Health Indices and Economic Growth Nexus: A Panel Co-integration Analysis for the Case of West African Countries

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Abstract

The existence of a link between health and economic growth seems incontestable as many researchers have worked on the issue and positively confirmed it particularly in Europe, Asia and Middle East. However, in the case of Africa, the dynamic links between health and economic growth in have not been adequately established as most of the studies centrally focused on health inputs usually proxied by health expenditure. This study therefore, attempts to empirically examine the relationship between health indices proxied by life expectancy and infant mortality rates, and economic growth in West African countries over the period of 1970 to 2016. However, the results obtained using panel unit root and panel co-integration techniques developed by Pedroni revealed that there is evidence of long run relationship among life expectancy, infant mortality rates and economic growth. In addition, the results of Granger causality tests revealed the existence of unidirectional causality running from both life expectancy and infant mortality rates to economic growth. Thus, the study concludes that investment in health should not be seen as a social cost by government but rather, as a veritable source of growth and development. Hence, the study recommends that policy makers should prioritize health sector policies through massive investment in health and education as a mechanism for improving health indices and promoting economic growth in West Africa in particular and African countries in general.

Keywords: Life expectancy, Mortality rates, Economic Growth, Co-integration, West Africa
JEL Code: I11, O4, F43

Contribution/Originality
This study is one of the very few studies that have investigated the long run relationship between health indices and economic growth in West African countries. Thus, it has contributed in terms of health discourse.

1.0 Introduction

While the link between health and economic growth is theoretically plausible and empirically supported in both single and cross-country studies, the efforts to improve the level of health in Africa still face many challenges. Virtually all human development indicators put African economies at the bottom of development scale. This can be attributed to, among other factors, the high incidence of infectious and communicable diseases, growing burdens of chronic and non-communicable diseases, weak health systems and inadequate human and material resources in the health sector (World Bank, 2015). Consequently, African countries still experience low life expectancy, high infant and under-5 mortality rates, high fertility rates accompanied by increased maternal and crude death rates, increased prevalence of HIV/AIDS, malaria and other health related problems which have been documented to be detrimental to economic development in virtually all studies that have examined the growth differences between poor and rich countries (e.g. Khembo & Tchereni, 2013). Therefore, it is likely that the growth potentials of Africa could be enormous with a gradual improvement in health status among its population. In view of this, various studies have been conducted to examine the link between health status inform of life expectancy, mortality rates, fertility rates, etc. and economic

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growth both on single and cross-country level (e.g. Khembo & Tchereni, 2013; Majdi, 2012; Abdullah, 2012; Mehrara & Musai, 2011; Bloom, Canning & Sevilla, 2004).

However, despite the above submission, the dynamic links between health and economic growth in Africa have not been adequately established. Most of the studies conducted (e.g. Awe & Ajayi, 2010; Bakare & Sanmi, 2011; Inuwa & Modibbo, 2012; Maijama'a & Mohammed, 2013; Modibbo, 2015 etc.) were on single country basis in Africa and as such, their findings cannot be generalized because of the heterogeneous nature of African continent. In addition, these single country studies were centrally focused on either the effects of diseases such as HIV/AIDS and malaria on economic growth, or using health inputs usually proxied by health expenditure. Only few studies were found to examine the connection between health outcomes and economic growth (e.g. Dauda, 2011, Modibbo, Muktar & Nasiru, 2015).

Furthermore, evidence from causality studies show that the direction of causality between health and economic growth is still a subject of much debate as well as its bidirectional causality. While some studies confirmed that the causal relationship runs from income to health (Hansen & King, 1996; Erdil & Yetkiner, 2004), there exist sound theoretical and empirical bases to the argument that health also contributes positively to economic growth (Bloom, Canning & Sevilla, 2001; Majdi, 2012). In the same vein, a relatively large number of studies also confirm that both health and economic growth could positively affect each other (Hamoudi & Sachs, 1999).

Based on the forgoing arguments, it seems obvious that in addition to having a very few studies on health outcomes and growth nexus in Africa, the nature of the relationship as well as the direction of causality still remain the subject of discussions. This calls for a need to advance more empirical testing to study the specific pathways that could improve our understanding about those causal connections (Schultz, 2008). Thus, the main objective of this study is to empirically examine the long run relationship between health indices and economic growth in African taking West African countries as a case study.

In pursuance of this study, the following hypotheses were formulated:

1. H_0: There exist no long run relationship between health indices and economic growth in West African countries.

2. H_0: There exist no causal relationship between health indices and economic growth in West African countries.

However, to put the paper on a proper perspective, the remaining part covers the following: section two reviews the literature. While section three presents the methodology, section four analyses the data. Finally, the last section concludes with summary of the findings and offers recommendations..

2.0 Literature Review

Research interest on the relationship between health and economic growth has been on the increase over the years. As rightly posited by Robyn (2011), better health can lead to economic growth not only through an increase in total GDP as population increases, but also more importantly, through long term gains inhuman and physical capital that raise productivity and per capita GDP. In line with this assertion, various studies have been put forward both on single and cross-country level to empirically examine the relationships between health variables and economic growth.

For instance, Huang, Fulginiti & Peterson (2010) examined how increase in HIV/AIDS and other diseases retards human capital development and consequently leads to slow economic growth. Using a panel data for 38 African countries in the years 1980, 1985, 1990, 1995, 2000 and 2004, findings based on three-period Overlapping Generations Model reveal that prevalence of HIV/AIDS is responsible for a substantial decline in life expectancy in African countries which results in lower educational attainment and slow pace of economic growth.

Also, Li and Liang (2010) examine the sources of economic growth in East Asian economies including China using a panel dataset from 1961 to 2007. Within the framework of Augmented Mankiw, Romer, and Weil's model, the results show that the impacts of life expectancy and mortality rate on economic growth were significant and consistent with the theoretical expectations.

In a study conducted by Abdullah (2012) to examine the relationship between economic growth and its various determinants on a panel data of 177 countries ranging from 1995 to 2009, the results using Pooled OLS technique show that for least developed countries, better health conditions positively enhance their economic growth.

In addition, Yardimcioğlu (2012) conducted a study to investigate the long run relationship between health proxied by life expectancy at birth and economic growth in the 25 OECD countries over the period from 1975 to 2008. The results obtained using Pedroni panel co-integration, Pedroni FMOLS and Canning-Pedroni causality methods revealed the existence of long run bidirectional relationship between life expectancy and economic growth in the OECD countries where a unit increase in life expectancy increases GDP by 0.18%.

In another study by Özçalik (2013), the dynamics of the relationships between health and economic growth has been investigated using panel OLS based on Fixed Effect Model on 10 OECD countries for a period of 2001 to 2011. The findings of the study show that health care spending is negatively affected by hospital beds density per 1000 population. On the other hand, GDP and life expectancy affect total health care positively.

Similarly, within the context of panel cointegration and causality tests, Ecevit (2013) employed Pooled OLS, Dynamic OLS and Fully Modified OLS techniques to examine the long run impact of life expectancy on economic growth using panel data for the period of 1970-2010 for 21 OECD countries. The results showed that life expectancy has a positive and significant long run effect on real per capita GDP in OECD countries over the period horizon of the study.

Also, Khembo and Tchereni (2013) analyzed the impact of human capital on economic growth using panel data from 13 Southern African Development Community (SADC) countries for the growth periods of 1990 – 1995, 1995 – 2000 and 2000 – 2005. Using Pooled OLS regression techniques, the findings show that while education capital has a positive and statistically significant effect on GDP per capita, health capital was not found to be a major determinant of economic growth in SADC region.

Furthermore, Ada and Acaroğlu (2014) analyzed the relation between economic growth and human capital for the period between 1990 and 2011 for 15 MENA (Middle East and North Africa) countries. Using fixed effect, random effect, and Generalized Least Square (GLS), the results show that life expectancy and fertility rate have statistically significant effect on GDP per capita while public health expenditure has no significant effect on GDP over the study period.

Moreover, Bedir, (2016) also carried out a study to test whether there is causality between income and healthcare expenditure as well as whether healthcare expenditure is a driving force for economic growth. Using the data for 13 emerging markets in Europe and Middle East African and Asian countries over the period from 1995 to 2013, the study employed a modified version of Granger causality test proposed by Toda and Yamamoto (1995), and Dolado and Lütkepohl (1996). Although there were mixed results of causality test among the countries, the overall findings have indicated that income is an important factor for explaining the difference in healthcare expenditure among studied countries.

Last but not the least, Korkmaz and Kulunk (2016) test whether there is a relation between human development indicators and economic growth of 10 OECD countries. Using panel data from 2007-2013 and Pedroni panel co-integration as well as panel causality techniques, the overall results show a unidirectional causal relationship from economic growth to higher education schooling rate and life expectancy at birth.

In view of the above studies, it is clear that a research vacuum on health and economic growth nexus still exists in Africa. In other words, it becomes obvious that there are very few studies with mixed results concerning the relationship between health expenditure, health outcomes (indices) and economic growth in Africa compared to other regions of the world. In fact, in all the reviewed literatures, no study was found in relation to West African countries. This lends strong justification for conducting this study.

3.0 Methodology

3.1 Sources and Method of data collection

The panel data set for this study consists of annual time series spanning from 1970 to 2016 for Thirteen (13) West African countries. These data were sourced from the publications of World Development Indicators (WDI, 2016). However, the selection of countries was purely based on the availability of data. The countries comprise: Benin, Burkina Faso, Ivory Coast, Gambia, Ghana, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo.

3.2 Method of Data Analysis

The data set for this study was analyzed using the EVIEWS econometric software version 10.0. In order to avoid any form of spurious results that would lead to erroneous conclusion, the empirical test for the nature of relationship between the health variables and economic growth were carried out based on the following steps:

3.2.1 Panel Unit Root Test

The unit root test for non-stationarity in the variables was conducted using the panel unit root test procedures developed by Levin, Lin and Chu (2002), Maddala and Wu (1999), and Im, Pesaran and Shin (1997) to examine whether the series are stationary or integrated of the same order. The general form of panel unit root test regression can be written as follows:

$$\Delta y_{it} = \rho y_{i,t-1} + \sum_{L=1}^{\rho_i} \theta_{iL} \Delta y_{it-L} + \alpha_{mi} d_{mt} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where; d_{mt} indicates the vector of deterministic variables and α_{mi} the corresponding vector of coefficients for model m = 1, 2, 3.The test was carried out using the null hypothesis that each individual time series contains a unit root against the alternative that each time series is stationary.

3.2.2 Panel Cointegration Test

If the series are non-stationary at levels but are found to be stationary at first difference, i.e. I (1), cointegration test can be performed to determine the existence of long-run relationship between the variables. However, this can be done using the panel cointegration technique developed by Pedroni (1999). As rightly posited by Mehrara and Musai (2011), this technique has some significant improvements over the conventional cointegration tests that are usually employed on a single country series. Accordingly, while pooling data to determine the common long run relationship, this technique allows the cointegrating vectors to vary across the members of the panel. In other words, this test allows for heterogeneity in the cointegration vector as well as averaging test statistics for cointegration in the time series across panel members.

However, Pedroni cointegration is based on the Engle-Granger method and it is given in its most general form as follows:

$$Y_{i,t} = \alpha_i + \delta_{it} + \beta_{1i} X_{1i,t} + \beta_{2i} X_{2i,t} + ... + \beta_{mi} X_{mi,t} + e_{it} \quad \text{.....2}$$

Where; t = 1, …, T; i = 1, …, N; m = 1, 2, …, M.

For a time series panel of observables y_{it} and X_{it} for members i=1,…,N, where t=1,…, T indicates the total number of observations during the time period and m=1,2,…, M indicates the number of variables in the regression. The parameters α_i and δ_i allow for the possibility of member specific fixed effects and deterministic trends, respectively. The existence of a cointegration relationship between the variables is tested through the stationarity of the error terms above. For the non-parametric statistics estimate, the error terms above are estimated as follows:

$$\hat{e}_{i,t} = \hat{\gamma}_i \hat{e}_{i,t-1} + \hat{u}_{i,t} \quad \text{.....3}$$

The H_0 hypothesis indicates no cointegration for all units, and the H_1 hypothesis indicates cointegration for all units. The alternative hypothesis does not assume a common first order autoregressive coefficient for all units and its test statistics have a normal distribution.

3.2.3 Granger Causality Test

The cointegration test usually remains silent about the direction of the causal link between any two variables. However, if two variables are cointegrated, there will be granger causality in at least one direction. This study therefore will employ granger causality developed by Granger (1969) to examine the nature of causality between health variables and economic growth using the following equations:

$$\Delta RGDP_{i,t} = \alpha_i + \sum_{i=1}^{m} \beta_i \Delta RGDP_{i,t-1} + \sum_{i=1}^{n} \lambda_i \Delta HVAR_{i,t-1} + \varepsilon_{ti} \quad \text{.....4}$$

$$\Delta HVAR_{i,t} = \phi_i + \sum_{i=1}^{p} \delta_i \Delta HVAR_{i,t-1} + \sum_{i=1}^{q} \theta_i \Delta RGDP_{i,t-1} + \kappa_{it} \quad \text{.....5}$$

HVAR represents the variable of health indices which could be life expectancy or infant mortality rate. The error terms ε_t and κ_t are supposed to be white-noise (i.e., they have zero means and constant variances) and may be correlated with each other for a given country. The *m, n, p, q* are the maximum number of lag length. Also, N is the number of countries in the panel (i.e. i=1,2,3,…,N), t is the time period (i.e. t=1,2,3,…,T).

Given the above equations, four findings are possible: when the sets of coefficient β, λ, δ, θ are not statistically significant, we say none of the variable Granger causes each other, meaning the variables are independent (no causality). On the other hand, there may be unidirectional causality meaning that

HVAR may Granger cause *RGDP* but not the other way round. It could also be the case where *RGDP* Granger causes *HVAR* but not the other way round. Furthermore, *HVAR* and *RGDP* may cause each other meaning that there is feedback or bilateral causality. The null hypotheses are as follows: *HVAR* (variable of health indices) granger causes *RGDP* if $\lambda_i \neq 0$. Similarly, RGDP granger causes HVAR if $\theta_i \neq 0$. However, there will be bidirectional causality if $\lambda_i \neq 0$ and $\theta_i \neq 0$.

4.0 Empirical Results

4.1 Panel Unit Root Test Results

In this study, the unit root tests techniques developed by Levin, Lin and Chu (LLC), Im, Pesaran and Shin (IPS) as well as the ADF-Fisher, and PP-Fisher tests have been used to examine the stationarity properties of the variables; and the results are presented in Table 1 below:

Table 1: Panel Unit Root Tests Results

		At Level		At First Difference	
Variables	**Methods**	**Statistics**	**P-Value**	**Statistics**	**P-Value**
LRGDP	IPS	1.337	0.909	-1.941	0.026**
	ADF-Fisher	8.845	0.984	36.658	0.012**
LLE	IPS	0.216	0.585	-4.369	0.000*
	ADF-Fisher	19.232	0.506	56.812	0.000*
LIMRT	IPS	0.469	0.680	-1.876	0.030**
	ADF-Fisher	0.701	0.827	19.279	0.013**

Source: Computed by the Researchers using Eviews Version 10. ** indicate level of significance at 1% and 5% level respectively.

From the results in Table 1 above, all the methods employed showed that RGDP, LE and IMRT are not stationary at level. However, all the variables were further examined and found to be stationary at first difference indicating that the variables are integrated of order one, I(1). This makes Pedroni panel cointegration suitable which is applicable only when all variables are integrated of the same order [I(1)].

4.2 Panel Co-integration Test Results

The Pedroni cointegration test results indicating a long-term relationship between the variables are shown in Table 2 below:

Table 2: Results of Panel Cointegration Test

Model 1: $LGDP_{it}= \alpha_{it}+ \beta L\text{LE}_{it}+ u_{it}$				
	Statistic	**Prob.**	**Weighted Statistic**	**Prob.**
Panel v-Statistic	0.1277	0.4492	-0.3034	0.6192
Panel rho-Statistic	-0.1974	0.4218	-0.2617	0.3968
Panel PP-Statistic	-5.4182	0.0000	-6.0404	0.0000
Panel ADF-Statistic	-3.5495	0.0002	-5.8336	0.0000
Group rho-Statistic	0.6661	0.7473	–	–
Group PP-Statistic	-8.5434	0.0000	–	–
Group ADF-Statistic	-6.5827	0.0000	–	–
Model 2: $LGDP_{it}= \alpha_{it}+ \beta\text{LIMRT}_{it}+ u_{it}$				
Panel v-Statistic	-1.8956	0.9710	-1.9212	0.9727
Panel rho-Statistic	0.1672	0.5664	-0.1208	0.4519
Panel PP-Statistic	-5.5924	0.0000	-6.0918	0.0000
Panel ADF-Statistic	-9.6823	0.0000	-8.8722	0.0000
Group rho-Statistic	1.5291	0.9369	–	–
Group PP-Statistic	-6.8874	0.0000	–	–
Group ADF-Statistic	-11.1079	0.0000	–	–
Model 3: $L\text{LE}_{it}= \alpha_{it}+ \beta\text{LIMRT}_{it}+ u_{it}$				
Panel v-Statistic	1.7284	0.0420	1.2081	0.1135
Panel rho-Statistic	-0.2582	0.3981	-0.8465	0.1986
Panel PP-Statistic	-3.2051	0.0007	-4.8363	0.0000
Panel ADF-Statistic	-4.3088	0.0000	-4.2969	0.0000
Group rho-Statistic	0.8541	0.8035	–	–
Group PP-Statistic	-5.2448	0.0000	–	–
Group ADF-Statistic	-7.1880	0.0000	–	–

Source: Computed by the Researchers using Eviews Version 10. H_0= No cointegration H_1= Cointegration

It can be seen that in all the results in table II above, the hypothesis testing statistics are greater than $Z_{0.05}$=1.96. Model 1investigates the long run relationship between economic growth and the life expectancy at birth, Model 2 investigates the long run relationship between economic growth and infant mortality rate, and Model 3 investigates the long run relationship between the life expectancy at birth and infant mortality rate. The probability values in Table II for, panel PP, panel ADF, group PP and group ADF are significant at the 5% level, confirming the long term relationship between the variables RGDP and LE, RGDP and IMRT, LE and IMRT. However, the above results confirmed the findings of the previous studies such as Bloom and Sachs (1998), Acemoglu and Johnson (2006), Dauda (2011), Peykarjou *et al.*, (2011), Robyn (2011) etc. who found the existence of a positive long run relationship between health outcomes proxied by life expectancy and economic growth, but contradicted the findings of Modibbo, Muktar and Nasiru (2015) who reported life expectancy to impact negatively on economic growth.

4.3 Granger Causality Test Results

Having established the existence of long run relationship between the variables of health indices and economic growth, the study further examined the direction of causality among the variables using Granger causality and Table 3 below presents the results.

Table 3: Granger Causality Test Results

Null hypothesis	F-Statistics	P-value	Causality
LRGDP does not granger cause LLE	0.1346	0.2267	*Runs from*
LLE does not granger cause LRGDP	7.3582	0.0034*	*LEXP to RGDP*
LRGDP does not granger cause LIMRT	0.1864	0.5912	*Runs from*
LIMRT does not granger cause LRGDP	5.4672	0.0126**	*IMRT to RGDP*
LLE does not granger cause LIMRT	0.7490	0.8230	*No Causality*
LIMRT does not granger cause LLE	0.0327	0.9513	

Source: Computed by the Researchers using EVIEWS software version 10. * and ** indicate level of significance at 1% and 5% level respectively.

According to the results, the causal relationship between life expectancy and economic growth is found to be unidirectional running from the former to the later which is statistically significant at 1% level. Therefore, the result rejects the null hypothesis that life expectancy does not granger cause economic growth in West African countries. Similarly, the result shows the existence of a unidirectional causality running from infant mortality rate to economic growth which is also significant at 5% level thereby rejecting the null hypothesis that infant mortality rate does not granger cause economic growth. However, the results depict no causal relationship between life expectancy and infant mortality rate.

5.0 Conclusion and Recommendations

This study empirically examined the long run relationship between health indices and economic growth in West African countries using panel data from the period of 1970 to 2016. The unit root properties of the data were examined using the IPS and ADF Fisher panel unit root tests after which the cointegration tests was carried out. The results obtained revealed the existence of long run equilibrium relationship between the variables of health indices (life expectancy and infant mortality rate) and economic growth in West African countries. Also, the findings from the Granger causality test established the presence of unidirectional causality running from health indices to economic growth.

To this end, the study concluded that there exist a long run equilibrium relationship between health indices and economic growth West African countries. Thus, improvements in health status can be said to be among the various factors influencing economic growth not only in West African countries. However, the extent to which improved health status can affect economic growth strongly depend on a number of health determining factors, including rising standard of living, life style as well as better education opportunities and greater access to quality health services. Therefore, in view of this result, the study concludes that investment in health should not be seen as a social cost by government but rather, as a veritable source of growth and development since improvement in health indices in terms of increase in life expectancy and decrease in mortality rate enhance economic growth. Hence, the study recommends that policy makers should prioritize health sector policies through massive investment in health and education as a mechanism for improving health indices and promoting economic growth in West Africa in particular and African countries in general.

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