds that high mortality rate reduce the economic growth by curtailing the time horizon. Resultantly people take actions that yield short-term benefits at the long term cost. The study also concludes that fertility, investment in physical and human Capital, are the channels through which adult mortality rate affects economic growth.

Gyimah-Brempong (2004) finds that investment (health expenditure) and stock (child mortality rate) of health human capital have a positive and significant relationship with growth of per capita income. However, the relationship is quadratic. Study concludes that investment in

health in LDCs will boost the economic growth in the short run and increases the level of income in the long run because investment in health becomes a part of Stock of human capital.

While analyzing the contribution of health by measuring it by the survival rate of males between age 15 and age 60 in economic growth, Jamison (2003) finds that better health accounted for about 11 percent of growth. Study concludes that investment in physical capital, education and health plays critical role in boosting the economic growth.

Measuring health status by infant mortality rate, life expectancy rate and crude health rate and per capita GNI as indicator of economic growth, Malik (2005) finds that if OLS is used then there is no significant relationship between health status and economic growth. However, when 2SLS is used then study finds highly significant effect of health indicators on economic growth.

Scheffler (2004) argues that health may not be treated as output (life expectancy, adult survival rate etc.), but it needs to be treated as input (health expenditure). Study finds that elasticity of health care spending with respect to GDP is greater than one. This means that if GDP increases by 10 percent then healthcare spending goes up by more than 10 percent. Consequently, developed countries spend more on health as compared to developing countries. Zon (2001) concludes that good health is a necessary condition for people to be able to provide labour services. Study finds that an increase in the demand for health services caused by an ageing population will negatively affect the economic growth.

Tallinn (2006) used adult mortality rate, fertility rate and life expectancy to analyze the economic costs of ill health along with economic benefits from improving it for Estonia. Study finds that fertility rate and adult mortality rate have a significant and negative impact on both OLS and Fixed effect model specification. Moreover By using survey data Study also concludes that ill health has a statistically robust and negative impact on labour supply and productivity at the individual level.

In an empirical analysis, Bloom et al. (2001) followed the Solow model with human capital. Although they find that health capital is a significant variable for economic growth under the two-stage least squares method, key variables such as capital and schooling are not significant; therefore, the results are questionable. For Latin America, there is a series of technical research documents of public health developed by the Pan American Health Organization, which find a strong correlation between economic growth and the regional health, estimating regressions similar to (Barro's, 1996) where health is much more robust than schooling (Mayer, et al. 2000).

Studies on the aftermath of health outcomes revealed that, the relationship between health and labour has been deeply studied. (Bloom and Canning, 2000) described how healthy

populations tend to have higher productivity due to their greater physical energy and mental clearness. Likewise, (Strauss and Thomas, 1998) reviewed the empirical evidence of the relationship between health and productivity, establishing correlations between physical productivity and some health indicators. They focused particularly on those related with nutrition or specific diseases.

Hence, given the above account of empirical literature on the link between health and economic growth is a pointer to the fact that, undertaken such study in the context of Nigeria is highly imperative as little or no study has been carried out to reflect the peculiarity of the country in the previous period.

RESEARCH METHODOLOGY

Theoretical Model

In the models developed to integrate impact of human capital as a determining factor of economic growth, (Romer, 1990,1991) have accentuated that human capital is the most important factor in determining economic growth.

Hence, considering the spotlight of this study, human capital is therefore separated into two parts namely, health human capital (HHC) and other forms of human capital i.e. education human capital (EHC).

Per capita income(Y) is assumed as a function of the stocks of physical capital (SPC), health human capital (HC), education human capital (EHC) and other variables (U) that include technology and other environmental variables.

$Y = f$ (SPC, HHC, EHC, U)……………………………………………………………. (3.1)

Y is per capita GDP, HHC is health human capital, EHCis Education human capital and U is all other explanatory variables. HHC in time t is the sum of the stock of health human capital in the previous period and accumulation to the stock in the current period. It is assumed that accumulation in the health human capital stock (HHC) depends on the amount of resources devoted to health care and the efficiency by which this expenditure is converted into health stock. It was further assumed that quantity of resources devoted to health investment is a product of the proportion of income devoted to health care (YHHC) and the level of income. The stock of health human capital evolves in the following way

$HHC_t = HHC_{t-1} + \Delta HHC_t$, and, ………………………………………………….…(3.2)

$\Delta HHC = \delta Y_{HHC} Y$ …….…………………………………………….…………..(3.3)

Where,δ is the productivity parameter of health expenditure and all other variables. Theability to transform health expenditure into health stock is assumed to be dependent on thestock of health human capital.

Hence, the health technology equation can be written as;

$$\delta = \delta (HHC) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(3.4)$$

Substituting equation 3.4 into the equation 3.3 and that in turn into the production function, the incomegrowth equation become.

$$Y = y(\Delta HHC + \Delta K + HHC_{t-1} + U) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.5)$$

Model Specification

Following the assertion of Akram, (2009), in order to determine relationship between health and economic growth, different health variables can be used and these can be categorized into two indicators namely; health input indicators and health output indicators. Health input indicators comprises of expenditure on health services, availability and quality of health facilities etc. While health output indicators includes life expectancy, Infant mortality rate and Adult survival rate, fertility rate etc.

Given the dearth of the time series data of Nigeria in this regard, the model used by (Naeem Akram, 2009) was adapted. Therefore, life expectancy, fertility rate and Infant mortality are used as health indicators, while health expenditure as percentage of GDP is used as the major output variable. The independent variable of the model is Per capita GDP and is used as a proxy for economic growth. Hence, their functional relationship is presented below;

$$PC\_GDP = f(LE, FR, IMR \ \& \ HE\_GDP)\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(3.6)$$

Where,

PC_GDP = Per Capital Gross Domestic Product

LE = life Expectancy Rate

FR = Fertility Rate

IMR = Infant Mortality Rate

HE_GDP = Health Expenditure as a percentage of GDP

Equation 3.6 in its explicit for is given as thus;

$$PC\_GDP = \alpha + \beta_1 LE + \beta_2 FR + \beta_3 IMR + \beta_4 HE\_GDP + \mu\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(3.7)$$

Where,

α is the intercept of the equation

$\beta_1 - \beta_4$ are the coefficients of the variables, and

μ is the error term.

The data

This study is based on secondary date. The data used in the study were sourced from the World Development Indicator (WDI), 2013.

Estimation Techniques

Unit Root Test

Stationarity is defined as a quality of a process in which the statistical parameters (mean and standard deviation) of the process do not change with time (Challis and Kitney, 1991).The assumption of the classical regression model necessitate that both the dependent and independent variables be stationary and the errors have a zero mean and finite variance. According to (Granger and Newbold, 1974) the effects of non-stationarity include spurious regression, high R^2 and low Durbin-Watson (DW) statistic. Below are basic reasons why data must be tested for non-stationarity.

First, the stationarity or otherwise of a series can strongly influence its behaviour and properties, for instance, persistence of shocks will be infinite for non-stationary series. Secondly, if two variables are trending over time, a regression of one, on the other hand, could have a high R^2 even if the two are totally unrelated and this is known as spurious regressions. Thirdly, if the variables in the regression model are not stationary, then it can be proved that the standard assumptions for asymptotic analysis will be invalid. In other words, the usual "t-ratios" will not follow a t-distribution, so it is impossible to validly undertake hypothesis tests about the regression parameters (Bowerman and O'connell, 1979).

Augmented Dickey-Fuller (ADF) test

The augmented dickey fuller test modifies the work done by Dickey and Fuller 1979 and 1976 respectively. The aim of the Dickey Fuller theory was to test the hypothesis that $\delta = 1$ in:

$$Y_t = \delta Y_{t-1} + \mu_t \quad \text{...(3.8)}$$

Thus, the hypotheses are formulated:

H_0: Series contains a unit root

H_1: Series is stationary.

The rejection of the null hypothesis under these tests means that the series do not have a unit root problem.

The standard Dickey Fuller test estimates following equation:

$$\Delta Y_t = \beta_1 + \beta_2 \delta Y_{t-1} + \mu_t \quad \text{...(3.9)}$$

Where Y_t is the relevant time series, Δ is a first difference operator, t is a linear trend and μ_t is the error term. The error term should satisfy the assumptions of normality, constant error variance and independent error terms. According to Gujarati (2004) if the error terms are not independent in equation (3.9), results based on the Dickey-Fuller tests will be biased.

The weakness of the DF test is that it does not take account of possible autocorrelation in the error process or term (μ). Clemente, et al (1998) noted that a well–known weakness of the

Dickey–Fuller style unit root test with I(1) as a null hypothesis is its potential confusion of structural breaks in the series as evidence of non-stationarity.

Blungmart, (2000) stated that the weakness of the Dickey-Fuller test is that it does not take account of possible autocorrelation in error process, μ_t. If μ_t is auto-correlated, then the OLS estimates of coefficients will not be efficient and t-ratios will be biased. In view of the above mentioned weaknesses the Augmented Dickey-Fuller test was postulated and is preferred to the Dickey-Fuller test.

The presence of serial correlation in the residuals of the Dickey-Fuller test biases the results (Mahadeva and Robinson, 2004). When using the Dickey-Fuller test the assumption is that the error terms μ_t are uncorrelated. But in case the μ_t are correlated, Dickey and Fuller developed a test, known as the Augmented Dickey-Fuller test to cater for the above mentioned problem.

The Dickey-Fuller test is only valid where there is no correlation of the error terms. If the time series is correlated at higher lags, the augmented Dickey-Fuller test constructs a parameter correction for higher order correlation, by adding lag differences of the time series. The Augmented Dickey-Fuller test estimates the following equation:

$\Delta Y_t = \beta_1 + \beta_2\delta\, Y_{t-1} + \sum_{i=1}^{n} \Delta Yt - 1 + \mu_t$ …………………………………………………...3.10.

Where μ_t is a pure white noise error term and where $\Delta Y_{t-1} = (\ Y_{t-1} - Y_{t-2},\ )$, $\Delta Y_{t-2} = (\ Y_{t-2} - Y_{t-3},\ )$, etc. According to Gujarati (2004) the number of lagged difference terms to include is often determined empirically, the idea being to include enough terms so that the error term in (4.5) is serially uncorrelated. In ADF as in DF the test is whether $\delta = 0$ and the ADF test follows the same asymptotic distribution as the DF statistic, so the same critical values can be used.

The calculated value of ADF is then compared with the critical value; if the calculated value is greater that the critical, we reject the null hypothesis that the series have unit root, thus confirming that the series are stationary.

In a nutshell Gujarati (2004) states that an important assumption of the DF tests is that the error terms μ_t are independently and identically distributed. The ADF test adjusts the DF test to take care of possible serial correlation in the error terms by adding the lagged difference terms of the regressand.

Phillips-Perron (PP) Tests

The Phillips-Perron tests are more comprehensive theory of unit root non-stationarity. Gujarati (2004) stated that the Phillips-Perron use non-parametric statistical methods to take care of the serial correlation in the error terms without adding lagged difference terms. According to Brooks (2008) the tests are similar to ADF tests, but they incorporate an automatic correction to the DF

procedure to allow for auto correlated residuals. The PP test and the ADF test have the same asymptotic distribution. Brooks (2008) explained that the PP tests often give the same conclusions as, and suffer from most of the same important limitations as, the ADF tests.

Co-integration Estimate

This is employed to determine the number of co-integrating vectors using Johansen's methodology with two different test statistics namely the trace test statistic and the maximum Eigen-value test statistic. The trace statistic tests the null hypothesis that the number of divergent co-integrating relationships is less than or equal to 'r' against the alternative hypothesis of more than 'r' co-integrating relationships, and is defined as:

$$\theta_{trace}(r) = -T \sum_{j=r+1}^{P} 1n\left(1 - \hat{\theta}_j\right)$$ ………….……………………………………….….……… (3.11)

The maximum likelihood ratio or the maximum eigen-value statistic, for testing the null hypothesis of at most 'r' co-integrating vectors against the alternative hypothesis of 'r+l 'co-integrating vectors, is given by:

$$\theta_{max}(r,r,+1) = -T\,1n\,(1-\hat{\theta}_{r+1})\quad \theta_{trace}(r) = -T \sum_{j=r+1}^{P} 1n\left(1 - \hat{\theta}_j\right)$$ ………..……………..…(3.12)

Where $\hat{\theta}_j$ = the eigen values, T = total number of observations. Johansen argues that, trace and statistics have nonstandard distributions under the null hypothesis, and provides approximate critical values for the statistic, generated by Monte Carlo methods.

In a situation where Trace and Maximum Eigenvalue statistics yield different results, the results of trace test should be preferred.

Vector Error Correction Model (VECM)

VECM model comes to play when it has been established that, there exist a long run relationship between the variables under consideration. This enables us to evaluate the cointegrated series. In a situation where there is no cointegration, VECM is no longer required and we can precede to Granger causality tests directly to establish casual relationship between the variables.

VECM regression equation is given below as thus:

$$\Delta Y_t = \alpha_1 + P_1 e_1 + \sum_{i=0}^{n} \beta_i Y_{t-i} + \sum_{i=0}^{n} \emptyset_i \Delta X_{t-i} + \sum_{i=0}^{n} Y_i Z_{t-i}$$ ………………….………………………(3.13)

$$\Delta X_t = \alpha_2 + P_2 e_{i-1} + \sum_{i=0}^{n} \beta_i Y_{t-i} + \sum_{i=0}^{n} \emptyset_i \Delta X_{t-i} + \sum_{i=0}^{n} Y_i Z_{t-i}$$

…………………………..………..(3.14)

In VECM, the cointegration rank shows the number of cointegrating vectors. For example a rank of two indicates that two linearly independent combinations of the non-stationary variables will be stationary.

A negative and significant coefficient of the ECM (i.e. e_{t-1} in the above equations) indicates that any short-term fluctuations between the independent variables and the dependent variable will give rise to a stable long run relationship between the variables.

Granger Causality Test

A general specification of the Granger causality test in a bivariate (X, Y) context can be expressed as:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + ... + \alpha_i Y_{t-i} + \beta_1 X_{t-1} + ... + \beta_i X_{t-i} + \mu$$

…………………………………………..(3.15)

$$X_t = \alpha_0 + \alpha_1 X_{t-1} + ... + \alpha_i X_{t-i} + \beta_1 Y_{t-1} + ... + \beta_i Y_{t-i} + \mu$$

…………………….……..………...(3.16)

In the model, the subscripts denote time periods and μ is a white noise error. The constant parameter "0 represents the constant growth rate of *Y* in the equation 3.15 and *X* in the equation 3.16 and thus the trend in these variables can be interpreted as general movements of cointegration between *X* and *Y* that follows the unit root process. Hence, in testing for Granger causality, two variables are usually analyzed together, while testing for their interaction. All the possible results of the analyses are four:

(i) Unidirectional Granger causality from variable Y_t to variable X_t.

(ii) Unidirectional Granger causality from variable X_t to Y_t

(iii) Bi-directional causality and

(iv) No causality

ESTIMATION AND INTERPRETATION OF RESULT

Unit Root Test

The result of the stationarity test conducted on each variables explained in the model using ADF and PP techniques in testing the hypothesis of unit root or no unit root as the case may be is presented in table 1 below;

Table 1: Unit Root Test Result

VARIABLES	ADF TEST H₀: Variable is not Stationary	PP TEST H₀: Variable is not Stationary	Order of Integration
	ADF TEST	PP TEST	Order of
	H_0: Variable is not Stationary	H_0: Variable is not Stationary	Integration
CP_GDP	-0.068857	-0.495444	
D(PC_GDP)	-4.680939***	-4.678100***	I(1)
FR	-1.064570	-1.639915	
D(FR)	-3.414481**	-3.015422**	I(1)
LE	-0.072294	-2.259617	
D(LE)	-2.986263**	-3.012874**	I(1)
IMR	-0.709690	-2.160433	
D(IMR)	-3.491033**	-3.439908**	I(1)
HE_GDP	-1.714331	-2.083889	
D(HE_GDP)	-6.087180***	-5.784215**	I(1)
Asymptotic Critical Values			
1%	-3.653730	-3.682421	
5%	-2.957110	-2.948872	
10%	-2.617434	-2.646914	

***, **, * implies significant at 1% level, 5% level, 10% level respectively. Δ represents first difference

The table 1 above revealed that, the null hypothesis that the variables are not stationary cannot be rejected given the asymptotic critical values that are less than the calculated values of ADF and PP. After all the variables have been transformed to their first difference, the null hypothesis was rejected and became stationary. Hence, we conclude that the variables are said to maintain stationarity at an integration of order one, I(1).

Lag Length Selection Test

The Schwarz Information Criterion (SC) was used in selecting the optimal lag length as guided by the information given by the test conducted. The result presented in table 2 revealed that two (2) lag length is appropriate for the analysis as supported by all the information criterion used.

Table 2: VAR Lag Order Selection Criteria

Endogenous variables: LCP_GDP LE FR IMR HE_GDP						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-101.7902	NA	0.000545	6.674390	6.903411	6.750304
1	241.4120	557.7036	1.29e-12	-13.21325	-11.83912	-12.75776
2	411.2217	222.8752*	1.71e-16*	-22.26385*	-19.74462*	-21.42880*

* 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

Johansen Cointegration Test

Having established that the variables are integrated of the same order, it is very important to determine whether there exists a long-run equilibrium relationship amongst them. Cointegration describes the existence of an equilibrium or stationarity relationship between two or more times series each of which is individually non stationary. We proceeded to testing for cointegration using the Johansen-Juselius maximum likelihood procedure in determining the cointegrating rank of the system and the number of common stochastic trends driving the entire system. We reported the trace and maximum eigen-value statistics and its critical values at five per cent (5%) in the table 3 below.

Table 3: Cointegration Tests

Unrestricted Cointegration Rank Test (Trace)				Unrestricted Cointegration Rank Test (Max-Eigen)		
Hypothesized No. of CE(s)	Eigen-vale	Trace Statistic	0.05 Critical Value	Eigen-Value	Maxi-Eigen Statistic	0.05 Critical Value
None *	0.967737	273.4515	69.81889	109.8828	33.87687	0.0000
At most 1 *	0.928101	163.5687	47.85613	84.23975	27.58434	0.0000
At most 2 *	0.671223	79.32898	29.79707	35.59600	21.13162	0.0003
At most 3 *	0.624244	43.73299	15.49471	31.32208	14.26460	0.0000
At most 4 *	0.321480	12.41091	3.841466	12.41091	3.841466	0.0004
Decision	Trace test indicates 5 cointegrating eqn(s) at the 0.05 level			Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level		
* denotes rejection of the hypothesis at the 0.05 level						

The result of multivariate cointegration test based on Johansen and Juselius cointegration technique revealed that there exist five cointegrating equations at 5% level of significant as indicated by both trace statistic and the max-Eigen statistic.

An Error Correction Model Estimate

We proceeded to estimate the VECM that was designed for use with non-stationary series that were known to be cointegrated. The VECM has cointegration relations built into the specification so that it restricts the long run behaviour of the endogenous variables to converge to their cointegrating relationship while allowing for short-run adjustment dynamics. The cointegration term is known as the error correction term (ECT) since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. The short run and long run causal relationship between the variables should be examined in a vector error correction (VECM) framework and the result of the estimated model is presented below:

Table 4: Vector Error Correction Estimates

Vector Error Correction Estimates					
Error Correction:	D(LPC_GDP)	D(LE)	D(FR)	D(IMR)	D(HE_GDP)
CointEq1	-0.282911	0.060260	-0.042622	1.274251	-8.097131
	[-2.98338]	[0.85493]	[-2.97055]	[0.90159]	[-1.56681]
D(LPC_GDP(-1))	0.552898	-0.041929	0.020149	-0.598533	3.644644
	[2.22155]	[-0.85010]	[2.00687]	[-0.60520]	[1.00786]
D(LE(-1))	0.645746	1.982602	-0.004401	0.992898	4.103590
	[2.84871]	[23.9123]	[-0.26074]	[0.59723]	[0.67505]
D(FR(-1))	29.44704	0.212562	0.904628	12.45070	-232.0855
	[2.94827]	[0.12906]	[2.69820]	[0.37700]	[-1.92190]
D(IMR(-1))	-2.039824	-0.023140	0.002601	1.591414	-0.062593
	[-0.62165]	[-3.31487]	[1.83064]	[11.3693]	[-0.12230]
D(HE_GDP(-1))	0.063364	0.003457	-0.003541	0.106708	-1.211373
	[1.02066]	[0.51099]	[-2.57129]	[0.78664]	[-2.44226]
C	-0.282049	0.067208	-0.016050	0.221074	-2.683752
	[-1.17147]	[2.56165]	[-3.00520]	[0.42023]	[-1.39517]
R-squared	0.619934	0.999585	0.996846	0.995451	0.541460
Adj. R-squared	0.399895	0.999344	0.995020	0.992818	0.275990

The VECM result presented above shows that all the explanatory variables have relationships with the dependent variable according to the a priori expectation and the model satisfy the stability condition, that is, the error correction term in the model should have the required negative sign and lie within the accepted region of less than unity.

The vector error correction term in column two has the expected negative sign and is statistically significant with t - value that is greater than two (-2.98338) and its value (0.282911) i.e. 28% shows a low speed adjustment towards equilibrium. The result of the estimation shows that the explanatory variables account for about 62% percent variation in GDP product per capital used as a proxy for economic growth and 38% percent can be due to other factors not captured in the model. Taking into consideration the degree of freedom, the adjusted R-squared shows that 40 percent of the dependent variable is explained by the explanatory variables.

The estimation also shows a positive and significant relationship between fertility rate, life expectancy, infant mortality rate, health expenditure percentage of GDP and GDP per capita income in Nigeria. It revealed that 1 unit increase in mortality rate on the average will lead to 0.64 unit decrease in economic growth. While the result also revealed that 1 unit increase in

fertility rate, life expectancy, health expenditure percentage of GDP holding other variables constant lead to 29.4, 0.65 and 0.06 unit   increase in economic growth respectively.

Granger Causality

Cointegration between two variables does not specify the direction of a causal relation, if any, between the variables. Economic theory guarantees that there is always Granger Causality in at least one direction Order, D. and L. Fisher, (1993). Hence, this aspect of the work seeks to verify the direction of Granger Causality between PC_GDP, LE, FR, IMR and HE_GDP. Estimation results for granger causality between the very variables are presented below:

Table 5

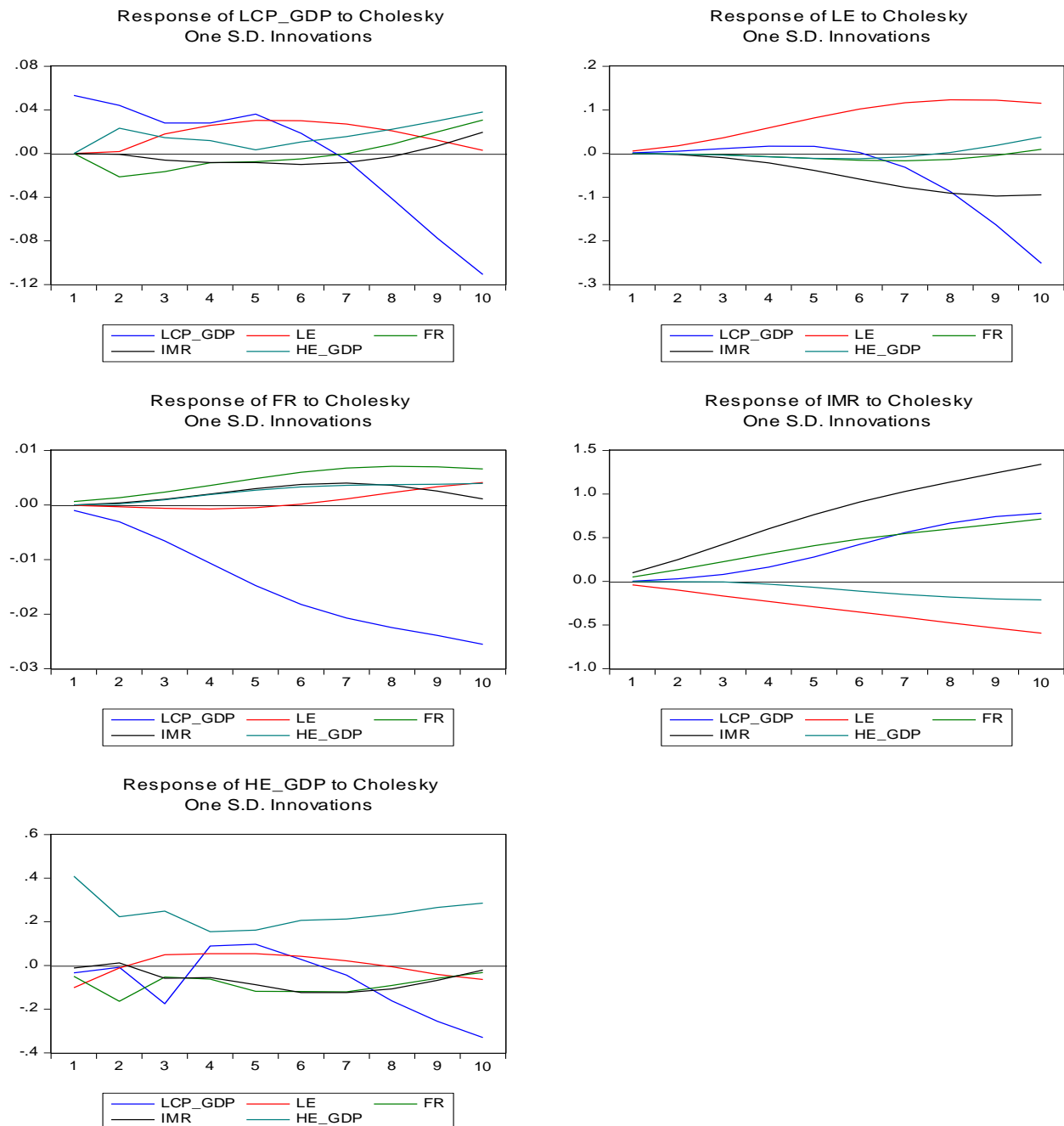| Null Hypothesis	F-Statistic	Decision	Probability	Type of Causality
LE does not Granger Cause LPC_GDP	11.9447	Reject H_0	0.0002	Uni-directional causality
LPC_GDP does not Granger Cause LE	50.4122	Reject H_0	8.E-10	Uni-directional causality
FR does not Granger Cause LPC_GDP	4.56879	Reject H_0	0.0195	Uni-directional causality
LCP_GDP does not Granger Cause FR	14.0665	Reject H_0	7.E-05	Uni-directional causality
IMR does not Granger Cause LPC_GDP	6.58814	Reject H_0	0.0047	Uni-directional causality
LPC_GDP does not Granger Cause IMR	18.6143	Reject H_0	8.E-06	Uni-directional causality
HE_GDP does not Granger Cause LPC_GDP	3.47231	Reject H_0	0.0455	Uni-directional causality
LPC_GDP does not Granger Cause HE_GDP	2.35842	Reject H_0	0.1138	Uni-directional causality
FR does not Granger Cause LE	60.2559	Reject H_0	1.E-10	Uni-directional causality
LE does not Granger Cause FR	42.2750	Reject H_0	5.E-09	Uni-directional causality
IMR does not Granger Cause LE	152.079	Reject H_0	2.E-15	Uni-directional causality
LE does not Granger Cause IMR	18.9034	Reject H_0	7.E-06	Uni-directional causality
HE_GDP does not Granger Cause LE	0.10306	Reject H_0	0.0024	Uni-directional causality
LE does not Granger Cause HE_GDP	6.15670	Reject H_0	0.0063	Uni-directional causality
IMR does not Granger Cause FR	51.4796	Reject H_0	6.E-10	Uni-directional causality
FR does not Granger Cause IMR	114.041	Reject H_0	7.E-14	Uni-directional causality
HE_GDP does not Granger Cause FR	0.36482	Reject H_0	0.0977	Uni-directional causality
FR does not Granger Cause HE_GDP	3.55744	Reject H_0	0.0425	Uni-directional causality
HE_GDP does not Granger Cause IMR	0.17170	DNR H_0	0.9431	No causality
IMR does not Granger Cause HE_GDP	3.50008	Reject H_0	0.0445	Bi-directional causality

Note: DNR means do not reject H_0

From the table above, it was found that there exist uni-directional relationship between fertility rate, life expectancy, infant mortality rate, health expenditure percentage of GDP and GDP per

capita income in Nigeria only with the exception of HE_GDP that does not granger cause IMR leading to a bidirectional relationship the two variables.

Impulse Response Function (IRF)

Impulse response analysis traces out the responsiveness of the dependent variables in a VAR to shocks from each of the variables (Brooks, 2008). Results of the impulse response analysis are presented in the Figure below;

Response of LCP_GDP to Cholesky One S.D. Innovations

Response of LE to Cholesky One S.D. Innovations

Response of FR to Cholesky One S.D. Innovations

Response of IMR to Cholesky One S.D. Innovations

Response of HE_GDP to Cholesky One S.D. Innovations

Since this study focuses on the impact of health on economic growth, only the response on the variable used as proxy for economic growth (PC_GDP) is explained. However, impulse response functions show the dynamic response of economic growth to a one-period standard deviation shock to the innovations of the system and also indicate the directions and persistence of the response to each of the shocks over10 quarters. For the most part, the impulse response functions have the expected pattern and confirm the results from the short run relationship analysis. Shocks to all the variables are significant although they are not persistent. Shock to the FR, LE, IMR and HE_GDP have a huge dampening impact on economic growth.

CONCLUSION

The evidences from various econometrics analyses from this study revealed that, there exist a statistically significant relationship between health and economic growth in Nigeria. This is evident given the contributions of both the health input variable and output variables used in this study. And most importantly, it was deduced that, there exist uni-directional causal relationship between health and economic growth in Nigeria. The implication of this is that an improvement in health enhances labour productivity and leads to gains in economic growth, while economic growth appears to lead to large health gains, particularly at low levels of economic development. Hence, it is important for the government to ensure that greater attention are given to enhance the improvement in health expenditure which is the main health input used in this study. This is without doubt that it will translate to the expected health outcome if the process of expending the fund allocated to the health sector is properly monitored and its efficiency is ensured. Therefore, we suggest that government at various levels should increase the allocation of fund to the health sector (infrastructure, personnel and advocacy) and develop strategies for the monitoring of the disbursement of such fund as well as increase the awareness of the availability of various health services to the society.

However, following the conclusion from this study on the uni-directional causal relationship between economic growth and health, it is suggested that further studies on this subject matter need to take into consideration the use of simultaneous equation framework which is capable of explaining better the interdependent relationships or indignity and possibility of reverse causation between economic growth and health.

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