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Health Expenditure, Economic Growth and Life Expectancy at Birth in Resource Rich Developing Countries: A case of Saudi Arabia and Nigeria

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ABSTRACT

Health care has recently been given more attention as disease and various pandemic affect the country's economic productivity. This study investigates the relationship between health expenditure, life expectancy at birth and economic growth in resource rich developing countries namely Saudi Arabia and Nigeria. The study adopts autoregressive distributed lag (ARDL) bound test, error correction model and Granger causality to determine the relationship and the direction of causality among the variables. The results establish that health expenditure and life expectancy positively influenced economic growth in the long run in both countries. While life expectancy has more impact in Saudi Arabia, health expenditure has more impact in Nigeria. Furthermore, the results in the short run reveal that both health expenditure and life expectancy positively influenced economic growth in Saudi Arabia whereas only health expenditure has positive impact on economic growth in Nigeria. The results also indicate one-way causality running from each of the health expenditure and life expectancy to economic growth without any feedback for the two countries. This study confirms a health-led growth hypothesis for both Saudi Arabia and Nigeria. Since health seems to promote economic growth, it becomes imperative for the government of the two countries to further strengthen the health sector with appropriate policy and funding.

ملخص

لقد أُعطيت الرعاية الصحية في الآونة الأخيرة اهتماما إضافيا بالنظر إلى أن الأمراض ومختلف الأوبئة تؤثر على الإنتاجية الاقتصادية للبلد. وتحقق هذه الدراسة في العلاقة بين الإنفاق على

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الصحة، ومتوسط العمر المتوقع عند الولادة، والنمو الاقتصادي في البلدان النامية الغنية بالموارد، أي المملكة العربية السعودية ونيجيريا.وهي تتبنى الانحدار الذاتي للإبطاء الموزع (ARDL)، ونموذج تصحيح الأخطاء، وسببية غرانجر لتحديد العلاقة واتجاه السببية بين المتغيرات. وتثبت النتائج أن الإنفاق على الصحة ومتوسط العمر المتوقع أثرا إيجابيا على النمو الاقتصادي في الأجل الطويل في كلا البلدين. وفي حين أن متوسط العمر المتوقع له تأثير أكبر في المملكة العربية السعودية، فإن الإنفاق على الصحة عرف تأثيرا أكبر في نيجيريا.وعلاوة على ذلك، تكشف النتائج في الأجل القصير أن الإنفاق على الصحة ومتوسط العمر المتوقع معا أثرا تأثيرا إيجابيا على النمو الاقتصادي في المملكة العربية السعودية في حين أن الإنفاق الصحي وحده هو الذي عرف تأثيرا إيجابيا على النمو الاقتصادي في نيجيريا. وتشير النتائج أيضا إلى أن كل من الإنفاق على الصحة ومتوسط العمر المتوقع يتجهان اتجاها واحدا نحو النمو الاقتصادي دون أي انعكاس بالنسبة للبلدين. وتؤكد هذه الدراسة فرضية نمو تقودها الصحة لكل من المملكة العربية السعودية ونيجيريا. وبما أن الصحة تعزز النمو الاقتصادي على ما يبدو، فإن من الضروري أن تواصل حكومتي البلدين تعزيز قطاع الصحة بسن السياسات وتخصيص التمويل المناسبين.

ABSTRAITE

Les soins de santé ont récemment fait l'objet d'une attention accrue, car les maladies et les diverses pandémies affectent la productivité économique du pays. Cette étude examine la relation entre les dépenses de santé, l'espérance de vie à la naissance et la croissance économique dans les pays en développement riches en ressources, à savoir l'Arabie saoudite et le Nigeria. L'étude adopte le test de liaison ARDL (autoregressive distributed lag), le modèle de correction des erreurs et la causalité de Granger pour déterminer la relation et la direction de la causalité entre les variables. Les résultats établissent que les dépenses de santé et l'espérance de vie influencent positivement la croissance économique à long terme dans les deux pays. Alors que l'espérance de vie a plus d'impact en Arabie Saoudite, les dépenses de santé ont plus d'impact au Nigeria. En outre, les résultats à court terme révèlent que les dépenses de santé et l'espérance de vie influencent positivement la croissance économique en Arabie Saoudite, tandis que seules les dépenses de santé ont un impact positif sur la croissance économique au Nigeria. Les résultats indiquent également une causalité unidirectionnelle allant des dépenses de santé et de l'espérance de vie à la croissance économique sans aucune rétroaction pour les deux pays. Cette étude confirme l'hypothèse d'une croissance tirée par la santé pour l'Arabie Saoudite et le Nigeria. Puisque la santé semble favoriser la croissance économique, il devient impératif pour le gouvernement des deux pays de renforcer davantage le secteur de la santé par une politique et un financement appropriés.

Keywords: Health expenditure; Life expectancy at birth; Economic growth; Autogressive distributed lag; Saudi Arabia, Nigeria

JEL Classification: C01, H51, I11, O11, P46

1. Introduction

The economic growth and development in both developed and developing economies have been attributed in somewhat to human capital development in many previous studies. Health care access, quality and delivery occupies a nucleus position in achieving Sustainable Development Goals (SDG) which is an offshoot of Millennium Development Goals (MDGs). Most of the countries that have invested substantially in human capital have been reported to have reaped the benefits of a sustainable economic development (Akinwale, 2018). The endogenous growth theory has highlighted a significant part played by human capital accumulation to productivity and long-term economic growth (Lucas 1988; Romer 1990). The world is transforming from a resource-based economy to knowledge- and skill-based economy. This transformation gives credence to the role human capital is playing to achieve this transition. Education and health are the major elements of human capital development of any society. While education as a measurement of human capital towards economic development has been generally explored in the past studies, there are limited scientific studies which have examined health in measuring human capital towards GDP growth. The Covid-19 pandemic which created serious economic turbulent across the world has shown the importance of health in economic growth (Akinwale, 2020).

Assessing the linkages between economic growth and health in the resource rich countries becomes important as a skilled and healthy individual is expected to do his/her job much better than a skilled but unhealthy individual. This signifies that education could be a necessary condition of human capital development but not a sufficient condition as health is crucial to the wellbeing of any workforce which engenders productivity. A healthy individual can effectively acquire the requisite skills and knowledge because good health status improves the stock of human capital which is needed to achieve higher income and sustainable growth (Boachie, 2017; Barro 1999).

Expenditure on health care has been posited by Mushkin's health-led growth hypothesis to ignite economic growth, as the study categorised health as a capital which could be accumulated through investment, and this investment can improve the quality of workers' life, improve life expectancy at birth, ameliorate morbidity rate as well as increase labours' productivity (Bedir, 2016; Elmi and Sadeghi, 2012; Murthy and Okunade, 2009; Mushkin, 1962). In another study conducted by Bloom, Kuhn and Prettner (2018) from the World Bank data obtained, using the Preston curve framework (Preston, 1975) confirms the assertions that countries with higher incomes tend to have better health status than countries with lower incomes. This is also confirmed in few related studies (Weil, 2015, 2014; Deaton, 2013). The effect of health care expenditure has varying results for both high- and low-income countries (Dhrifi, 2018). It would be interesting to explore the resource rich developing economy as well in order to find out if there exists the link between economic growth and health as well as the nature of causal direction between them.

The studies on health care and economic growth are limited as most studies considered mainly education to be associated with human capital. This makes understanding of the association between GDP and health to be somewhat incomplete. Furthermore, the results of the few related studies on health and economic growth are mixed and inconclusive. While there are studies that show positive association (Boachie, 2017) between the two variables, others reveal negative association. More so, the results of some studies show different causal direction as some studies show one-way causality from health to GDP growth (Bloom and Fink, 2014), some other studies show the reverse (Ogunjimi and Adebayo, 2019); whereas few studies show bidirectional causality and no causality. While few related studies have been conducted among OECD, the evidence of this related study from resource rich developing economies is scanty or not available. Hence, the purpose of this paper is to investigate the association between economic growth and health in resource rich developing economies focusing on Saudi Arabia and Nigeria as they are both members of organization of petroleum exporting countries (OPEC). Furthermore, the two countries have recently came up with various strategies and visions to diversify their economies from crude oil. The remaining sections of this paper are divided as follows; section 2 presents the literature review and empirical studies on health and economic growth, section 3, 4 and 5 presents the methodology for the study, results analysis, and conclusion respectively.

2. Literature Review

This section discusses the overview of health and life expectancy at birth as well as the empirical literature of the study.

2.1 Overview of Health and Life Expectancy at birth in Resource rich Countries: A Case of Saudi Arabia and Nigeria

This study refers resource rich economies as those countries that have been blessed with the natural resources such as crude oil, natural gas, gold and other solid minerals among others. These countries are expected to be richer than other countries because of their resource base. Though a few of these countries have been able to increase their national income and GDP through these natural resources but many of them are still underdeveloped. This could be due to what is termed resource curse which among other factors arise as a result of abandoning other sectors of the economy to solely rely on a single resource. Saudi Arabia and Nigeria are richly endowed with crude oil of the total estimated proved reserves of 297.7 thousand million barrels and 66.4 thousand million barrels respectively (BP Statistical Review, 2019). The contribution of oil sector to foreign exchange earnings of Saudi and Nigeria are 70% and 90% respectively, while the oil sector contribution to GDP is 50% and 10% for Saudi and Nigeria respectively (General Authority of Statistics, 2019; Adelowo et al., 2016). The two countries have embarked on the economy diversification path so as to reduce their dependence on oil. The fluctuation of global oil price has significantly impaired the economic growth-path of the two economies anytime there is a downward trend in the global crude oil price which for instance led to economic recession especially in Nigeria in year 2016/2017 and year 2020/2021 during Covid-19 pandemic. This diversification path has led to the creation of Vision 2030 in Saudi Arabia therein consists of various goals and strategies of driving the economy towards growth and reducing the reliance on oil. Improvement in the health sector has been recognized as one of the ways to achieve sustainable growth.

The snap glance of health expenditure in Saudi Arabia and Nigeria is shown in Table 1 below. The current health expenditure as a percentage of GDP is 4.2%, 3.7% and 5.7% for Saudi Arabia while 2.6%, 3.3% and 3.7% for Nigeria for the year 2000, 2010 and 2016 respectively. This shows that Saudi Arabia is spending an average of 4.5% on health (as % of GDP) based on the three years mentioned and Nigeria spends an average of 3.2% on health (as % of GDP). The domestic government of Saudi Arabia spends 67.8% of the total current health expenditure of year 2016 whereas the Nigerian government spends 13% of the total current health expenditure for the year 2016.

Table 1: Life Expectancy and Health Expenditure in Saudi Arabia and Nigeria

Year	**Current HE (% of GDP) for Saudi**	**Current HE (% of GDP) for Nigeria**	**Domestic Government HE (% of current HE) for Saudi**	**Domestic Government HE (% of current HE) for Nigeria**	**Life Expectancy for Saudi (in years)**	**Life Expectancy for Nigeria (in years)**
2000	4.21	2.64	72.05	20.12	72.6	43.3
2010	3.66	3.26	64.85	13.76	73.9	50.9
2016	5.74	3.65	67.80	13.02	74.8	53.5

HE: Health Expenditure
Source: World Bank Development Indicators, 2019

This indicates that government is mainly provider for health care and health spending in Saudi Arabia whereas domestic private individuals and companies are primary providers of health service and health spending in Nigeria. The average life expectancy at birth in Saudi Arabia is above 70 years while that of Nigeria is approximately 50 years as shown in Table 1. The domestic government spending on health (as a ratio of the total expenditure) ranges between 7% and 10% for Saudi Arabia over the period 2000-2016 whereas that of Nigeria ranges between 2% and 5%. The figure of current health spending per capita (in current US$) is over US$1000 for Saudi individual in year 2016 while this figure is less than US$100 for Nigeria individual in the same year. This could be due to the high population in Nigeria in one hand, but on the other hand it revealed that an average individual in Nigeria has less income to spend on health care. The content analysis of Table 1 indicated that Saudi Arabia fared better than Nigeria in the health indices presented despite that they are both resource rich countries.

2.2 Empirical Literature

This research is situated within the augmented neo-classical economic growth theory (Mankiw et al., 1992) and endogenous growth theory (Romer, 1990; Lucas, 1988). It is believed that human capital is a vital factor which promotes the increase of aggregate output in the economy. Human capital, specifically health and education, is being viewed as a separate factor of productivity and growth for the past three decades (Bedir, 2016). Improvement in health is very significant to increase labor productivity and capital accumulation. According to Mushkin's (1962) health-led growth hypothesis, health care spending (investment) has been suggested to increase income and stimulate the aggregate economic output. Meanwhile, Preston (1975) is of the view that country with higher incomes seem to have a better health conditions for her citizens and residents than the country with lower incomes. Hence, two-way causality can be analyzed between economic growth (income) and health.

Ozturk and Ada (2013) studied the link between GDP and health spending among the European Union (EU) members which consists of Portugal, Greece, Spain, Austria, Belgium, Luxembourg, Denmark, France and Italy over the period 1980—2009. The result of cointegration revealed that economic growth and health spending have long run relation in 6 out of 9 Countries. More so, the result of granger causality is mixed in the sampled countries. Economic growth granger cause health expenditure in Spain, Luxembourg, Portugal, Austria, France and Italy; there is bidirectional causality in the case of Belgium; whereas no causal connection was found between health spending and GDP in Denmark and Greece. While Hassan and Kalim (2012) could not detect a short run causality between health spending per capital and real GDP per capital in Pakistan, but a bidirectional causality was established between them in the long term.

Boachie (2017) investigated the influence of health on GDP in Ghana using ARDL bounds test for the period 1982-2012 whereby GDP per capita and life expectancy measure economic growth and health respectively. The result disclosed that good health positively and significantly fosters GDP at both short- and long-run.

Bedir (2016) assessed the connection between income and health expenditures in some selected developing countries in Asia, Middle East African and Europe for the period 1995-2013. The results on one hand revealed a one-way causality from health to income for South Africa, Egypt, Korean Republic, Hungary, and the Philippines. On the other hand, the results also revealed causality from income to health for China, Greece and UAE among others. Meanwhile two-way causality was also found for Russia and Czech Republic. Ogunjimi and Adebayo (2019) assessed the nexus among GDP, health outcomes and health expenditure in Nigeria between 1981 and 2017 using Toda-Yamamato Causality and ARDL bound statistical test. The outcomes showed a one-way causality from health spending to infant mortality; a unidirectional causality from GDP and health spending to life expectancy and maternal mortality was found; and a causality from GDP to health expenditure was also established.

Bhargava et al. (2001) examined the impacts of adult survival rates (ASR) on economic growth. The results indicated positive impacts of ASR on GDP growth rates in low-income nations whereas the estimated impact was negative for highly developed countries. Wang (2015) using GMM estimated the optimal health care spending among the OECD between 1990 and 2009. The outcome of the study disclosed that when the percentage of health expenditure to GDP is below the optimum level of 7.55 per cent, increases in health expenditure effectively resulted in an improved economic productivity, whereas health expenditure beyond this level would not improve health care service.

Bloom et al. (2004) revealed that good health positively influences economic growth using a production model. Aboubacar and Xu (2017) studied the nexus between health care expenditure and GDP in Sub-Saharan Africa between 1995 and 2014 using GMM. The outcome indicated that health spending significantly influenced GDP of the region. Boussalem et al. (2014) in their study between GDP and public health expenditure in Algeria found causality from health spending to GDP in the long run. However, the result revealed a one-way direction from GDP to health expenditure in the short run. Wang (2011) used panel of 31 countries between 1986 and 2007 to analyse the nexus between GDP and health spending. The results of the panel regression showed that health spending accelerate GDP growth whereas the GDP growth decreases health spending growth. The quantile regression reported that health expenditure tends to increase economic growth in middle- and high-income countries but tend to decrease GDP in low-income nations. In the study of Eggoh et al. (2015) which explored the association between GDP and human capital for the period 1996-2010 in 49 African countries. The result reported that health expenditures negatively influenced economic growth, which was attributed to underinvestment in health sector, bureaucracy and corruption in many African countries.

Erçelik (2018) using autoregressive distributed lag (ARDL) examined the association between output and health spending in Turkey between 1980 and 2015. The result indicated a positive long run association between output and health care spending. Also, Pradhan (2010) explored the impact of health expenditure on GDP in 11 nations, which comprises countries from Europe, Asia and North America for the period 1961-2007. The outcome of the panel framework indicated a two-way direction between health expenditure and GDP.

The empirical results have indicated that while some studies have showed health variables such as expenditure, adult survival rate, and life expectancy among others as significant contributors to economic growth in some countries, other studies showed that economic growth is the main contributor to health variables. Furthermore, there are studies that showed bi-directional association between health and economic growth and few others was not able to find any association between them. The past studies have been conducted among EU members, Asian countries, Sub-Saharan Africa and other few countries with no study among the resource rich countries. Hence, this article assesses the association between health factors and GDP in resource rich countries with the case study of Saudi Arabia and Nigeria.

3. Methodology

This section covers the variables, data and the method used for this study.

3.1. Variables, Measurement and Data Sources

This study used time series data which span between 2000 and 2016 for Saudi Arabia and Nigeria. The data of concern include health expenditure per capita, life expectancy at birth and GDP per capital. Current health expenditures per capita in current US dollars measure the total estimated healthcare goods and services consumed by each individual within a year in a country. Life expectancy at birth measures how long (in years) a new-born baby would live given the present health condition in such a country, and assuming the condition is constant throughout his/her life period.

Health expenditure per capital (HEC) and life expectancy at birth (LEB) are the variables which are used to proxy health, while GDP per capita (Constant at 2010 US$) is used to proxy economic growth (GDPC) and were obtained from World Bank data bank. Unlike most studies which used either health expenditure or life expectancy, this study used the two variables together to capture health. The period of the sample used for this study was based on the constraints on the availability of data on World Bank Development Indicator data bank.

3.2. Model Specification

This study is premised on the economic growth model wherein health (proxied by health expenditure and life expectancy at birth) is a major factor contributing to economic growth (GDP per capita) as shown in Eqn. (1)

$$GDPC = f(HEC, LEB) \tag{1}$$

Natural logarithm is introduced to the growth model stated above to eliminate the stochastic error term from the model, then the log linear form for Eqn. (1) is expressed in Eqn (2) as:

$$LGDPC = B_0 + B_1LHEC + B_2LLEB + U_t \tag{2}$$

Where B_0 is the constant term; B_1 and B_2 are the coefficients of LHEC and LLEB respectively; and U_t is the error term.

It therefore becomes imperative to test for a unit root on the data to obtain the data that are stationary so as to prevent the model from spurious results. A variable is adjudged stationary when the mean, variance and autocovariance are constant for each given lag (Brooks, 2008). A unit root test is carried out in this study using the Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1979). The existence of a unit root implies nonstationary of the data and denoted as null hypothesis, whereas nonexistence of a unit root is indicated by the alternative hypothesis. If the null hypothesis of the ADF test could not be rejected, that depicts that the variable is not stationary, which then leads to the removal of the unit root by differencing the data by *d* times in order to make it stationary i.e I*(d)*. It is expected that the variables that would be used for the model could be stationary at level I(0) or at *first difference* I(1). If a variable is stationary at s*econd difference* I(2), such variable would be dropped in order to avoid spurious result. When the data comprises I(0) and I(1) variables, then the autoregressive distributed lag (ARDL) could be adopted (Pesaran and Shin, 1998). This method has the capacity to estimate relationship better than other methods when the variables are cointegrated of different order and when the size of the sample is relatively small.

ARDL is a method which assesses the links between two or more variables in both long- and short-term (Pesaran et al., 2001). This is tested using the ARDL Bounds test of cointegration as stated in Eqn. (3) below.

$$\Delta LGDPC_t = \alpha_0 + \sum_{j=0}^{n} \gamma_j \, \Delta LGDPC_{t-j} + \sum_{j=0}^{n} \beta_j \, \Delta LHEC_{t-j} + \sum_{j=0}^{n} \Theta_j \, \Delta LLEB_{t-j} + \varphi_1 LGDPC_{t-1} + \varphi_2 LHEC_{t-1} + \varphi_3 LLEB_{t-1} + \varepsilon_t \qquad (3)$$

From Eqn. (3) above, the changes in the natural log of each of the variables at time t are represented by$\Delta LGDPC_t$, $\Delta LHEC_t$, and $\Delta LLEB_t$. Furthermore, the constant value, number of lags and the error term are represented by α_0 , n and ε_t respectively. While $\Delta LGDPC_t$ is the dependent variable, $\Delta LHEC_t$ and $\Delta LLEB_t$ are the independent variables. The short run parameters are represented by the coefficients β_j, γ_j, Θ_j whereas the long run parameters which indicate the existence of cointegration through bound test are depicted by φ_1, φ_2 and φ_3. The null and alternative hypotheses are stated below as derived from Eqn. (3). The null hypothesis signifies that there is no cointegration between the variables, while the alternative hypothesis indicates the presence of cointegration.

H_0: $\varphi_1 = \varphi_2 = \varphi_3 = 0$

H_1: $\varphi_1 \neq \varphi_2 \neq \varphi_3 \neq 0$

According to Pesaran et al. (2001), if the calculated value of the F-statistic is above the upper bounds of the critical value, then the existence of cointegration is established through the rejection of null hypothesis. However, if the calculated F-statistic is below the lower bounds of the critical value, then there is absence of cointegration among them. Meanwhile when the value of the F-statistic is in between the upper bound and the lower bound of the critical values, then this implies inconclusive result. Once the model established the existence of cointegration, then the long run coefficients and effects of the independent variables can be obtained after estimating a long run growth model of Eqn. (4).

$$LGDPC_t = \alpha_0 + \varphi_1 LGDPC_{t-1} + \varphi_2 LHEC_{t-1} + \varphi_3 LLEB_{t-1} + \varepsilon_t \qquad (4)$$

This indicates that error correction model within ARDL framework could be performed (Akinwale and Muzindutsi, 2019). The coefficients β_j, γ_j, Θ_j of each explanatory variables explained the short run causality (Narayan and Smyth, 2009; Altaee et al., 2016; Akinwale and Grobler, 2019). This is expressed in Eqn. (5) as follows:

$$\Delta LGDPC_t = \alpha_0 + \sum_{j=0}^{n} \gamma_j \, \Delta LGDPC_{t-j} + \sum_{j=0}^{n} \beta_j \, \Delta LHEC_{t-j} + \sum_{j=0}^{n} \Theta_j \, \Delta LLEB_{t-j} + \lambda \mathrm{ECT}_{t-1} + \varepsilon_t \qquad (5)$$

The coefficient of ECT_{t-1} is represented by λ and this indicates the adjustment coefficient, which should be negatively significant in order to confirm the cointegration relationship and the long run speed of adjustment.

4. Discussion of Results

Table 2 describes the natural log of the three series. The mean values of the three series are higher for Saudi Arabia than that of Nigeria. However, the standard deviation values for the three series are higher for Nigeria than that of Saudi Arabia. This shows that Saudi Arabia performs better in the three index and also less volatile, though the levels of volatility in the two countries are generally low. The probability values of Jarque-Bera test are greater than 5% which signify that the three variables are normally distributed in both countries.

Table 2: Descriptive statistics

Item	Saudi Arabia			Nigeria		
	LGDPC	**LHEC**	**LLEB**	**LGDPC**	**LHEC**	**LLEB**
Mean	9.8759	6.4777	4.2966	7.5926	3.9813	3.9073
Maximum	9.9762	7.1584	4.3143	7.8490	4.6749	3.9804
Minimum	9.7183	5.9075	4.2844	7.1601	2.6825	3.8344
Std. Dev.	0.0750	0.4574	0.0094	0.2472	0.6787	0.0486
Jarque-Bera	0.6544	1.5343	1.0410	2.2195	2.5908	1.6680
Probabiliy	0.7209	0.4643	0.5942	0.3296	0.2330	0.5311

The ADF results in Panel(A) for Saudi Arabia show that the log of economic growth and health expenditure are stationary at I(1) while log of life expectancy at birth is stationary at I(0) as reflected in Table 3. More so, in Panel(B) for Nigeria, log of health expenditure is stationary at I(1) while that of life expectancy and economic growth are stationary at I(0). The series for the two countries do not contain any data that is stationary at I(2), and the series consist of both I(0) and I(1). This indicates the absence of unit root in the series and at the same time make the data suitable for ARDL Bounds test.

Table 3: ADF test for unit root

Series	**Panel A (Saudi Arabia)**		**Remark**	**Panel B (Nigeria)**		**Remark**
	Levels	First Difference		Levels	First Difference	
LGDPC	-0.73	-3.73^{**}	I(1)	-9.25^{***}	-3.19^{**}	I(0)
LHEC	-0.22	-3.90^{**}	I(1)	-2.22	-3.34^{**}	I(1)
LLEB	-4.42^{***}	-8.32^{***}	I(0)	-4.25^{***}	-0.01	I(0)

(*), (**), (***) denote 10%, 5%, 1% and significant level, respectively

Eqn. (3) was conducted to establish the presence of cointegration between LGDPC and the exogenous variables (LHEC and LLEB) using ARDL. The results as shown in Table 4 reveal the rejection of null hypothesis at

5% level for both countries as the computed F-statistic is above the upper boundaries. While the calculated F-statistic is 5.07 as against the upper bound critical value of 4.85 for Saudi Arabia, the calculated F-statistic is 16.64 in the case of Nigeria. This implied a long run association among the variables in both countries.

Table 4: Bounds test for F-statistic

Country	K	F-statistic	5% Level of Significance	
			Lower Bound	Upper Bound
Saudi Arabia	2	5.07	3.79	4.85
Nigeria	2	16.64	3.79	4.85

Table 5 shows the long run coefficients and impact among the variables as derived from Eqn. (4). The results indicate that both health factors (LHEC and LLEB) have positive influence on economic growth in both Saudi Arabia and Nigeria in the long run. In Saudi Arabia, health expenditure and life expectancy positively influence economic growth by 0.15 and 12.35 respectively, whereas health expenditure and life expectancy at birth positively influenced GDP by 0.30 and 0.29 respectively in Nigeria. This implied that 1% rise in health expenditure and life expectancy in the long run would raise economic growth by 0.15% and 12.35% respectively in Saudi Arabia but would raise economic growth by 0.30% and 0.29% in Nigeria. Furthermore, while life expectancy is significant at 1% level in Saudi Arabia, health expenditure is significant at 1% level in Nigeria.

Table 5: Estimated Long run Coefficients using ARDL

Variables	Coefficient (Saudi Arabia)	Coefficient (Nigeria)
LHEC	0.15	0.30***
LLEB	12.35***	0.29

(*), (**), (***) indicate 10%, 5% and 1% significant level, respectively

After the long run relationship has been established, it becomes necessary to study the short run dynamics as well as the long-term speed of adjustment of the error correction model as stated in Eqn. 5. Table 6 reports that in the short term, LLEB and LHEC positively influenced LGDPC by 2.43 and 0.07 respectively in Saudi Arabia though only LLEB is statistically significant. The ECT is in line with the expectations. The coefficient value of -0.71 indicates that 71% of any shock from equilibrium is corrected each year which means the speed of adjustment back to equilibrium is relatively fast. Also, Table 6 reveals that while LHEC has a positive and significant effect on LGDPC in Nigeria with 0.31 coefficient value in the short run, LLEB has a negative and insignificant influence on LGDPC with a value of -2.98. The ECT is negatively significant at 1%, and the value of -0.72 implies that any deviation from the long run equilibrium would automatic adjust back with a speed of 72%.

Table 6: Short run Coefficients using ECM

Variables	**Coefficient (Saudi Arabia)**	**Coefficient (Nigeria)**
ΔLHEC (-1)	0.07	0.31^{***}
ΔLLEB (-1)	2.43^{**}	-2.98
ECT(-1)	-0.71^{***}	-0.72^{***}

(*), (**), (***) indicate 10%, 5% and 1% significant level, respectively

The causal analysis between the variables was also conducted using Granger (1969) causality test. Table 7 shows a one-way causality from LHEC and LLEB at birth to LGDPC for Saudi Arabia, and from LLEB to LHEC. On the other hand, there is only one-way causality from LLEB and LHEC to LGDPC in Nigeria without any other form of causality. These results confirmed health-led growth hypothesis for the two countries since there is no causality from LGDPC to either LHEC or LLEB.

Table 7: Granger Causality Results

Null Hypothesis:	**F-Statistic (Saudi)**	**F-Statistic (Nigeria)**
ΔLHEC does not Cause ΔLGDPC	3.32^{*}	12.79^{***}
ΔLGDPC does not Cause ΔLHEC	1.18	0.13
ΔLLEB does not Cause ΔGDPC	10.79^{***}	4.02^{*}
ΔGDPC does not Cause ΔLLEB	0.19	1.70
ΔLLEB) does not Cause ΔLHEC	4.23^{**}	2.65
ΔLHEC does not Cause ΔLLEB	0.28	1.83

(*), (**), (***) denote 10%, 5% and 1% significant level, respectively

The results from this study have shown that both health expenditure and life expectancy positively influence economic growth of the two resource rich countries. These results are in line with some related studies (Boachie, 2017; Aboubacar and Xu, 2017; Schultz, 2005; Gyimah-Brempong and Wilson, 2004) but different from other studies (Eggoh et al., 2015). The life expectancy seems to have much impact in Saudi Arabia which could not be farfetched from the longer number of years people live. As people live longer, they tend to contribute more to the economic growth of Saudi Arabia. Socioeconomic and human development factors which contribute to life expectancy are not discussed in this study. Health expenditure has more influence on economic growth than life expectancy in Nigeria. Nigeria has increased the spending on health care so as to meet the target of Abuja Declaration of 2001 which is allocation of a minimum of 15 per cent of their yearly budget to advance the health sector. However, the life expectancy in Nigeria is relatively lower than the world's average (World Bank Development Indicator, 2019), which is ordinarily affecting the GDP in the short run as the average life expectancy of people in the country is 54 years. There is a need for the country to improve the socioeconomic infrastructure and human development which would invariably improve life expectancy. The results of the long run growth model are further supported by the Granger Causality test, which reveal that causality runs from each of health expenditure and life expectancy at birth to economic growth without any feedback, which is against the results obtained by few studies (Ogunjimi and Adebayo, 2019; Erçelik, 2018; Halıcı-Tülüce et al., 2016) but similar to few other studies (Bedir, 2016; Ozturk and Topçu (2014). There is a great need for the government to continue to invest in health care human and infrastructural development so as to boost the productivity of the residents of the two countries which would improve the economic growth.

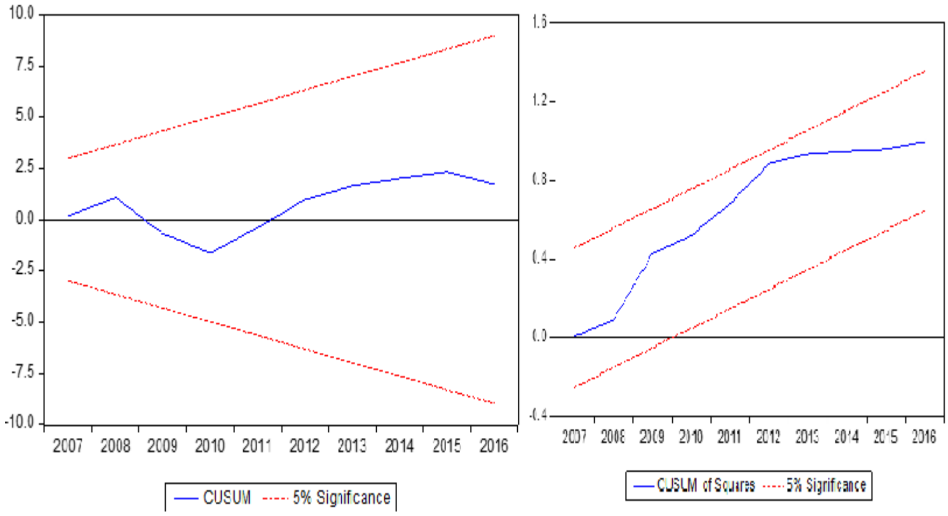
The residual and stability diagnostic tests were also conducted to determine the adequacy of the data used for this study. The results of the test for autocorrelation, heteroskedasticity and normality are stated in Table 8. The results reveal that the model passed all the diagnostic tests as the null hypotheses of no serial correlation, no heteroskedasticity and normal residuals could not be rejected as their probability values are above 5% level of significant for the two countries.

Table 8: Diagnostic test results

Item	Statistic	P-Val (Saudi)	P-Val (Nigeria)
Serial Correlation	LM Test	0.58	0.66
Normality	JacqueBera	0.86	0.69
Heteroscedasticity	Breusch Pagan Godfrey	0.82	0.50

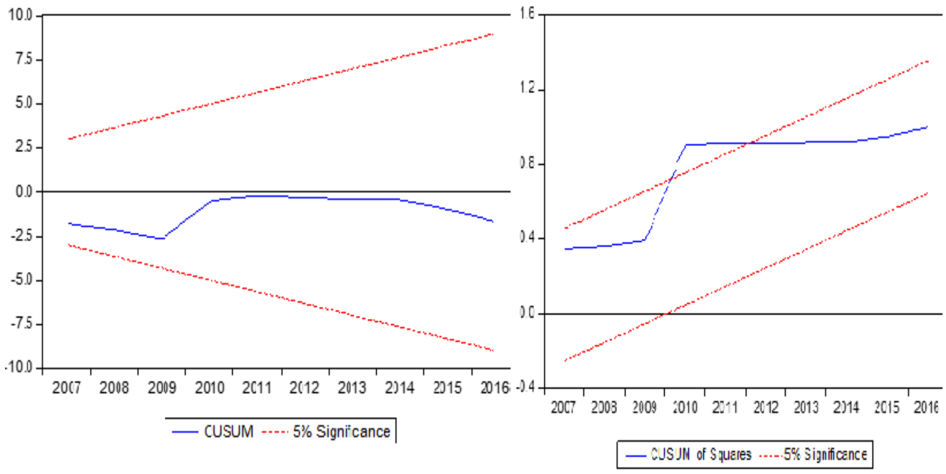
Also, the results of stability tests are represented by the graphs of CUSUM and CUSUM sum of squares (CUSUMsq), and they are expected to be within the boundary of 5% level of significance. Figure 1 shows that both the CUSUM and CUSUMsq are within the two limits for Saudi Arabia, which represent that the model is structural stable over the long run period observed.

Figure 1: Stability test of CUSUM and CUSUMsq for Saudi Arabia



Furthermore, While CUSUM test shows stability of the model in Figure 2 in the case of Nigeria as the graph is in between the two boundaries at 5% level, the CUSUMsq shows that the graph slightly goes out of the boundary of 5% level between year 2010 and 2011 and this could be an outcome of financial meltdown towards the end of 2009 which affected most sectors of the economy. However, the model is adjudged adequate as it passed the residual and stability diagnostic tests.

Figure 2: Stability test of CUSUM and CUSUMsq for Nigeria



5. Conclusion

This study explored the linkages between economic growth, life expectancy at birth and health expenditure in Saudi Arabia and Nigeria. The research utilized the ARDL, ECM and granger causality to assess the long run, short run and causal relationships among the variables. The results of bounds test indicate a cointegration among the variables which signified the existence of long run relationship in both countries. In the long run, health expenditure and life expectancy at birth positively influence economic growth in both countries. Although, life expectancy at birth has higher impact than health expenditure in Saudi whereas health expenditure has higher impact in Nigeria. The results of the two countries in the short run are also similar to that of the long run except that life expectancy at birth negatively affected economic growth in Nigeria. The causality test showed a one-way causality running from each of health expenditure and life expectancy at birth to economic growth. This study hereby validates health-led growth hypothesis in the resource rich countries of Saudi Arabia and Nigeria.

References

Adelowo, C., Olaopa, O. and Akinwale, Y. (2016), “Policy Direction for Effective Interaction and Linkages among the Elements of Nigeria’s National Innovation System,” *Journal of Entrepreneurship and Innovation Management*, 5(1), 1-32

Akinwale, Y. (2020), “Technology innovation and financial performance of MSMEs during Covid-19 lockdown in Dammam area of Saudi Arabia: a case of food and beverage sector,” International Journal of Technology Learning, Innovation and Development, 12(2), 136-152.

Akinwale, Y. (2018), “Towards the Realisation of Vision 2030 and Beyond in Saudi Arabia: A Causality Analysis between Education and Economic Growth,” *Journal of Applied Economic Sciences*, 13(4), 944 - 954.

Akinwale Y., Jeseleye, O., and Siyanbola, W. (2013), “Empirical analysis of the causal relationship between electricity consumption and economic growth in Nigeria,” *British Journal of Economics, Management and Trade*, 3(3), 277-295

Akinwale, Y. and Muzindutsi, P-F. (2019), “Electricity consumption, trade openness and economic growth in South Africa: An ARDL approach,” *Journal of Economic Cooperation and Development*, 40(1), 135-156

Aboubacar, B and Xu, D. (2017), “The impact of health expenditure on the economc growth in Sub-Saharan Africa,” *Theoretical Economic Letters*, 7, 615-622

Altaee, H., Al-Jafari, M, and Khalid, M. (2016), “Determinants of Economic Growth in the Kingdom of Saudi Arabia: An Application of Autoregressive Distributed Lag Model,” *Applied Economics and Finance*, 3(1), 83-92

Bhargava, A., Jamison, D., Lau, L. and Murray, C. (2001), “Modeling the effects of health on economic growth,” *Journal of Health Economics*, 20, 423–440

Bedir, S. (2016), “Healthcare Expenditure and Economic Growth in Developing Countries,” *Advances in Economics and Business*, 4(2), 76-86

Boachie, M. (2017), "Health and economic growth in Ghana: An empirical investigation," *Fudan Journal of Humanities and Social Sciences*, 10(2), 253-265.

Barro, R. (1999), "Determinants of economic growth: Implications of the global evidence for Chile," *Cuadernos de Economia*, 36 (107), 443–478.

Bloom, D. and Fink, G. (2014), "The economic case for devoting public resources to health," *In J. Farrar, N. White, D. Lalloo, P. Hotez, T. Junghanss, & G. Kang (Eds.), Manson's tropical diseases (23rd ed., pp. 23–30),* Philadelphia: Elsevier.

Bloom, D., Kuhn, M. and Prettner, K. (2018), "Health and Economic Growth," *IZA Institute of Economics Discussion Paper No. 11939*, Germany

Bloom, D., Canning, D. and Sevilla, J. (2004), "The effect of health on economic growth: a production function approach," *World Development*, 32(1), 1-13

Boussalem, F., Boussalem, Z. and Taiba, A. (2014), "The relationship between public spending on health and economic growth in Algeria: testing for cointegration and causality," *International Journal of Business and Management*, 2(3), 25-39

BP Statistical Review (2019), "Review of World Energy," Available at: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf.

Brooks C. (2008), "Introductory Econometrics for Finance," 2nd edition, *Cambridge University Press: London*.

Deaton, A. (2013), "The great escape: Health, wealth, and the origins of inequality," *Princeton, NJ: Princeton University Press*.

Dickey D, and Fuller W. (1979), "Distribution of the estimators for autoregressive time series with a unit root," *Journal of the American Statistical Association*, 74, 427-431.

Elmi, Z. and Sadeghi, S. (2012), "Health care expenditures and economic growth in developing countries: panel co-integration and causality," *Middle-East Journal of Scientific Research*, 12(1), 88-91.

Engle, R. and Granger, C. (1987), "Cointegration and error-correction: representation, estimation, and testing," *Econometrica*, 55, 251-276.

Eggoh, J., Houeninvo, H., and Sossou, G.A. (2015), "Education, health and economic growth in African countries," *Journal of Economic Development*, 40(1), 93–111

Erçelik, G. (2018), "The Relationship between health expenditure and GDP per capita in Turkey from 1980 to 2015," *Journal of Politics, Economy and Management*, 1(1), 1–8

General Authority of Statistics (2019), "Economic Indicators," Available at: https://www.stats.gov.sa/en/node/10127.

Granger, C. (1969), "Investigating causal relations by econometric models and cross-spectral Methods," *Econometrica: Journal of the Econometric Society*, 37(3), 424-438.

Gyimah-Brempong, K., and Wilson, M. (2004), "Health human capital and economic growth in sub-Saharan African and OECD countries," *The Quarterly Review of Economics and Finance*, 44 (2), 296–320.

Halıcı-Tülüce, N., Doğan, İ., and Dumrul, C. (2016), "Is income relevant for health expenditure and economic growth nexus?," *International Journal of Health Economics and Management*, 16(1), 23-49.

Hassan, M. and Kalim, R. (2012), "The triangular causality among education, health and economic growth: A time series analysis of Pakistan," *World Applied Sciences Journal*, 18(2), 196–207.

Johansen, S. and Juselius, K. (1990), "Maximum likelihood estimation and inference on cointegration with applications to the demand for money," *Oxford Bulletin of Economics and Statistics*, 52(2), 169-210.

Lucas, R. (1988), "On the mechanics of economic development," *Journal of Monetary Economics*, 22, 3–42.

Mankiw, N., Romer, D., Weil, D. (1992), "A contribution to the empirics of economic Growth," *Quarterly Journal of Economics*, 107(2), 407–437.

Murthy, V and Okunade, A. (2009), "The core determinants of health expenditure in the African context: some econometric evidence for policy," *Health Policy*, 91, 57-62.

Mushkin, S. (1962), "Health as an investment," *Journal of Political Economy*, 70, 129-157

Narayan, P. and Smyth, R. (2009), "Multivariate Granger causality between electricity consumption, exports and GDP: evidence from a panel of Middle Eastern countries," *Energy Policy*, 37, 229–236

Ogunjimi, J. and Adebayo, A. (2019), "Health Expenditure, Health Outcomes and Economic Growth in Nigeria," *Munich Personal RePEc Archive (MPRA) Paper No. 94989*.

Ozturk, S. and Topçu, E. (2014), "Health expenditures and economic growth: Evidence from G8 countries," *International Journal of Economics and Empirical Research*, 2(6), 256-261.

Ozturk, F. and Ada, Y. (2013), "Is Health Expenditure Important for Economic Growth in Selected EU Countries?" *The Empirical Economics Letters*, 12(7), 715-722

Pesaran, M. and Shin, Y. (1998), "An autoregressive distributed-lag modelling approach to cointegration analysis," *Econometric Society Monographs*, 31, 371-413.

Pesaran, M., Shin, Y. and Smith, R. (2001), "Bounds testing approaches to the analysis of level relationships," *Journal of Applied Econometrics*, 16(3), 289-326.

Pradhan, R. (2010), "The long run relation between health spending and economic growth in 11 OECD countries: Evidence from panel cointegration," *International Journal of Economic Perspectives*, 4(2), 427–438

Preston, S. (1975), "The Changing Relation between Mortality and Level of Economic Development," *Population Studies*, 29, 231–48.

Romer, P. (1990), Endogenous technological change," *Journal of Political Economy*, 99(5), S71–S102.

Schultz, T. (2005), "Productive benefits of health: Evidence from low-income countries," *IZA Discussion Paper* No. 1482, Yale University Economic Growth Center Discussion Paper No. 903. Retrieved from https://ssrn.com/abstract=645001.

Wang, F. (2015), “More Health Expenditure, Better Economic Performance? Empirical Evidence From OECD Countries,” *Inquiry*,52, 1-5.

Wang, K. (2011), “Health care expenditure and economic growth: quantile panel-type Analysis,” *Economic Modelling*, 28(4), 1536-1549

Weil, D. (2015), “A review of Angus Deaton’s ‘the great escape: health, wealth, and the origins of inequality’,” *Journal of Economic Literature*, 53, 102–114.

Weil, D. (2014), “Health and economic growth,” *In P. Aghion & S. N. Durlauf (Eds.), Handbook of economic growth*, Vol. 2B, pp. 623–682). Amsterdam: Elsevier.