

AN EMPIRICAL RELATIONSHIP BETWEEN CARBON DIOXIDE EMISSIONS, HUMAN HEALTH AND ECONOMIC GROWTH NIGERIA

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Abstract

The paper examined empirical relationship between carbon dioxide (CO₂) emission, human health and economic growth in Nigeria. It employs the use of annual time series data sourced from Central Bank of Nigeria (CBN) and world bank from 1981-2016. Carbon dioxide (CO₂) emission is used as independent variable while Human Health (proxy to Life Expectancy) and Economic Growth (proxy to Gross Domestic Product) are used as dependent variables. This paper employs Autoregressive Distributed Lag (ADRL) bound testing approach. The results of co-integration indicate that, there is a long run relationship between carbon dioxide (CO₂) emission and human health in Nigeria. Thus, there is no short run relationship between carbon dioxide (CO₂) emissions, and human health in Nigeria. The empirical result further indicates that, carbon dioxide (CO₂) emissions have both short run and long run negative relationship economic growth in Nigeria. Therefore, based on the empirical result the paper recommends that government must take a step to change the current energy use patterns away from fossil fuels and an alternative energy sources like wave energy from the sea and solar should be explored to the fullest among others.

Keywords: Carbon Dioxide (CO₂) Emission, Human Health and Economic Growth

Introduction

Carbon dioxide (CO₂) emission is believed to be from the burning of fossil fuels and the manufacturing of cement, which includes carbon dioxide produced during consumption of solid, liquid and gas fuels (Sanglimsuwan, 2011). The concentration of carbon dioxide (CO₂) emission in atmosphere can significantly result to an increase in temperature, extreme weather events, sea level rise and consequently climate changes, these become a major problem to human health, animal life's, and productivity (Sanglimsuwan, 2011).

Carbon dioxide (CO₂) emission has been recognized to be a cause of serious health problems. Such problems are, asthma, cardio-vascular, cerebral spinal meningitis, high blood pressure, malaria, cholera, heat stroke, influenza, psychosis and respiratory disorder and other related health outcome, which lead to low productivity and poor economic growth (UNDP, 2005). As argued by Gallup, Sachs and Mellinger (1999), that vector borne diseases, particularly malaria, can have such a large effect on labor productivity which could make the nation to be trapped in a vicious cycle of disease, low productivity, poverty and health cases, thus these have implications on the future welfare of the society. Similarly, Nigeria as most populous country in Africa ranks number one (1)

and number four (4) worldwide in the list of countries with high number of deaths recorded due to Carbon dioxide (CO₂) emission (Nuhu & Adofu 2021).

According to (Ali, 2012), Carbon dioxide (CO₂) emission affects economic activities by damaging the ecosystems as a result of flood, erosion, and drought among others. The extinction of endangered species and death resulted from extreme weather which can leads to permanent damage to economic activities by limiting investments in economic and physical infrastructure, and human capital, thereby reducing productivity in an economy. Similarly, Carbon dioxide (CO₂) emission compound Nigeria's productivity challenges in several ways. For instance agriculture is dependent on climate patterns which may be significantly affected by distortions of many sorts (see Ali, 2012). In the Sothern region of country where there is concurrent devastation of lives and livelihood in recent times. Over 50 million Nigerians, living along the low laying coasted regions and potentially posing threats to Nigeria oil facilities located within these regions. This therefore has resulted to displacement of persons, sickness and hunger, fewer jobs and ultimately poor economic growth (Ali, 2012).

The steady increase in Carbon dioxide (CO₂) emission is attributed to the utilization of fossil fuel. It has proven scientifically that atmospheric (CO₂) concentration has increased from approximately 280 parts per million (PPm) in pre-industrial time to 379 PPm in 2005, a 42% increase (IPCC, 2007). Statistics has shown that about 4.3 million deaths occurred due to diseases related to carbon dioxide (CO₂) emission globally (WHO, 2014). The report further stated that carbon dioxide (CO₂) is responsible for about four to five million recent cases of bronchitis and its economic burden is 0.5% and 2.5% portion of World's gross domestic product (GDP). Similarly, Chindo. S. and Abdul-Rahim (2014) projected that carbon dioxide (CO₂) emission may result in loss of 6% to 30% in Nigeria's GDP by 2050, which translates to US \$100 billion to US \$460 billion if no adaptation measure are taken (Department for International Development, 2009). The study further predicted that the country may suffer a loss of 2% to 11% in GDP by 2020 if the situations continue.

International Organizations such as United Nations have made efforts to cut down the effect of carbon dioxide (CO₂) emission through governmental binding agreements such as the Kyoto protocol (Halicioglu, 2009). This protocol is the United Nations Framework Convention on Climate Change i.e. (UNFCCC) which seeks to reduce global stabilized greenhouse gas concentrations in the atmosphere. Similarly, the Nigeria's policy thrust on atmospheric protection which aimed at proper regulation of air quality standard and natural gas conservation. And the Federal Environmental protection Agency (FEPA) Act 1988/92 which was charged with environment related responsibilities in Nigeria etc. All these measures fail to give a mere contribution to cut down carbon dioxide (CO₂) emission into the Nigeria's economy.

Nevertheless, this study is different from the work of Kim and Lane, (2013); Deshpande, *et al.*, (2014) etc Barger and Messer, (2002); Jaba *et al.*, (2014), Yazdi *et al.*, (2014); Odusanya *et al.*, (2014) Opoku, 2014, Ejubekpokpo (2014); and Chindo *et al.*, (2014) and other previous studies in the following areas:

Firstly, as many as these studies are, none of these studies have attempted to look at the impact of Carbon dioxide (CO₂) emission on human health and economic growth in a single framework neglecting the linkage between Carbon dioxide (CO₂) emission, health and productivity simultaneously.

Secondly, Kim and Lane, (2013), Jaba *et al.*, (2014), and Muftau *et al.*, (2014), explored selected African and developed countries experience. Therefore, from the foregoing background, it is

evidence that carbon dioxide (CO₂) emission has no become a health and developmental issue rather than just an environmental issue, which threaten the health outcome and economic growth in Nigeria. Thus, it is against this background that, this study seeks to empirically examine the impact of carbon dioxide (CO₂) emission on human health and economic growth in Nigeria.

Theoretical Framework/ Literature Review

Theoretical Framework

In segment deals with theories that are related to this paper .These are Grossman (1972) theory and Batimooore and Tudok (2010) theory:-

Grossman (1972) Theory

The theory is based on the objective one of this paper which is adopted from Grossman (1972) who developed a theoretical health production function, which is specified as:-

$$H=F(X) \text{ ----- (1)}$$

Where H is a measure of individual health outcome and X is a vector of individual inputs to the health, production function. The elements of vector (x) are nutrient, individual endowments like genetic makeup, and community endowments such as the environment. Grossman's theoretical health production function model was designed for analysis of health production function at micro level. To switch from micro level to macro analysis, without losing the theoretical ground, the element of the vector x were represented by per capital variables and regrouped into sub-sectoral vectors of economics, social and environmental factors as:-

$$h=f(y, s, v) \text{ (2)}$$

where Y is a vector of pre capital economic variables, S is a vector of per social variables and V is a vector of per environmental factors in its scalar form equation (2) can be rewritten as:-

$$h=F(y_1, y_2, \dots, y_n, S_1, S_2, \dots, S_m, V_1, V_2, \dots, V_l) \text{ (3)}$$

Batimore and Tudok (2010) Theory

According to Batimooore and Tudok (2010), using foster growth and pollution model with a utility function that is additively separable between consumption and pollution, derive an inverted U path for pollution and a J curve for abatement that starts when a given capital stock is achieved, that is expenditure on pollution abatement to zero until “development has created enough consumption and enough environmental damage to merit expenditures on abatement?

However, emphasizing on the pollution- growth relationship, foster’s growth and pollution model assesses some major factors. Batimooore and Tudok (2010) said here major factors are considered in this model. These include large direct effects of pollution on growth, high technology side which enhances growth, and rapidly inclining marginal utility of consumption which h puts more pressure on industrial production. This model could be stated explicitly as follows:-

$$GDP = \alpha_0 + \alpha_1 Pol + \alpha_2 TCH + \alpha_3 CON + \varepsilon_i \text{ (4)}$$

According to Batimooore and Tudok (2010), pollution has negative effect on growth, while technology and consumption have positive effects on growth. Even when pollution or carbon emissions would be expected to have negative effect on GDP, empirical studies have shown that the signs may be positive. Batimooore and Tudok (2010) said the shocking positive sign of pollution in some studies is due to the output generated during carbon emissions or pollution which

contributes positively to growth. Increase in carbon emissions implies that there is a rise in industrial activities which generate the pollution, which in turn leads to increase in growth.

Literature Review

This subsection focused on relevant literature on the relationship between carbon dioxide (CO₂) emissions, human health and economic growth. These are:

Adeyemi *et al.* (2008) investigated the effect of environment of health of under five mortality rate in Nigeria, using a multiple regression. They found that most death associated to children under the age of five is accounted for by this variable expenditure on health as percentage of GDP access to portable fertility rate and carbon dioxide emission.

Assaadzadeh *et al.* (2014) examined the role of environmental quality and life expectancy in determining per capital health expenditures in OPEC countries for the period 2000-2010. They found that increase in carbon dioxide emissions increases health expenditures, while a rise in life expectancy at birth decreases expenditure in short run.

Adeyemi *et al.* (2008) examined the environment of health on less than five mortality rate in Nigeria using a multiple regression. They found that most death associated to children under the age of five are accounted for by these variable expenditure on health as percentage of GDP access to portable fertility rate and carbon dioxide emission.

Akpan and Akpan (2013) investigated the long run and the causal connections among electricity consumption, carbon emissions and economic growth in Nigeria. They used annual times series data from 1970 to 2008. The empirical result shows there is positive relationship between economic growth and carbon emissions in the short run. The findings of the Granger Causality test showed a unidirectional causality running from economic growth to carbon emissions with no vice versa causality.

Bello and Abimbola (2010) investigated relationship between economic growth and environmental quality in Nigeria using the ordinary least square approach from 1980 to 2008. They found out that carbon emissions in Nigeria are not driven by economic growth but by financial development. The result further shows that environmental Kuznets curves do not exist in Nigeria.

Bruce and Smith (2012) believed that the wood biomass burning affects pregnant women adversely by increasing the risk of adverse pregnancy outcomes. They further maintained that the effect also weakens proper cognitive development of children.

Deshpande *et al.* (2014) examined the relationship between health care expenditure and national life expectancy in 181 developed and developing nations. Empirical results of the study showed that there is no significant correlation between health care expenditure and life expectancy in developing countries, but is significance relationship between the variables in developed countries, however, money is not allocated effectively towards health spending, but in developed countries, the spending is more efficient and more effective than developing countries.

Hessen, and Selte (2012) examined the relationship between air pollution and human health effects. Their focus was to investigating the impact of deteriorating health due to air pollution. They used data from Oslo and employed a log it models. They found that an increase in small particulate matter increases number of sick leaves, which negatively impacts trade and industry in Oslo.

Jerret *et al.* (2003) investigated the relationship between environmental quality (proxies by total pollution emission and government expenditures developed towards defending environmental quality and health care expenditures). They use cross sectional data from 49 countries of Ontario, Canada. They found that countries with higher pollution have higher per capital health expenditures and countries that spend more on defending environmental quality have lower expenditures on health care.

Kim and Lane (2013) considered infant mortality rate, life expectancy and government health expenditure in order to empirically analyze the relationship between public health expenditure and national health outcomes in 17 developed countries between 1973 and 2000. The results of the study showed a negative relationship between government health expenditure and infant mortality rate and a positive relationship between government health expenditure and life expectancy.

Muftau *et al.* (2014) examined the relationship between CO₂ emission and economic growth, in West Africa countries from 1970-2011. They used fixed effect panel regression model. The findings of co-integration indicated that there is a long run equilibrium relationship between CO₂ emission, Gross Domestic Product and others. Their results indicate that in the long run there is N-Shape relationship between income and Carbon Dioxide (CO₂) emission and the EKC is not supported for West Africa.

Odusanya *et al.* (2014), examined the effect of per capital carbon dioxide emission on real per capital health expenditure in Nigeria from 1960 to 2011. They concluded that as carbon dioxide emission increases, health expenditures, significantly increase in long run and short run.

Pope *et al.* (2010) showed that indoor air pollution from solid fuel use domestically cause acute respiratory diseases in children, mostly under five of age and chronic obstructive lung and cancer diseases in adults. They further reveal evidence of the leakage between indoor air pollution from solid fuels to the other health complications such as adverse pregnancy outcomes and low birth weight.

Rico and Turrubiates (2005) examined the impact of health on economic growth using simple ordinary least square (OLS) method to estimate this relationship. All variables were found to be positively relationship to economic growth. The study further shows that improved health standards raise the economic growth.

Saibu and Jaiyeola (2013) analyses causal effect of oil production and carbon emissions from gas flaring on the growth rate in Nigeria between 1970 and 2011. The result revealed that the economic growth rate, change in crude oil production growth rate, crude oil production growth rate, crude oil consumption growth rate, consumption growth rate, change in growth rate of carbon monoxide emission from gas flaring, growth rate of carbon monoxide emission from gas flaring, change in investment growth rate and investment growth rate are significant factors influencing economic growth in Nigeria.

Methodology

This section presents method and tools of analysis. The paper employed the use of annual time series data from 1981 to 2016 and employed Autoregressive distributed lag ARDL models for the estimation.

Model Specification I

The Grossman (1972) model: This model is adopted version of Grossman (1972) model. The objective is specified as;

$$LFEXP = F(CAREM, HEXP, LIF, EDU) \dots\dots\dots (5)$$

Where, LFEXP is life expectancy, F is functional relationship, HEXP is health expenditure, LIF is liquid emission, EDU is education rate, and CAREM is carbon dioxide emissions. Representing equation (1) in non-linear Cobb-Douglas functional form, equation (2) is specified as: $LFEXP = CAREM^{B_1} HEXP^{B_2} LIF^{B_3} EDU^{B_4} \dots\dots\dots (6)$

Therefore, it would be necessary to transform the equation (6) into linear form that allows the use of the OLS technique. In doing this, the double log transformation rule is applied on the equation (6). The essence of this is that it provides estimated parameters that can be interpreted directly as elasticizes, that is, the sensitivity of a change in the LFEXP following a change in the variables included in the model. Thus, taking the natural logarithm of both sides of the equation (5) and still assuming linearity among the variables given:-

$$\log LFEXP = B_0 + B_1 \log CAREM + B_2 \log EDU + B_3 \log HEXP + B_4 \log LIF + E_t \dots\dots\dots (7)$$

Model Specification II

The Baltimore and Tudok (2010) model: The model is modified version of Baltimore and Tudok (2010) titled "Relationship between energy and GNP" and Ejubekpokpo (2014) titled "The Impact of Carbon dioxide emission on Economic Growth in Nigeria". In general, the structural form of the model is as follows:

$$RGDP = \beta_0 + \beta_1 CO_2 + \beta_2 URBAN_t + \beta_3 GAF + \beta_4 GEXP_t + E_t \dots\dots\dots (8)$$

Where: RGDP: Real Gross Domestic product, CO_2 : Carbon dioxide Emissions, $URBAN_t$: Urbanization, GAF_t : GAS Emission, $GEXP_t$: Government expenditure and E_t : Error term

Empirical Results

This section interprets the unit root test, co integration test, short run and long run coefficient of the ARDL model, diagnostics tests and stability tests.

Table 4.2: Unit Root Test

Variable	Augmented Dickey-fuller		Phillips-perron	
	Levels	First Different	Level	First Different
XP	-3.959129**	-1.462900	-0.828021	-2.019191
CO_2	-2.647879	4.941423***	-2.301151	7.316961***
HEXP	-0.258426	-5.131016***	4.184100**	19.10560***
EDEXP	-3.315900*	-5.538271***	-3.307130*	13.16477***
RGDP	-2.284151	-4.655918***	-2.268345*	4.612594***
LIF	-4.218015**	-6.640116***	-4.308196***	16.34729***
GAF	-2.366676	-5.247103***	-2.366676	5.302317***
URB	-4.766988***	-6.209600***	-2.772808	-1.730523
GEXP	-0.440552	-8.121258***	-1.133417	8.263071***

Source: Author's computation from E-view's output

Note: *** is 1% level of significance, ** is 5% level of significance and * is 10% level of significance.

Table 4.2 presented the unit root test using Augmented Dickey Fuller (ADL) and Phillips-perron tests. The results revealed that none of the series go beyond integrated of order one i.e. 1(1). The ADF result showed that life expectancy is stationary at level value i.e.1 (0), while the ADF and PP results showed that carbon dioxide (CO₂) emissions, real growth domestic, health expenditure gas emissions and government expenditure are stationary after the first difference i.e.1 (1). Educational expenditure, liquid emissions and urbanization are stationary at level and first difference. The PP results showed that, health expenditure, education expenditure, real GDP, and liquid emissions are stationary at both level and first difference. Whereas, PP result revealed that life expectancy and urbanization are not stationary.

Table 4.3.ARD L Bounds Test (MODEL I)

F- statistics = 83.01605
Critical value Bounds

Significant levels	I (0) Bounds	I (1) Bounds
10%	2.2	3.09
5%	2.56	3.49
1%	3.29	4.37

Source: Author's Computation from E-view's output

Table 4.3 shows the ARDL bound test which determines the present of co integration after the unit root test. The ARDL bound testing result reveals the evidence of co integration among the variables. From Table 4.3 indicates that the F-Statistic value is 83.01605, which means the null hypothesis of no co integration can be rejected at 1% level of significant. This is because the F-Statistic is greater than the upper bound critical value of 4.37, clearly exceeds 1% critical value for the upper bound. Therefore is there is long run relationship between carbon dioxide (CO₂) emissions and human health.

Table 4.4: Results of short-run coefficients using ARDL (Model I)

Short-run coefficients				
Dependent Variable: Human Health				
Variable	Coefficients	Standard Error	T-statistics	P-value
CO ₂	0.000016	-0.000225	0.072169	0.9433
HEXP	-0.000461	0.000139	-3.316473	0.0041
EDEXP	0.000504	0.000131	3.859842	0.0013
LIF	0.001571	0.000283	5.554658	0.0000
ECM (-1)	-0.026765	0.001054	25.388879	0.0000

Source: Author's Computation from E-view's output

Table 4.4 indicated that Carbon dioxide (CO₂) emission has no significance relationship with human health in the short run. The coefficient of health expenditure is negatively and statistically significant at 1%, which means that an increase in health expenditure by 1% leads to corresponding decrease in human health by 0.000461%. Furthermore, liquid emission is positive and statistically significant at 1% level. The coefficient of educational expenditure is positive and statistically significant at 1%. This means an increase in education expenditure by 1% leads to corresponding increase in human health by 0.000504%.

Table 4.5. Results of Long-run coefficients using ARDL (Model I)

Depend Variable:		Human Health		
Variable	Coefficients	Standard Error	T-statistics	P-value
CO ₂	0.029820	0.009553	3.121703	0.0062
HEXP	-0.042273	0.018073	-2.338952	0.0318
EDEXP	0.066075	0.018251	3.620234	0.0021
LIF	0.119066	0.026458	4.500271	0.0003
Constant	2.551942	0.291436	8.756440	0.0000

Source: Author's Computation from E-view's output

The coefficient of carbon dioxide (CO₂) emissions is positive and statistically significant at 1% with human health as the dependent variable. This indicates that an increase in carbon dioxide (CO₂) emissions by 1% brings about an increase in human health by 0.029820%. The coefficient of health expenditure is negatively related with human health and statistically significant at 5% level of significance. More so, Liquid emission is positively and significant impact on human health at 1% level of significant. The coefficient of education expenditure is positively related with human health and statistically significant at 1%. This indicates an increase by 1% in education expenditure leads to corresponding increase in human health by 0.066075%.

Table 4.6: Result of the Diagnostic Tests (Model I)

Serial correlation Test		
F-statistics =0.142460	Prob. F(2,15)	0.8684
Heteroscedasticity Test		
F-statistics =1.216003	Prob. F(13,17)	0.3469
Normality Test		
Jarque Bera = 0.5235	Prob.	0.769806

Source: Author's Computation from E-view's output

To ensure the adequacy of the ARDL models, post-estimation diagnostic tests for serial correlation and heteroscedasticity have been conducted and the outcomes are presented in the Table 4.6. For serial correlation test Breusch-Godfrey LM test was used and p-value is 0.8684. This indicates that the null hypothesis of no serial correlation is accepted. However, for the Heteroscedasticity test (Breusch-Pagan-Godfrey) i.e. autoregressive conditional heteroscedasticity (ARCH), the result did not show any evidence of heteroscedasticity in the ARDL model. In other words, the result shows the evidence of homoscedasticity as shown by the insignificant p-value (0.3469) of F-statistics. The normality test using Jarque Bera statistics also support the normality of the model with an insignificant probability value of 0.769806. Therefore, we can conclude that the ARDL model is strongly adequately.

Table 4.7 Bounds Test (MODEL II) ARDL

F- statistics = 5.037072

Critical value Bounds

Significant levels	I (0) Bounds	I (1) Bounds
10%	2.2	3.09
5%	2.88	3.49
1%	3.29	4.37

Source: Author's computation from E-view's output

After unit root test, there is the need to know the value of F-statistics in order to determine the presence of co-integration. This has been estimated using ARDL bound testing approach model and the result reveals evidence of co-integration among the variables. From Table 4.7, the F-statistics calculated (5.037072) is greater than the upper bound value of 4.37 at 1% level of significance. Therefore we reject the null hypothesis of no co-integration and accept alternative hypotheses at 1% level of significant. Hence, there is long run relationship between carbon dioxide (CO₂) emission and economic growth at 1% level of significance.

Table 4.8 .Results of short-run coefficients using ARDL (Model II)

Depend variable: Economic growth				
Variable	Coefficients	Standard Error	T-statistics	P-value
CO ₂	-0.205396	0.063732	-3.222811	0.0038
GAF	-0.174339	0.059406	-2.934714	0.0074
URB	0.577802	0.244382	2.364335	0.0269
GEXP	-0.021998	0.034237	-0.642515	0.5269
ECM(-1)	-0.344627	0.063774	-5.403867	0.0000

Source: Author's computation from E-view's output

The short-run coefficient of carbon dioxide emissions is negatively related with economic growth and statistically significant at 1%. This means that an increase in carbon dioxide emissions by 1% leads to corresponding decrease in economic growth by 0.20.5396%. Gas emission is negatively related with economic growth at 1% level of significance. The coefficient of urbanization is positively related with economic growth and statistically significant at 5%. This is to say, an increase in urbanization by 5% translates 2.88901% increase in Economic growth. Furthermore the coefficient of government expenditure is negatively related with economic growth and statistically not significant.

Table 4.9. Results of long-run coefficients using ARDL (Model II)

Depend variable: Economic growth				
Variable	Coefficients	Standard Error	T-statistics	P-value
CO ₂	-0.399773	0.228075	-1.752808	0.0930
GAF	-0.612846	0.168046	-3.646886	0.0013
URB	0.480807	0.598022	2.476174	0.0211
GEXP	-0.015059	0.126283	-0.119250	0.9061
Constant	6.536013	9.949463	0.656921	0.5178

Source: Author's computation from E-view's output

The coefficient of carbon dioxide emissions is negatively related with economic growth and statistically significant at 10%. For example a 10% increase in carbon dioxide emission leads to decrease in economic growth by 3.99773%. Gas emissions is negatively related with economic growth at 1% level of significant. The coefficient of urbanization is positively related with economics growth and statistically significant at 5%. This indicates that an increase in urbanization by 5% leads to about 7.404035% increase in economic growth. Meanwhile the long run coefficient of government expenditure is negative and statistically not significant.

Table 4.10. Results of the Diagnostic Tests (Model II)

Serial correlation Test		
F-statistic= 0.971000	Prob. F(2,21)	0.3951
Heteroscedasticity Test		
F-statistics = 1.928920	Prob. F(7,23)	0.5032
Normality Test		
Jarque Bera = 0.872518	Prob.	0.646450

Source: Author's computation from E-view's output

The result of the diagnostic test for model is present in Table 4.10 upper panel. For serial correlation test (Breusch-Godfrey LM test), was used and p-value is (0.3951). This also indicates that the null hypothesis of no serial correlation is accepted, since F-statistic is not significant even at 10%. For the heteroscedasticity test (Breusch-Pagan-Godfrey and Auto-regressive conditional heteroscedasticity ARCH), the result did not show any evidence of heteroscedasticity in the ARDL model. In other word, the result shows the evidence of homoscedasticity as shown by the insignificant p-value (0.5032) of F-Statistics. The normality test using Jarque Bera statistics also support the normality of the model with an insignificant probability value of 0.646450. Therefore, we can conclude that the ARDL model is strongly adequate.

Discussion of Findings

This section discusses the findings of this paper in relation to the findings of literature reviewed.

This paper examines the relationship between carbon dioxide (CO₂) emission, human health, and economic growth in Nigeria. Firstly, the paper investigated the relationship between carbon

dioxide (CO₂) emission and human health while secondly; the paper examined the impact of carbon dioxide (CO₂) emission on economic growth.

The Autoregressive Distributed Lag (ARDL) bound testing technique of co-integration as adopted to investigate the existence of co-integration has been applied to ascertain the long run relationship between carbon dioxide (CO₂) emission, human health and economic growth. Table: 4.3 shows that F-Statistic is (83.01605) in model I, which indicated that; the null hypothesis of no co-integration can be rejected at 1% significant level. This is because the F-Statistic is greater than the upper bound critical value of 4.37, clearly exceeds 1% critical value for the upper bound. This means that, there is a long run relationship between carbon dioxide (CO₂) emission and human health. Similarly, the coefficient of carbon dioxide (CO₂) emissions is positively associated with human health and statistically significant at 1%. This indicates that an increase in carbon dioxide (CO₂) emissions by 1% leads to corresponding increase in human health by 0.029820%. This result is consistent with the finding of Pope *et al.* (2010). The findings however is inconsistent with the findings of Jerret *et al.* (2008).

The F-statistics calculated (5.037072) in model II is greater than the upper bound value of 4.37 at 1% level of significance as shown in table 4.7. Therefore, we reject the null hypothesis of no co-integration and accept alternative hypotheses at 1% level of significant. Hence, there is long run relationship between carbon dioxide (CO₂) emission and economic growth at 1% level of significance. Similarly, the coefficient of carbon dioxide (CO₂) emissions is negatively associated with economic growth and statistically significant at 10% level, in the long run. This implies that a 10% increase in carbon dioxide emissions leads to decrease in economic growth, by 3.99773%. The result is consistent with the findings of Akpan and Akpan (2013) and Ejubbekpokpo, (2014). The finding however disagreed with the findings of Chindo *et al.* (2014), and Muftau *et al.* (2010).

Conclusion and Recommendations

This paper research work investigated the co-integration, relationship between carbon dioxide (CO₂) emissions, human health and economic growth in Nigeria over the period of 1981-2016 using ARDL approach to co-integration. The empirical results revealed that there is a long run relationship between carbon dioxide (CO₂) emissions, and human health in Nigeria. The result further indicates that, carbon dioxide (CO₂) emissions have both short run and long run negative relationship economic growth in Nigeria. Therefore base on the empirical result the paper recommends that government must take steps to change the current energy use patterns away from fossil fuels and alternative energy sources like wave energy from the sea and solar should be explored to the fullest.

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