International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2018, 8(3), 43-50.

Greenhouse Gas Emissions and Health Outcomes in Nigeria: Empirical Insight from ARDL Technique

Oluwatoyin Matthew[1], Romanus Osabohien[2]*, Fagbeminiyi Fasina[3], Afolake Fasina[4]

[1]Department of Economics and Development Studies, College of Business and Social Sciences, Covenant University, Ota, Ogun State, Nigeria, [2]Department of Economics and Development Studies, College of Business and Social Sciences, Covenant University, Ota, Ogun State, Nigeria, [3]Department of Economics and Development Studies, College of Business and Social Sciences, Covenant University, Ota, Ogun State, Nigeria, [4]Department of Economics and Development Studies, College of Business and Social Sciences, Covenant University, Ota, Ogun State, Nigeria. *Email: romanus.osabohien@covenantuniversity.edu.ng

ABSTRACT

This study examines the long-run effect of emissions of greenhouse gas (GHG) on health outcomes in Nigeria using time series data from 1985 to 2016 engaging the auto-regressive distribution lag (ARDL) econometric approach to cointegration and it was observed that human activities increase GHG to the atmosphere, this is through combustion of fossil fuels and CO_2, these are two major sources of GHG emissions (GHGE). When the quantity of carbon dioxide increases in the air, more heat is stored in the atmosphere; and this comes upon human beings thereby causing a great harmful effect to human health. The result from ARDL econometric approach to cointegration shows that 1% increase in GHGE reduces life expectancy by 0.0422% which is used as a proxy for health outcome, if this happens, invariably, mortality rate will be 146.6%. Therefore, the major strategy among others recommended in this study for controlling gaseous emissions and increase life expectancy is public health expenditure as the results also shows that 1% increase in government health care expenditure increases life expectancy approximately by 18.10%.

Keywords: Greenhouse Gas Emissions, CO_2, Health Outcomes, Auto-regressive Distribution Lag
JEL Classifications: Q4, H51, B4

1. INTRODUCTION

Depletion of resources and changes in climatic conditions remains as the major environmental challenges globally (Intergovernmental Panel on Climate Change, [IPCC], 2007). But the effects of these challenges and susceptibility to these challenges however, are not the same across regions of the world. Some continents are more susceptible to the effects of climatic variation and dilapidation of the environment than other continents of the world (IPCC, 2007; Mesagan and Ekundayo, 2015). For instance, it is feared that Africa and indeed Nigeria, may have the most insensitive impact of climate change than other regions and indeed countries of the world and it is also the continent that is least prepared to handle these impacts (Terr-Africa, 2009; World Bank, 2010). Evidences have shown from literature that emission of greenhouse gases (GHG) like CO_2 (carbon two oxide) and SO_2 (sulphur two oxide) are two main sources of climate change and their impacts are increasing daily due to human activities (Botkin and Keller, 1997; Behera et al., 2017). Although the contribution of the African continent to GHGE is relatively low globally (IPCC, 2001), the main causes of GHGE in Africa are not discovered fully yet from literature. In recent years, researchers have discovered that the agricultural sector has experienced problems resulting from environmental pollution which can be attributed to new methods adopted in production process and increased production structures imbibed in meeting the growth of the population and the demand of new energy globally (Narayan and Narayan, 2008; Seo et al., 2009; Agbonlahor and Phillip, 2015; Kumah, 2015; Siyan and Adegoriola, 2017).

Energy from fossil fuels like oil and gas which are widely explored in Africa, though, most times they are exported or even lost via gas flaring or leakages (OECD Development Centre/African Development Bank, 2003; 2004) with attendant consequence of threat to increase in GHG and global warming. Globally, Nigeria is known to be one of the highest producers and consumers of fossil fuel, irrespective of this, crude oil resource seems to pose a danger to the citizens of Nigeria in the coming decades (Alege et al., 2017). This is due to the fact that, unless problem of management of environmental sustainability the control of GHGE and adopt control measures to handle climate change, the country stands to suffer a shock. Unfortunately there are no sufficient data or studies to give pragmatic support of the concrete main causes of GHGE in sub-Sahara Africa (SSA). This scenario, when its left unchecked, will triggers incidence of the forecasts on the harmful effects of climatic variation on the standard of living and economies predicted by IPCC (2007) and Yohe et al. (2007) more especially as there are sufficient evidence to show that CO_2 emission have significant relationship with global warming. Hoelller et al. (1991) suggested that the opportunity cost of abandoning CO_2 emissions is likely to be dangerous to the developing nations like Nigeria and other SSA countries due to the rapid growth rate experienced by these countries. The situation is likely to remain the same (that is, the hazards) even if these less developed countries (LDCs) are permissible in multiplying gas emissions over another 100 years. Meanwhile, there is the possibility of having a large reduction in man-made CO_2 emissions globally only if the LDCs make a conscious effort to do this too.

The importance of health cannot be underestimated since it is very important aspect of an individual's wellbeing and a nation's economy, as it is often said that "a healthy nation is a wealthy nation". Since the individuals make a nation, giving the citizens of a country good healthcare service is a very important and necessary condition needed to achieve long-term sustainable economic development. Health can be defined as the fitness of a total physical condition, that is, the fitness of the body or mind especially in terms of the absence of illness, injuries or impairments. The issue of a good health condition is very important because it deals with not just humans but with the human body. Without a good health condition, it is almost impossible, if not totally impossible to carry out any meaningful economic activity, thus having good health is vital to the growth of any nation (Matthew et al., 2015). GHGE has adverse effects on the health of the individuals that live in the country. When health is adversely affected, there will be low aggregate output in the country.

Following the above assertion, the objective of this study is to; analyse the long run effect of GHGE (as proxied by CO_2 emissions) on the aggregate health outcomes of individuals. The study formulates the following hypothesis stated in the null form; H_0: There is no long run effect of GHGE on the aggregate health outcomes. The other sections of the paper are organized as follows; section two is brought insight from literature which are relevant to this study; the third section is the theoretical framework; the method engaged for the study is presented in section four; while the results as obtained from the econometric analysis are presented and discussed in section five and the last section (section six) presents the inference and recommendations with respects the policies what will turnaround the effect of GHGE.

2. LITERATURE REVIEW

People's activities as a result of the combustion of fossil fuels, cement manufacturing and land use for agriculture purposes causes of Carbon Dioxide emissions which are basically gaseous substances (IPCC, 2007). Globally, there has been a serious concern about the cumulative increased level emissions of gas which are been trapped into the atmosphere. Anderson et al. (2008) and Alege et al. (2017) using the VAR approach opined that GHGE have been on the increase since the industrial revolution. One of the dangers posed by these GHGE is that it results to the climatic changes, and this affects the environment negatively as well as hinders both human and economic activities adversely. Behera et al., (2017); Jiang and Li (2017), opined that increased emissions of GHG threatens an economy because they can bring about a massive decline in agricultural output.

According to the reports of Wood (2004) and the Environmental Health Committee (2004), these gaseous pollutants have reached a worrisome level. Exhaustion from all combustion engines which contain these pollutants has adverse effects on the health status of the populace which in turn also affects their productivity adversely. Taking it to the larger environment, the combustion of engines contribute to carbon dioxide accumulation in the atmosphere and are responsible for climate changes (Gislason, 2006). Emission of air pollutants such as carbon dioxide and methane, which are GHG play notable role in global warming, as they shut in heat without returning them as infrared or thermal radiation thereby contributing to the emerging global hazard(Pearce et al, 1999; Oguntoke and Adeyemi, 2017). According to recent estimation (NASA, 2005), the effects of methane, a chemically reactive GHG is substantially larger than ever estimated. In case of sulphur dioxide, both terrestrial and aquatic ecosystem are adversely affected by acid rain that it produces (NPI, 2006).

The adverse effects of gas emissions on humans are quite all-encompassing (NPI, 2006). Specifically, the pollutants have known adverse effects on human health especially children, who are the most susceptible age group due to their peculiarities. Ozone, sulphur dioxide, nitrogen dioxide gaseous substances can cause an increase in respiratory tract illness, asthma attacks and a reduction in the functioning of the lung. In some communities, breathing and circulation hospitalisations, cardiac death and even cancer of the lung are attributed to unpleasant repercussions of air pollutions (Oguntoke and Adeyemi, 2017). When the level of concentration of nitrogen dioxide (NO2) is high, it can cause serious lung damage which results in shortness of breath and chest pain (Oguntoke and Adeyemi, 2017). Methane as an asphyxiant is known to displace oxygen, and when the displacement is 18%, asphyxia can result in exposed persons (Oguntoke and Adeyemi, 2017). In the case of H2S, short-term contact with a high level of concentration may cause respiratory tract ailments. The aftermath effect after a long while may result to undue tiredness, appetite lost, pain, and tetchiness, loss of memory, faintness and women miscarriages (Oguntoke and Adeyemi, 2017). Too much contact with high level of concentration (say about 10–50 ppb) of SO2 causes respiratory tract ailments (NPI, 2006).

Levels of GHGE into the atmosphere (which includes carbon dioxide (CO_2) levels have been associated with increase in climate change, and hence experts have suggested lately on how to tackle climate change, which has to do with gradually reducing emissions of GHG; for instance, committing to the reduction of gaseous emission to 5% below 1990 points under the Kyoto Protocol (UNDP, 2007; 2008). The United Nations Structure Resolution on climatic change categorizes response to climatic changes into main folds: firstly, the mitigation of climate change by plummeting emissions of GHG and attractive sinks; secondly, by adjusting the effect climate change on health. Many of the developed nations devoted themselves by been a part of the UNFCCC and the Kyoto Protocol. These countries went ahead to adopt national policies and took equivalent measures on the alleviation of climate change and reduced their overall GHGE (Protocol 1997; Klein et al., 2007). The Kyoto Protocol recognized a strong link among the reduction of CO_2 emission goals, emissions trading and the role of the LDCs including SSA (Ellerman et al., 2009).Technology has also been reported to have some effects on level of GHGE. IPCC (1996) noted that improvements in technologies and measures that can be adopted in these three energy end-use sectors (viz.: Commercial/residential/institutional buildings, transportation and industry), as well as in the energy supply sector and in agriculture, forestry and waste management sectors could considerably reduce the levels of green house emissions globally. Agricultural production systems and technology really have roles to play in reducing levels of GHGE (Osabuohien et al., 2018; Willoughby et al., 2014).

3. THEORETICAL FRAMEWORK

It has been established that since the 1900s, the activities of the human beings cause GHGE which is at a dangerous state, and this has adversely affected the health of the individuals in the society (Ansuategi and Escapa, 2002). The resultant consequence of this increase in the rate of emissions, the concentration of GHG in the atmosphere has increased by 30%, since pre-industrial times (Ansuategi and Escapa, 2002). Examples of such anthropogenic activites include; trade, agriculture, deforestation (or forestry activities), fossil energy or fuel consumption and those other activities associated with economic growth. However, the theoretical basis for this study is based on the structural models of climate–economy interactions of Ramsey–Cass–Koopmans infinitely-lived agent framework (Sharma, 2011; Ramsey, 1928; Cass, 1965; Koopmans, 1965). They believed that the increase in the consumption of fossil fuel has been, to a large extent, attributed to the increasing level of economic growth.

In addition, Sharma (2011) opined that the Environmental Kuznets Curve (EKC) is involved in describing the two-fold relationship existing between economic actions and pollutants of GHG substances that are emitted by GHG one hand; and among the level of economic activity and the use of natural resources on the other hand. The EKC theory has it that dilapidation of the environment primarily hiked when a nation's income per capital is minimal over a period. Thus, as the economy experience growth, invariably dilapidation of the environmental reduces. This reduction leads to an upturned "U-shaped" relationship between income per capital, natural resources use and emissions waste (Sharma, 2011). Sharma reiterated that energy like crude oil, natural gas and coal, are highly essential as they needful in the satisfaction of both residential and industrial energy needs, useful in the transportation of human beings/goods and electricity generation. The combustion of fossil fuel is essential in all nations as it is required in producing goods and services. It is also a known fact that the combustion of fossil fuel releases a lot of carbon dioxide which contaminates the environment, which in turn has an adverse effect on the health of the individuals living in such an environment. Despite the fact that Sharma observed that a higher economic growth (as proxied by the gross domestic product) has an impact on the emissions of CO_2 at least in the short-run, the health of individuals is still adversely affected (Sharma, 2011).

4. METHODOLOGY

The auto-regressive distribution lag (ARDL) econometric technique is engaged in this study to achieve its objectives. The insight of the ARDL technique was drawn from the studies of Osabohien et al. (2017), Ahmed and Hasan (2016). In their study, Ahmed and Hasan (2016) examined the effect of public health expenditure and governance on health outcomes in Malaysia engaging data-set from 1984-2009. Engaging an ARDL cointegration approach, results from Ahmed and Hassan (2016) with respect to cointegration method reveals that there exist a long-run relationship between health outcomes, government expenditure on health. Akin to Ahmed and Hassan (2016), Osabohien et al. (2017), this study engaged the ARDL to analyse the long run effect of GHGE on the aggregate health outcome where people's health is adversely affected.

4.1. Model Specification and Method of Estimation

The ARDL approach to cointegration is engaged for this study to achieve its objectives. The ARDL cointegration approach gained popularity from the works of Pesaran (2004), Pesaran and Shin (1998), Pesaran et al. (1999) and Pesaran et al. (2001) which have advantages over the traditional approach to cointegration. The main advantage of the ARDL approach to cointegration is that it is applicable despite the nature of stationarity of the variables; that is, whether variables achieve stationarity at levels [I(0)] or at first difference [I (1)] and variables should not be differenced to order two [1(2)] (Pesaran et al., 2001). The error correction mechanism (ECM) assimilates the dynamics of the short-run and the long-run equilibrium. It was discovered from literature that the use of ARDL model averts the issues that may result from non-stationary time series data. The implicit and explicit forms of the model are shown in Equations (1) and (2):

$$hoc=f\,(tghge, mr, phexp, fetr) \quad (1)$$

$$hoc=\beta_0+\beta_1 tghge_t+\beta_2 mr_t+\beta_3 phexp_t+\beta_4 fetr_t+e_t \quad (2)$$

Where: hoc means health outcome proxied by life expectancy in years, tghge means total GHGE (kt of CO_2 equivalent), mr means mortality rate, phexp means public health expenditure and fetr means fertility rare (Table 1). β_0 is the constant term, β_1, β_2, β_3 and β_4 are the parameters of the explanatory variables, while e is the error term.

Table 1: Variables, data sources and measurement

Variable name	Identifier	Source of data	Definition and measurement
Health outcome	hoc	WDI, 2017	Health outcome measured by life expectancy at birth, total (years)
Total GHGE	GHGE	WDI, 2017	Emissions of total GHG measured by kt of CO2 equivalent. Which is made up of emissions of carbon dioxide resulting from consumption og liquid fuel (kt); emission of agricultural methane (thousand metric tons of carbon dioxide equivalent); emissions of agricultural methane (% of total) emissions of methane in energy sector (thousand metric tons of carbon dioxide equivalent)
Mortality rate	mr	WDI, 2017	Death rate, crude (per 1000 people)
Public health expenditure	phexp	WDI, 2017	Health expenditure, public (% of government expenditure)
Fertility rate	fetr	WDI, 2017	Fertility rate, total (births per woman)

Source: Authors' compilation using Word Bank WDI data set, 2018. WDI means World Development Indicators, GHGE: Greenhouse gas emissions

$$\Delta hoc_t = \beta_0 + \sum_{t=1}^{n} \beta_1 \Delta tghge_{t-1} + \sum_{t=0}^{n} \beta_2 \Delta mr_{t-1} + \sum_{t=0}^{n} \beta_3 \Delta phexp_{t-1} + \sum_{t=0}^{n} \beta_4 \Delta fetr_{t-1} + \gamma ECM_{t-1} + e_t \quad (3)$$

Where: Δ means the change in operator and the ECM_{t-1} denotes error correction term. γ demotes the speed of adjustment from the short-run to the long-run. Given the above, the ARDL model is represented in Equation (4)

$$\Delta hoc_t = \beta_0 + \sum_{t=1}^{n} \beta_1 \Delta tghge_{t-1} + \sum_{t=0}^{n} \beta_2 \Delta mr_{t-1} + \sum_{t=0}^{n} \beta_3 \Delta phexp_{t-1} + \sum_{t=0}^{n} \beta_4 \Delta fetr_{t-1} + e_{t-1} \quad (4)$$

Thus, it is expected that β_1, β_2, and $\beta_4 < 0$; $\beta_3 > 0$. ceteris paribusly, the 'a priori expectaion is that an increase in the exogenous variables except public healthh expenditure and fertility negatively affect health status thereby reducing life expectancy.

H_0: $\beta_0=\beta_1=\beta_2=\beta_3=\beta_4$ (no long run relationship exist).

H_1: $\beta_0\neq\beta_1\neq\beta_2\neq\beta_3\neq\beta_4$ (Long run relationship exist).

An ARDL is a method approach to cointegration involves three different phases. The first phase is the formulation and testing of the hypothesis that cointegration does not exist. Concisely, the null hypothesis is stated such that jointly, the coefficients of lagged exogenous variables in the fundamental ARDL ECM are assumed to be zero. ARDL co-integration has three major advantages over the traditional approach to cointegration; first is that all the variables under study need not to be stationary at the same order, and secondly the ARDL model is applicable when the underlying variable are integrated of order 1 [I(0)],or order 0 [I (0)], as shown in Table 1, and three, the ARDL obtains more efficient estimate of the long-run model Osabohien et al., 2017; Sulaiman and Abdul-Rahim, 2017; Harris and Sollis, 2003; Pesaran et al., 2001; Pesaran and Pesaran, 1997). Two different groups of values for the variables are shown Table 1. Firstly, the underlying assumption is that variables attain stationarity at first difference [I (1)], while the second assumption is that variables attain stationarity at level [I (1)] as shown in Table 1. Annual data (time-series) data form 1985–2016 sourced from world development indicators (WDI of World Bank) is engaged to achieve the objective of the study as presented in Table 1.

4.2. Presentation and Discussion of Results

This sub-section of the study presents the summary statistics of the variables as shown in Table 2. The results showed the summary statistics of the selected variables that were engaged in this study, the variables are: hoc (health outcome represented by total life expectancy in years), tghge (total GHGE), mr (mortaility rate), phexp (public health expectancy), and fetr (fertility rate) (Table 1). The mean, standard deviation, minimum and maximum are as presented, to bring out the real information needed for the study (Osabohien et al., 2017). To fully ascertain the trend of the respective variables, Table 3 presents the test of stationarity (both at levels and at first difference respectively) that were conducted with the Augmented Dickey-Fuller (ADF) unit root test for stationarity.

4.3. Unit Root Test for Stationarity

It is observed from literature that in most cases, time series variables possess a unit root while other variables may not have a unit root. Variables are said to have unit root when they are not stationary at levels (Sankaran and Samantaraya, 2015; Pantula et al., 1994). This is presented in Table 3 which revealed that some of the variables (total GHGE, mortality rate and public health expenditure) are not stationary at levels this means that they possess a unit root after conducting the test of stationarity (unit root test) at levels and this is the rationale for differencing to make them stationary as shown in Table 3 (Sankaran and Samantaraya, 2015). The rule of thumb for stationarity is that the absolute value of the ADF trace statistic should be greater than the corresponding absolute critical value for variables to be considered as stationary as presented in Table 3.

Before conducting the ARDL cointegration, the unit root test for the stationarity was carried out on all the exogenous variables in the model to examine the integrating order of the selected variables. This is considered to be a necessary condition in validating the assumption that none of the variables should not be differenced twice or second-order stationary (that is, I [2]), this is to prevent 'spurious or nonsensical' output. Drawing an insight from the study of Ouattara (2006), F-statistic calculated that Pesaran et al. (2001) presented tend not to be effective at order two [I (2)], since the method is based on the premise that variables either cointegrated at order zero [I (0)] or cointegrated at order one [I(1)]. Therefore, engaging a unit root tests in the ARDL approach to cointegration is to ensure that none of the variables is integrated of order 2 (Table 3). Following the results in Table 3, the next step is to present the ARDL (both the short-run and long-run dynamics) results as shown in Table 4. The upper part of Table 4, (ADJhoc) indicates co-integrating equation. It could be seen from the results that there exist a long-run relationship among specified variables demanded the specification of the ECM.

Table 5 showed the output of ECM for the variables. The ECM (term) coefficient is seen to be significant statically and negative at 1% level. The result confirms that there is the presence of a long-run equilibrium relationship among the time series (GHGE, mortality, public health expenditure and fertility rate) in the health outcome equation. From the results in Table 5, the coefficient of the error correction term (−0.3792) shows the rate of adjustment and is also consistent with the hypothesis of convergence towards the long-run equilibrium once the health outcome equation is disturbed through emissions of gas, burning of fossil fuel and other harmful pollutants. The rate of adjustment of health outcome to previous equilibrium position once there is exogenous shock is about 37.92%. This is due to the fact that the ARDL result obtained indicates that in the long run gas emissions pose a danger of reducing total life expectancy by 0.00442%, if not corrected; it means that the mortality rate will be increased by 146.6025% in the long run. The best correction strategy recommended in this study is public health expenditure which has the capacity of improving health outcome by approximately 18.10%. Specifically, the ECM coefficient implies that about 37.92% of any health status is corrected in the next period as presented in Table 5.

5. DISCUSSION OF RESULTS

As obtained from the ARDL estimations, it can be deduced that activities of humans cause harmful effect to health, as changes in atmospheric GHG concentrations will affect the amount of energy stored in the atmosphere (Harris and Sollis, 2003; Usikalu, 2009). This is akin to Howard et al, (2008), as noted in his study that human increasing GHG to the atmosphere, mainly through the burning of fossil fuels. Given for instance, CO_2 is known to be the major source of GHG, when the amount of CO_2 is increased, it means that more heat is trapped in the atmosphere, this causes a great harmful effect to human health. This is validated in this study as it was found that 1% increase in GHG emissions reduces life expectancy (health outcome) by 0.00422%, if this happens, invariability, mortality will be at 146.6%. The finding of this study agrees with the findings of Harris and Sollis, (2003) and Usikalu, (2009) which highlighted different negative effects of GHG emissions on health status, these negative effect ranges from among others high mortality rates. In the same vein, World Bank (2010), estimated that approximately 150,000 people dies in

Table 2: Summary statistics of variables

Variable	Mean	Standard deviation	Minimum	Maximum
hoc	47.7477	2.3997	45.8397	52.9779
tghge	232456.6	82815.29	132908.9	374421.7
mr	16.8969	2.0008	12.7660	18.6880
phexp	6.6512	1.4834	3.7280	9.1934
fetr	6.1585	0.3225	5.5910	6.72600

Source: Authors' computation using STATA 13, 2018

Table 3: Unit Root Test for Stationarity

Variables	DF t-statistic	Critical value 5%	Integration order	Remarks
hoc	−3.8687	−3.5950	I (0)	Stationary
tghge	−6.7438	−3.6908	I (1)	Stationary
tr	−4.4518	−3.5806	I (1)	Stationary
thexp	−4.8656	−3.6908	I (1)	Stationary
ffetr	−3.5950	3.2730	I (0)	Stationary

Source: Authors' computation using STATA 13, 2018

Table 4: Estimates from ARDL (short run and long run dynamics)

D. lexp	Coefficient	Standard error	P-value
AD Jhoc			
L1	−0.0256	0.2278	0.000*
Long run			
tghge	−0.0000442	0.0004355	0.036**
mr	−1.466025	0.2559884	0.000*
hexp	0.1810143	2.342356	0.0051***
fr	2.001483	1.078266	0.046***
Short run			
hoc			
LD	3.448545	1.345036	0.237
L2D	−3.037226	2.843127	0.479
L3D	1.139522	1.835389	0.646
tghge			
D1	8.27e-07	1.15e-06	0.02**
LD	5.76e-07	8.05e-07	0.605
L2D	3.72e-07	4.32e-07	0.547
L3D	3.84e-07	4.56e-07	0.554
mr			
D1	−1.544662	0.1602934	0.000*
LD	0.3054472	0.427064	0.000*
L2D	0.4123689	0.3534929	0.000*
L3D	−0.3363343	0.3749154	0.000*
fr			
D1	−0.9039226	0.4028309	0.043*
LD	0.2889809	0.4118527	0.002*
L2D	0912524	0.4112986	0.000*
L3D	−0.4961635	0.4016899	0.001*
hexp			
D1	−0.0028426	0.0157857	0.032*
LD	−0.0004514	0.0101516	0.972
L2D	−0.0004924	0.003407	0.909
L3D	−0.0004715	0.001072	0.736
_cons	1.325775	10.42015	0.919

Source: Authors' computation using STATA 13, 2018. While *.**.***shows that the variables are significant at 1%, 5% and 10% respectively, while LD shows the lag dynamics. ARDL: Auto-regressive distribution lag

Table 5: Estimates from vector error-correction model

Regressors	Regressand				
	D_hoc	D_tghge	D_mr	D_phexp	D_fetr
ECterm	−0.3792***	−1140909	1.052773***	50.64121	−0.2045***
	(0.000)	(0.112)	(0.000)	(0.105)	(0.0000)
hoc (LD)	−1.855954	−3940783	1.91837***	3.629614	0.35455***
	(0.000)	(0.179)	(0.000)	(0.977)	(0.001)
tghge (LD)	−1.12e-07*	−0.2977	8.41e-08**	−2.73e-06	−2.95e-08
	(0.011)	(0.335)	(0.011)	(0.839)	(0.009) ***
mr (LD)	4.13019***	−5140218	3.745647***	−20.83299	0.5041**
	(0.000)	(0.203)	(0.000)	(0.906)	(0.001)
phexp (LD)	−0.00427***	6116.084	0.00333***	−0.1510438	−0.00084***
	(0.0000)	(0.338)	(0.000)	(0.587)	(0.000)
fetr (LD)	−0.0165	2675633	−0.2600132	−180.696***	1.042612
	(0.951)	(0.158)	(0.202)	(0.028)	(0.000)
Adj. R^2	0.9994	0.71421	0.9995	0.3763	0.9994
AIC	52.54087				
HQIC	53.43942255				
SBIC	92777				

Source: Author's computation using STATA 13, 2018. *,**,** means significant at 1, 5 and 10%, respectively. LD signifies that they were lagged and differenced. The probability values are in parenthesis

developing nations per annum as a result of the negative impact of climate change resulting from GHG emissions.

In line with the studies of Yazdi et al. (2014); Mohammed et al. (2015), they employed the ARDL method of co-integration to investigate the importance of environmental quality and health expenditures using time series data set (1967–2010) in Iran. Their studies found out that public expenditure on health and polluting objects like sulphur oxide emissions and carbon emissions have a long run relationship and submits that public expenditure remains one of the ways to control those effects. Thus, this is confirmed in this study as has been shown in ARDL results that long run correlation exists between health outcome, GHG emissions mortality rate, public health expenditure and fertility rate. In this wise, as agreed with Yazdi et al. (2014) 1% increase in government health care expenditure increases life expectancy approximately by 18.10%, while 1% increase in GHG emissions has 0.0042% negative effect on health status, this will cause an increase in mortality rate and 1% increase in mortality rate (total death rate-infant and adult) reduces life expectancy by 146.6%.

Also, this study agrees with the study of Ahmed and Hasan (2016) which also employed the ARDL technique in analysing the impact expenditure care expenditure and governance on health outcomes in Malaysia using time series data and concluded that government health care investment reduces death rate. On the other hand, Jerrett et al. (2003); Narayan and Narayan (2008), examined the relationship that exists among environmental quality and government expenditure on health. Their studies engaged the cross-sectional data from 49 countries including Canada, the studies found out that countries with higher pollution have higher per capita health expenditures, and countries with more environmental budget have significantly high health expenditures, this is similar to Narayan and Narayan (2008) that investigated the cointegration between government health expenditure and carbon emissions as indicators of environmental quality in selected OECD nations for 10 years (1980–1989) in both the short-run and long-run dynamics, their study concludes that there is a long-run relationship between the health care expenditure and health outcome variables as confirmed in this study.

Declerc et al. (2011), who showed that life expectancy, would be enhanced to a life period of approximately two years given that the main cities in Europe will reduce industrial pollution remains as the major cause of air pollution. Following the study of Odusanya et al. (2014) who carried a study in examining the impact of emissions of carbon on health outcome in Nigeria using a time-series data covering 1960–2011. Their study found out that an increase in the rate of carbon dioxide emission poses a danger in health status, which is in line with Al-Mulali and Fereidouni (2012) and Behera, et al., (2017). This study agrees with the findings of these studies.

6. CONCLUSION AND RECOMMENDATIONS

This study had examined the long run relationship between GHG Emissions and health outcomes in Nigeria. In conclusion, the study observed that emission of carbon dioxide is the main source of GHG emissions; therefore, the study posits that reduction in the emissions of carbon dioxide should be seen as a thing of importance in improving health outcome in Nigeria. This reduction can be done through the reduction of deforestation and conservation of land, controlling of wildfire, adopting better methods of combusting residues of crops and effective use of energy by forest dwellers amongst other measures. This will in turn help to reduce the rate at which people fall sick as a result of respiratory diseases.

The study, therefore, recommends the following; first, environmental policies should be formulated towards the mitigation of the impact of emissions of CO_2 should be directed the agricultural and industrial sector (to bring about economic growth) rather than the environment that will constitute hazards to human health. Second, the government should increase public health expenditure so that the health of the individuals in the society will be adequately taken care of and the mortality rate will reduce. This will ensure that the citizens would get good medical treatments in the hospitals when such need arises. This will in turn improve the health outcomes in Nigeria. Lastly, in order to increase life expectancy, there should be a reduction in GHG Emissions.

7. ACKNOWLEDGMENTS

The authors wish to acknowledge and appreciate the Covenant University Centre for Research, Innovation and Discovery for funding the publication of this article.

REFERENCES

Agbonlahor, M.U., Phillip, D.O.A. (2015), Deciding to settle: Rural-rural migration and agricultural labour supply in southwest Nigeria. Journal of Developing Areas, 49(4), 10-23.

Ahmeed, D.H., Naser, J., Dean, R.T. (2016), Particles impact characteristics on cutting surface during the abrasive water jet machining: Numerical study. Journal of Materials Processing Technology, 232, 116-130.

Alege, P.O., Oye, Q.E., Adu, O.O., Amu, B., Owolabi, T. (2017), Carbon emissions and the business cycle in Nigeria. International Journal of Energy Economics and Policy, 7(5), 1-8.

Al-Mulali, U., Sab, C.N.B.C., Fereidouni, H.G. (2012), Exploring the bi-directional long-run relationship between urbanization, energy consumption, and carbon dioxide emission. Energy, 46(1), 156-167.

Anderson, J., Fergusson, M., Valsecchi, C. (2008), An overview of global greenhouse emissions and emission reduction scenarios for the future policy. Department of Economics and Science Policy. Brussels, Belgium: European Parliament.

Ansuategi, A., Escapa, M. (2002), Economic growth and greenhouse gas emissions. Ecological Economics, 40(1), 23-37.

Behera, S.R., Dash, D.P. (2017), The effect of urbanization, energy consumption, and foreign direct investment on the carbon dioxide emission in the SSEA (South and Southeast Asian) region. Renewable and Sustainable Energy Reviews, 70, 96-106.

Botkin, D.B., Keller, E.A. (1997), Environmental Science: Earth as a Living Planet. 2nd ed. New York: John Wiley Press. p215.

Cass, D. (1965), Optimum growth in an aggregative model of capital accumulation. Review of Economic Studies, 32, 233-240.

Declercq, W., Wirawan, E., Walle, L.V., Kersse, K., Cornelis, S., Claerhout, S., Vanoverberghe, I., Roelandt, R., De Rycke, R., Verspurten, J., and Agostinis, P. (2011). Caspase-mediated cleavage of Beclin-1 inactivates Beclin-1-induced autophagy and enhances apoptosis by promoting the release of proapoptotic factors from mitochondria. Cell death & disease, 1(1), e18.

Ellerman, A.D., Jacoby, H.D., Decaux, F. (2009), The Effects on Developing Countries of the Kyoto Protocol and CO_2 Emissions Trading. Cambridge: Joint Program on the Science and Policy of Global Change Massachusetts Institute of Technology.

Environmental Health Committee. (2004), Ambient air pollution: Health hazards to children. Pediatrics, 114(6), 1699-1707.

Gislason, S. (2006), Effects of Air Pollution. Available from: http://www.nutramed.com. [Last accessed on 2017 Dec 13].

Harris, R., Sollis, R. (2003), Applied Time Series Modelling and Forecasting. Chichester, UK: Wiley.

Hoelller, P., Dean, A., Nicolaisen, J. (1991), Macroeconomic Implications of Reducing Greenhouse Gas Emissions: A Survey of Empirical Studies. OECD Economic Studies. No 16. Available from: http://www.oecd.org/dataoecd/47/58/34281995.pdf. [Last accessed on 2017 Jan 10].

Howard, V., Rosamond, W., Flegal, K., Furie, K., Go, A., Greenlund, K., Haase, N., Hailpern, S.M., Ho, M., Kissela, B., Kittner, S. (2008), Heart disease and stroke statistics-2008 update. Circulation, 117(4), e25-e146.

IPCC. (1996), Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analyses. Contribution of Working Group II to the IPCC.

IPCC. (2001), Houghton, J.T., Ding, Y., Griggs, D.J., Noguer, M., van der Linden, P.J., Dai, X., Maskell, K., Johnson, C.A., editors. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.

IPCC, (2007), Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge. London: Intergovernmental Panel on Climate Change.

Kumar, M., Sheikh, M. A., & Saleem, S. (2014). Carbon stock in submergence forest of Srinagar hydroelectric project, Uttarakhand, India. Forest Science and Technology, 10(2), 61-66.

Jerrett, M., Eyles, J., Dufournaud, C., Birch, S., (2003), Environmental influences on health care expenditures: An exploratory analysis from Ontario, Canada. Journal of Epidemiology and Community Health, 57, 334-338.

Jiang, X.T., Li, R. (2017), Decoupling and decomposition analysis of carbon emissions from electric output in the United States. Sustainability, 9(6), 1-13.

Klein, R.J.T., Huq, S., Denton, F., Downing, T.E., Richels, R.G., Robinson, J.B., Toth F.L. (2007), Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J., Hanson, C.E., editors. Inter-relationships between Adaptation and Mitigation. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Inter-governmental Panel on Climate Change. Cambridge: Cambridge University Press, UK. p745-777.

Koopmans, T.C. (1965), On the concept of optimal economic growth. In: The Econometric Approach to Development Planning. Amsterdam: North Holland.

Kumah, C.H. (2015), A comparative study of use of the library and the internet as sources of information by graduate students. Library Philosophy and Practice, 6(1), 15-26.

Matthew, A.O., Adegboye, B.F., Fasina, F.F. (2015), Public health expenditure and health outcomes in Nigeria. International Journal of Financial Economics, 4(1), 45-56.

Mesagan, E., Ekundayo, P. (2015), Economic growth and carbon emission in Nigeria. IUP Journal of Applied Economics, 3(2), 44-56.

Mohammed, A.M., Nassor, S.N., Omar, B.H. (2015), The relationship between energy consumption, CO_2 emissions and economic growth in Tanzania. International Journal of Energy Sector Management, 9(3), 361-375.

Narayan, P.K., Narayan, S. (2008), Does environmental quality influence health expenditures? Empirical evidence from a panel of selected OECD countries. Ecological Economics Journal, 65(2), 367-374.

NASA. (2005), Methane's Effect on Climate Change may be Twice Previous Estimates. Available from: http://www.scienceagogo.com. [Last accessed on 2017 Dec 13].

NPI. (2006), Sulphur Dioxide Fact Sheet: Department of the Environment and Water Resources, Australia. Available from: http://www.npi.gov.au. [Last accessed on 2017 Dec 13].

OECD Development Centre/African Development Bank. (2003/2004), Growth trends and outlook for Africa: Time to unleash Africa's huge energy potential against poverty, concludes. African Economic Outlook. African: OECD Development Centre/African Development Bank.

Odusanya, I.A., Adegboyega, S.B., Kuku, M.A. (2014), Environmental quality and health care spending in Nigeria. Fountain Journal of Management and Social Sciences, 3(2), 57-67.

Oguntoke, O., Adeyemi, A. (2017), Degradation of urban environment and human health by emissions from fossil-fuel combusting electricity generators in Abeokuta metropolis, Nigeria. Indoor and Built Environment, 26(4), 538-550.

Osabohien, R., Osabuohien, E., Urhie, E. (2017), Food security, institutional framework and technology: Examining the nexus in Nigeria using ARDL approach. Current Nutrition and Food Science, 13(4), 1-10.

Osabuohien, E., Okorie, U., Osabohien, R. (2018), Rice Production and Processing in Ogun State, Nigeria: Qualitative Insights from Farmers' Association. In: Obayelu, E., editor. Food Systems Sustainability and Environmental Policies in Modern Economics Hershey, PA: IGI Global. p188-215.

Pantula, S.G., Gonzalez-Farias, G., Fuller, W.A. (1994), A comparison of unit-root test criteria. Journal of Business and Economic Statistics, 12(4), 449-459.

Pearce, L.A., Hart, R.G., Benavente, O., McBride, R. (1999), Antithrombotic therapy to prevent stroke in patients with atrial fibrillation: a meta-analysis. Annals of Internal Medicine, 131(7), 492-501.

Pesaran, M.H. (2004), General Diagnostic Tests for Cross Section Dependence in Panels, University of Cambridge, Working Paper, No.0435, 1-39.

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

Pesaran, M.H., Shin, Y. (1998), An autoregressive distributed lag modelling approach to cointegration analysis. In: Strom, S., editor. Econometrics and Economic Theory: The Ragnar Frisch Centennial Symposium. Cambridge: Cambridge University Press.

Pesaran, M.H., Shin, Y., Smith, R.J. (1999), Pooled mean group estimation of dynamic heterogenous panels. Journals American Statistical Association, 94, 621-634.

Pesaran, M.H., Pesaran, B. (1997), Working with Microfit 4.0: Interactive [Econometric Analysis; Windows version. Oxford: Oxford University Press].

Protocol, K. (1997), United Nations Framework Convention on Climate Change. Kyoto: Kyoto Protocol. p19.

Ramsey, F. (1928), A mathematical theory of saving. Economic Journal, 38, 543-549.

Sankaran, A., Samantaraya, A. (2015), Does kaldor's hypothesis hold in India? The Journal of Developing Areas, 49(4), 59-67.

Seo, S.N., Mendelsohn, R., Dinar, A., Hassan, R., Kurukulasuriya, A. (2009), A ricardian analysis of the distribution of climate change impacts on agriculture across agro-ecological zones in Africa. Environmental and Resource Economics, 43, 313-332.

Sharma, S.S. (2011), Determinants of carbon dioxide emissions: Empirical evidence from 69 countries. Applied Energy, 88, 376-382.

Siyan, P.E., Adegoriola, A. (2017), An assessment of nexus between infrastructural development and Nigerian economic growth. African Journal of Business Management, 4(3), 23-33.

Sulaiman, C., Abdul-Rahim, A.S. (2017), The relationship between CO_2 emission, energy consumption and economic growth in Malaysia: A three-way linkage approach. Environmental Science and Pollution Research, 24(32), 25204-25220.

Terr-Africa (2009), Land and Climate: The Role of Sustainable land Management (SLM) for Climate Change Adaptation and Mitigation in Sub-Saharan Africa (SSA). Terr Africa: Regional Sustainable Management Publication.

UNDP. (2007; 2008), Human Development Report 2007/2008. Fighting Climate Change: Human Solidarity in a Divided World, Palgrave Macmillan.

Usikalu, M.R. (2009), Health impact of climate change due to combustion of fossil fuel. International Journal of Physical Sciences, 4, 880-884.

Willoughby, A.A., Omotosho, T.V., Aizebeokhai, A.P. (2014), A Simple Resistive load I-V Curve Tracer for Monitoring Photovoltaic Module Characteristics, a Paper Presented at the 5th International Renewable Energy Congress (IREC).

World Bank. (2010), The cost to Developing Countries of Adapting to Climate Change New Methods and Estimates the Global Report of the Economics of Adaptation to Climate Change Study Consultation Draft. Washington D. C.: The World Bank Group.

Wood, J. (2004), Motor car Emission, Safety and Alternatives. Retrieved from Microsoft Encarta Premium Suite on 13th December, 2017.

World Development Indicators (WDI). (2017), Data Bank. Accessed from: http://www.worldbank.org/data/onlinedatabases/online databases.html. [Last retrieved on 2018 Jan 12].

Yazdi, S.K., Zahra, T., Nikos, M. (2014), Public Healthcare Expenditure and Environmental quality in Iran, Recent Advances in Applied Economics. Available from: http://www.wseas.us/e-library/conferences/2014/Lisbon/AEBD/AEBD-17.pdf. [Last retrieved on 2018 Jan 12].

Yohe, G.W., Lasco, R.D., Ahmad, Q.K., Arnell, N.W., Cohen, S.J., Hope, C., Janetos, A.C., Perez, R.T. (2007), Perspectives on Climate Change and Sustainability. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L.