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# THE EFFECT OF POPULATION AND FINANCIAL DEVELOPMENT ON ENVIRONMENTAL HEALTH IN NIGERIA (1980-2019)

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**Abstract**

*In recent times, environmental health quality has raised issues on dynamics of population, financial development and environmental health quality in Nigeria. The present study has made an attempt to explore interlinks among these variables using Autoregressive Distributive Lag (ARDL) bound cointegration approach. The study period is from1980 to 2019. The coefficient of population has a positive and statistically significant effect on carbon emission proxy for environmental quality for both short and long-run. The coefficient* *market capitalization (MCP) is statistically significant at 5% level and with the positive sign in the both short-run and long-run. However, credit to private sector has negative and significant impact on carbon emission. Nigeria should develop its financial sector to enhance investment in energy saving equipment that will reduce carbon emission, hence improve environmental quality. Also, the growing population should be encouraged to use the clean form of energy for their daily activities.*

**Keywords:** *population; financial development; environmental health; autoregressive distributive lag.*

**JEL Classification:** Q56, J10, G10

## Introduction

The interaction between population and environmental health has become a growing concern in recent years for many nations of the world. With the increasing number of people living in urban areas and the world's population projected to increase to 9.8 billion by 2050, the link between urbanization and environmental health becomes imperative [United Nations, 2017]. The human population is known to largely rely on nature for raw materials for its provision of food, air, and water and other activities, which in turn can affect the environment. The growing population in Africa is accompanied by a swift growth in urbanization, industrialization, and an exhaustive abuse of environmental resources [Kone, 2018]. For instance, an increase in population growth is known to bring about increases in the demand for natural resources, such as water and fossil fuels, which in turn results into pressure on agricultural lands as a result of deforestation, bush burning etc. leading to all kinds of pollution which contributes to an unhealthy environment. According to Santra (2011), environmental hazards occur from increase in population, rise in the use of resources, technological advancement and the poor approach of humans to the environment.

As explained by the Environmental Kuznets Curve (EKC), development initially leads to deterioration in the environment but after a certain level of growth has been achieved, environmental degradation can begin to reduce. It has also been argued that financial factors can help improve economic growth but have implications on the environment. According to Mesagan and Nwachukwu (2018), increased investment in industrial technology in the bid to improve economic

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growth can help stimulate consumption of industrial energy which can either lead to increases or decreases in carbon emissions. Most African countries often rely on the use of industrial machinery, which are unfriendly to the environment and tend to generate more pollution and excessive carbon emissions; hence, more economic activities increase the chances for environmental degradation. Similarly, when there is access to loans through the financial institution, it makes the purchase of goods, which releases more toxic gas to the environment such as automobiles, refrigerators easier [Mohammed *et al*., 2019]. Likewise, with financial development, assessing advanced technology and machineries, which are less harmful to the environment, can become easier. For example, Dasgupta *et al*. (2001) postulated that countries with stable and developed financial markets tend to enjoy cleaner environment than their counterparts with less stable financial markets. With this in mind, countries continue to seek ways in which they can improve the quality of the environment by lessening the emissions of greenhouse gases, which contributes to the cause of global warming.

Nigeria being a country with high population that heavily depends on oil as a source of revenue and fossil oil for its energy supply, the questions that readily comes to mind is whether a relationship exists between Nigeria's populations and environmental degradation? If yes, can financial development amidst a growing population help in improving the quality of the environment? In order to answer these questions, the study assessed the impact of population and financial development on environmental health.

The rest of the paper is divided into five sections study, section two presents the review of relevant literature, section three presents the methodology, section four discusses the results while section five concludes the study.

## Literature Review

Some studies have examined the nexus among population growth, financial development and environmental health across various regions of the world. This link has been explored mostly, in the advanced countries [Paramati *et al.*, 2017], Asia [Feridun, 2006; Ahmed *et al*., 2021; Shahbaz *et al.*, 2013], and Africa [Tsaurai, 2018; Aluko, & Obalade, 2020]. In existing studies, mixed empirical evidences have been established while investigating the link between financial development and environmental health. Ahmed et al (2021) for example employed the linear ARDL in their study in Japan from 1971 to 2016. Their result showed that financial development positively stimulates ecological footprints while population density improves environmental quality in Japan. The study reported that high population density will reduce ecological footprints in the long-run and the use of better technology will reduce ecological deficit in Japan. Similarly, Baloch *et al.* (2019) using the Driscoll-Kraay panel regression found that financial development increase ecological foot print in the Belt and Road countries. Also, Tamazian *et al.* (2009) studied the role of financial development in the BRIC environment. With the use of the standard reduced-form modelling approach, the study reported that capital market and banking sector development accompanied by high foreign direct investment reduces carbon dioxide emissions. The study argues that financial development increase energy demand which in turn decreases Co2 emissions.

In the same vein, Tamazian and Rao (2010) examined the link between financial development and environmental degradation and found that financial development in countries with strong institutions reduces carbon dioxide emissions which then increases environmental quality and vice versa. In a study of 129 countries, Al-mulali *et al.* (2015) reported that financial development engenders higher environmental quality in low, lower-middle, upper-middle, and high-income countries while energy consumption, urbanization, and trade openness through their positive effect on ecological footprint, increase environmental damage of most countries examined. Feridun (2006) studied the case of China using the ARDL technique and reported that financial development leads to a decrease in environmental pollution in China. However, Paramati *et al.* (2017) reported that Stock market capitalization increases CO2 emissions in developing G20 countries and reduces it in the developed G20 countries. A unidirectional causality from stock market capitalization to CO2 emissions was also reported in the study.

Zhang (2011) likewise reported a positive influence of financial development on Co2 emissions in China. The study also reported foreign direct investment amongst the indicators of financial development to be the least influence on carbon emissions. Shahbaz *et al.* (2013) employed the ARDL, VECM approach and found that financial development reduces and granger cause Co2 emissions in Indonesia. However Shahbaz *et al.* (2016) examined the effect of financial development on environmental quality in Pakistan and reported that inefficient financial development that is bank-based adversely affects environmental quality. Aluko and Obalade (2020), also reported that financial development negatively influences environmental quality while larger population, greater affluence and higher levels of technology reduces environmental quality in the Sub-Saharan African countries. The study also reported a bidirectional relationship between financial development and Carbon emissions.

While in a West African study, Tsaurai (2018) with the use of the pooled OLS technique found that domestic credit provided by financial sector significantly increased carbon emissions in the examined countries. Wang *et al.* (2019) examined the relationship between urbanization, financial development, population growth, technology with CO2 emissions. The study recorded that all the variables examined have significant positive relationships with c02 emissions. Kayani et al (2020) assessed the implications for sustainable development in top ten CO2 emitter countries and revealed a positive relationship between financial development, urban population and co2 emissions in the long-run.

Evidences have also been provided to show the link between population and environmental health. For instance, Cole and Neumayer (2004) examined the link between population size and environmental quality. For $CO_2$ emissions, the elasticity of emissions with respect to population was found to be unity with the population sizes examined while for SO2 emissions, population-emissions elasticity was found to be negative for small population sizes, but begins to rise rapidly when population increases. This means that for $CO_2$ emissions, population increases are matched by proportional increases in emissions while a higher urbanization rate and lower average household size increase emissions. Similarly, in a multivariate analysis by Martínez-Zarzoso *et al*. (2007) on the impact of population growth on $CO_2$ emissions in European Union countries, results showed the existence of different patterns for old and new EU members. For the old EU countries, the impact of population growth on $CO_2$ emissions was lower than unity and non-significant while for the new EU countries; the elasticity emission-population was lower than 2.73 indicating more than proportionate between population and emission.

O'Neill *et al.* (2012) examined the relationships between demographic change and carbon dioxide emissions in. They found that CO2 emissions from the use of energy respond almost proportionately to changes in the size of population. The study concludes that by 2050, population growth paths could lead to changes in global emissions of CO2 by about 15% and to 40–60% by 2100. Wang *et al.* (2012) employed the Partial Least Squares (PLS) with STIRPAT model in China and concluded that urbanization adversely affects environmental quality. Li and Ma (2014) studied the relationship between the urbanization rate, economic development and environmental change in China. Their results revealed an inverted-U-shaped relationship between urbanization rate and changes in china's regional environmental quality. A study in India by Ohlan (2015) with the use of ARDL technique found that population growth increases carbon emissions. Zaman *et al.* (2011) also investigated the relationship between population and environmental degradation for three SAARC countries. The result from the study reveals that increasing population growth impounds pressure on production, which may burden land cultivation and lead to the deterioration of the environment. Sulaimon and Abdul-Rahim (2018) however reported that population growth to have no influence on carbon emissions in Nigeria. According to Yahaya et al (2020), in their study on the Nigerian environment found that population, energy consumption, and financial development increases environmental degradation in the short run and leads environmental decay in the long-run. The study also reported that output growth and trade helps in promoting environmental quality.

From the above literature, it could be observed that there is no consensus yet on the link among population growth, financial development and environmental health. Also, few studies exist yet in developing countries, particularly Nigeria, hence this study.

**Methodology**

Based on previous theoretical and empirical findings as articulated in the literature, as well as the structure of the Nigerian economy, the environmental health in Nigeria proxied with carbon dioxide emission depends on gross domestic product (GDP), square tests of GDP to test inverted environmental Kuznet curve, financial development proxied by broad money supply (BMS), credit to private sector (CPS), market capitalization (MCP), Interest rate (INT) and population (POP). Subjective evidence from literature reveal that the autoregressive distributed lag model (ARDL) is one of the major workhorses in dynamic single- equation regression. The ARDL approach yields consistent estimates of the long–run coefficients that are asymptotically normal, irrespective of whether the underlying are I(1) or I(0) [Pesaran, & Shin, 1995]. One particularly attractive reparameterisation to researchers is the error-correction model; which uses have increased over time [Engle, & Granger, 1987]. Thus, Equation (3.29) and equation (3.30) forms the basis of our ARDL model, and the effect of population and financial development or financial deepening on environmental health can be expressed as:

$$EHT_t = \alpha_0 + \alpha_1 GDP_t + \alpha_2 GDP_t{}^2 + \alpha_3 BMS_t + \alpha_4 CPS_t + \alpha_5 MCP_t + \alpha_6 INT_t + \alpha 7POPt + \alpha 8ENECt + \varepsilon t \quad (1)$$

The short-run and long-run effect of population and financial deepening on environmental health can be expressed as:

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$\Delta EHT_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta EHT_{t-1} + \sum_{i=1}^{n} \alpha_{2i}\, \Delta GDP_{t-1} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta {GDP_{t-1}}^2 +$
$\sum_{i=1}^{n} \alpha_{4i}\, \Delta BMS_{t-1} + \sum_{i=1}^{n} \alpha_{5i}\, \Delta CPS_{t-1} + \sum_{i=1}^{n} \alpha_{6i}\, \Delta MCP_{t-1} +$
$\sum_{i=1}^{n} \alpha_{7i}\, \Delta INT_{t-1} + \sum_{i=1}^{n} \alpha_{8i}\, \Delta POP_{t\,-1} + \sum_{i=1}^{n} \alpha_{8i}\, \Delta ENEC\ _{t\,-1} + \beta_1 GDP_{t-1} +$
$\beta_2 {GDP_{t-1}}^2 \quad + \beta_3 BMS_{t-1} + \beta_4 CPS_{t-1} + \beta_5 MCP_{t-1} + \beta_6 INT_{t-1} + \beta_7 POP_{t-1} +$
$+\beta 8ENECt\!-1\!+\!\varepsilon t$
(2)

The ARDL model testing procedure starts with conducting the bound test, which states the null hypothesis of zero cointegration, that is:

$$\beta_I = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_8 = 0$$
$$\beta_I \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq \beta_8 \neq \beta_8 \neq 0$$

The statistic underlying the procedure is the F-statistic, which is used to test the significance of lagged levels of the variables, in order to establish the existence of cointegration. The error correction representation of equation can be specified as follows:

$\Delta EHT_t =$
$\alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta EHT_{t-1} + \sum_{i=1}^{n} \alpha_{2i}\, \Delta PGDP_{t-1} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta {PGDP_{t-1}}^2 +$
$\sum_{i=1}^{n} \alpha_{4i}\, \Delta BMS_{t-1} + \sum_{i=1}^{n} \alpha_{5i}\, \Delta CPS_{t-1} + \sum_{i=1}^{n} \alpha_{6i}\, \Delta MCP_{t-1} +$
$\sum_{i=1}^{n} \alpha_{7i}\, \Delta INT_{t-1} + \sum_{i=1}^{n} \alpha_{8i}\, \Delta ENEC_{t-1} + ECT_{t-1} + e_t$ (3)

Error correction term (ECT) measures the speed of adjustment. The coefficient of the error correction term is expected to be negative and statistically significant to further confirm the existence of a cointegrating relationship. In equation (3), environmental health (EHT) depends on per capita GDP (PGDP), the square of per capita GDP to capture environmental Kuznet effect $(PGDP)^2$, broad money supply as a proxy for financial deepening (BMS) and Credit to private sector as a proxy for financial deepening (CPS). Market capitalization (MCP) and interest rate (INT) also serve as variables for financial deepening. Fossil energy consumption (ENEC) can also influence environmental health. Table 1 presents data description and sources of the variables employed in the study.

**Table 1. The Measurements of Variables and Sources of Data**

| Variables (Symbol) | Measurements | Sources |
|---|---|---|
| **Dependent Variables** | | |
| **Environmental Health (ETH)** | Carbon emission per capita | WDI |
| **Independent Variables** | | |
| **Per Capita Income (PGDP)** | Real Per capita GDP is measured by Real GDP divided by population | WDI |
| **Population (POP)** | Urban population growth rate (annual %) | WDI |
| **Broad Money Supply (BMS)** | Broad money supply to GDP ($m_2$) | WDI |
| **Credit to Private Sector (CPS)** | Ratio of private sector credit to gross domestic products | WDI |
| **Market Capitalisation (MCP)** | Ratio of market capitalisation to gross domestic products | WDI |
| **Interest Rate (INT)** | Interest rate (Lending Rate) | WDI |
| **Energy Consumption (ENEC)** | Fossil fuel energy consumption (% of total) | WDI |

Source: Authors' compilation

## Empirical Result and Discussion

The common practice in time series modelling has involved the application of (augmented) Dickey-Fuller and Phillips-Perron tests to determine whether a series possesses a unit root, improved and efficient tests with much better statistical properties are now Dickey-Fuller test statistic using a generalized least squares (DF GLS). This modified test not only has the best overall performance in terms of small-sample size and power, but also has substantially improved power when an unknown mean or trend is present [Stock, 1994; Elliott *et al.*, 1996]. The test unit root result in Table 2 shows that the null hypothesis of a unit root cannot be rejected for the level series of some variables using KPSS and DF GLS techniques. However, the null hypothesis of a unit root can be rejected for the first difference of all the series at a 5 per cent level of significance.

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**Table 2. Unit Root Test**

| | KPSS | | | DF-GLS | | |
|---|---|---|---|---|---|---|
| Variable | T-Stat | Prob. | Order | T. Stat | Prob. | Order |
| EHT<br>D(EHT) | -0.9873<br>-8.5968 | 0.4236<br>0.0000 | I(1) | -1.5920<br>-5.0427 | 0.4219<br>0.0512 | 1(1) |
| POP<br>D(POP) | -1.2274<br>-6.0590 | 0.6010<br>0.0000 | I(1) | -2.9779<br>-5.8042 | 0.0891<br>0.0372 | 1(1) |
| BMS<br>D(BMS) | -0.8447<br>-7.6349 | 0.7932<br>0.0000 | I(1) | -1.9620<br>-7.0438 | 0.9511<br>0.0000 | 1(1) |
| CPS<br>D(CPS) | -1.3426<br>-4.8735 | 0.2699<br>0.0000 | I(1) | -2.9959<br>-5.8117 | 0.0682<br>0.0019 | 1(1) |
| MCP<br>D(MCP) | 1.6328<br>-3.9990 | 0.0329<br>0.0041 | I(1) | -1.8921<br>-3.0821 | 0.0471<br>0.0032 | 1(1) |
| INTR<br>D(INTR) | -2.1820<br>-8.9302 | 0.0732<br>0.0000 | 1(1) | -2.0049<br>-8.0418 | 0.0910<br>0.0000 | 1(1) |
| GDP<br>D(GDP) | -1.0687<br>-6.0685 | 0.6852<br>0.0067 | 1(0)<br>1(1) | 0.6780<br>-5.6784 | 0.2871<br>0.0041 | 1(0)<br>1(1) |
| ENEC<br>D(ENEC) | -4.0721 | 0.0042 | 1(0) | -1.7900<br>-4.5591 | 0.4911<br>0.0382 | 1(1) |

Source: Authors' Compilation (2021) using E-view 10

Furthermore, pair wise ranger causality was performed to see whether there is a causality relationship between these variables. The direction of causality is depicted in Table 3. The result shows that the null hypothesis that states that environmental health (EHT) does not Granger Cause population (HEXP) is rejected given the p-value which is below 5%. It is also observed from the result that population growth (POP) Granger caused environmental health (EHT). The null hypothesis that population growth (POP) does not Granger Cause credit to private sector (CPS) is rejected given the p-value which is below 5%, however, the null hypothesis that credit to private sector( CPS) does not Granger Cause population (POP) is accepted which is statistically insignificant at 5%. It implies that a uni-directional causal relationship exist between population and financial deepening proxies by credit to private sector (CPS). The causality runs from population to financial deepening proxies by credit to the private sector. Furthermore, the unidirectional causality runs from credit to private sector to environmental health. It was also revealed that a uni-directional causality run from market capitalisation (MCP) to environmental health. Thus, given the result, this study rejects the null hypothesis that states that there is no causal relationship between population and financial deepening, population and environmental health and financial deepening and environmental health in Nigeria.

**Table 3. Granger Causality Result**

| Pairwise Granger Causality Tests | | |
|---|---|---|
| **Null Hypothesis:** | **F-Statistic** | **Prob.** |
| EHT does not Granger Cause POP | 5.9016 | 0.0007* |
| POP does not Granger Cause EHT | 3.8037 | 0.0053* |
| POP does not Granger Cause BMS | 2.7057 | 0.0316* |
| BMS does not Granger Cause POP | 1.3803 | 0.4920 |
| EHT does not Granger Cause CPS | 1.5028 | 0.1381 |
| CPS does not Granger Cause EHT | 4.1582 | 0.0029* |
| EHT does not Granger Cause MCP | 1.0317 | 0.6392 |
| MCP does not Granger Cause EHT | 5.4176 | 0.0041* |
| POP does not Granger Cause MCP | 4.9318 | 0.0016* |
| MCP does not Granger Cause POP | 1.3791 | 0.2118 |

Note: * Rejection of null hypothesis at 5%

Source: Authors' compilation

**Co-integration test Results**

The results of the co-integration test based on the ARDL-bounds testing method are presented in Table 4. The result indicates that the F-statistic is greater than the upper critical bound from Pesaran *et al.* (2001) at 5% significance level using restricted intercept and no trend. This study therefore rejects the null hypothesis of no cointegration among the variables. This shows that there is a long-run causal relationship among these variables in Nigeria. F-test results indicate that we reject the null hypothesis of no cointegration between variables, since computed value of F-statistics is greater than I(1) bound value at 5% level of significance. Thus, we concluded that variables are cointegrated which implies that there is a long-run relationship among the variables. The bounds test result shows that there exists cointegration because the bounds F-statistics value is greater than the I(0) and I(1) series, the study then proceeds to present both the short run and long-run result for the models.

**Table 4. Cointegration Result**

**F Bounds test**

| Test Statistic | Value | Signif. | I(0) | I(1) |
|---|---|---|---|---|
| | | | Asymptotic: n=1000 | |
| F-statistic | 5.618989 | 10% | 3.17 | 4.14 |
| | | 5% | 3.79 | 4.85 |
| | | 2.5% | 4.41 | 5.52 |
| | | 1% | 5.15 | 6.36 |

Source: Authors' Computation Critical bound from Pesaran *et al.* (2001)

Table 5 presents the long-run and short-run coefficients using ARDL approach. Population (POP) has positive and significant impact on carbon emission in both short-run ($t_c = 2.19,\ P < 0.05$) and long-run ( $t_c = 2.24,\ P < 0.05$). Also, the lagged of population is significant in explaining environmental health in Nigeria. This result indicates that a unit change in population increases carbon emission by 0.0191 and 0.2019 in short-run and long-run respectively. This result validates theoretical position that population growth worsen the environmental situation. This finding is consistence with the result of Ohlan (2015), Zaman *et al.* (2011) and Yahaya *et al.* (2020). However, it disagrees with the finding of Sulaimon and Abdul-Rahim (2018) which reported that population growth has no influence on carbon emissions in Nigeria. Broad money supply (BMS) has no significant impact on environmental health proxy by carbon emission in the short-run and long-run in Nigeria. The credit to private sector (CPS) has negative and significant impact on carbon emission in both short-run ($t_c = -3.50,\ P < 0.05$) and long-run ($t_c = -2.10,\ P < 0.05$). This result indicates that a unit change in credit to private sector reduces carbon emission by 0.1299 and 0.2911 in short-run and long-run respectively. This finding is consistence with the finding reported by Tamazian and Rao (2010) and Ahmed *et al.* (2021). Market capitalization has positive and significant impact on carbon emission in both short-run ($t_c = 2.37,\ P < 0.05$) and long-run ($t_c = 2.09,\ P < 0.05$). The result shows that a unit changes in market capitalization worsen environmental health by 0.5082 and 0.8181 in the short-run and long-run respectively. This finding is in agreement with Zhang (2011), Paramati *et al.* (2017), Al-mulali *et al.* (2015), Aluko and Obalade (2020).

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**Table 5. Population, Financial Development and Environmental Health**

| Dependent Variable: Environmental Health proxies by Carbon emission | | | | |
|---|---|---|---|---|
| | | Long-Run | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistics** | **P Value** |
| POP | 0.2019 | 0.0901 | 2.2408 | 0.030 |
| BMS | -0.2241 | 0.2971 | -0.7542 | 0.821 |
| CPS | -0.2911 | 0.1381 | -2.1078 | 0.027 |
| MCP | 0.8181 | 0.3913 | 2.0907 | 0.011 |
| GDP | 0.3881 | 0.1691 | 2.2950 | 0.037 |
| $GDP^2$ | -0.6697 | 0.8811 | 0.7600 | 0.711 |
| INT | -0.9282 | 0.3771 | -2.4614 | 0.004 |
| ENEC | 0.5911 | 0.2180 | 2.7114 | 0.001 |
| Constant | 0.6621 | 0. 2901 | 3.1664 | 0.001 |
| | | Short- Run | | |
| D(ETH(-1)) | 0.1939 | 0.0941 | 2.0605 | 0.021 |
| D(POP) | 0.0191 | 0.0087 | 2.1954 | 0.043 |
| D(POP(-1)) | 0.0817 | 0.0314 | 2.6019 | 0.002 |
| D(BMS) | 0.5990 | 0.2211 | 2.7091 | 0.007 |
| D(BMS(-1)) | 0.0192 | 0.0111 | 0.1729 | 0.219 |
| D(CPS) | -0.1299 | 0.0371 | -3.5013 | 0.000 |
| D(MCP) | 0.5082 | 0.2922 | 2.3670 | 0.003 |
| D(MCP(-1)) | -0.2101 | 0.1011 | -2.444 | 0.035 |
| D(GDP) | 0.1783 | 0.0881 | 2.0238 | 0.031 |
| D($GDP^2$) | 0.0101 | 0.0515 | 0.1961 | 0.928 |
| D(INT) | -0.4291 | 0.1771 | -2.4229 | 0.001 |
| D(INT(-1)) | -0.2911 | 0.1421 | 2.0485 | 0.000 |
| D(ENEC) | 0.3921 | 0.1221 | 3.2113 | 0.030 |
| D(ENEC(-1)) | 0.1689 | 0.0716 | 2.3589 | 0.038 |
| D(ENEC(-2)) | 0.4901 | 0.2107 | 2.3260 | 0.013 |
| $ECT_{t-1}$ | -0 .6141 | 0.2911 | 2.1095 | 0.042 |
| R-squared | 0.691 | | | |
| | | F-statistics | 4.8901 | 0.000 |
| | | Diagnostic Tests | | |
| F-Statistics | | Prob. | | |
| Serial Correlation | 1.421 | 0.198 | | |
| Functional form | 0.811 | 0.203 | | |
| Normality | 0.791 | 0.133 | | |
| Heteroscedasticity | 0.722 | 0.921 | | |
| | | Stability Tests | | |
| CUSUM | Well Behaved | | | |
| CUSUM of Squares | Well Behaved | | | |

Source: Authors' compilation

Gross domestic product (GDP) has positive and significant impact on carbon emission in both short-run $(t_c = 2.0238,\ P < 0.05)$ and long-run $(t_c = 2.2950,\ P < 0.05)$. A unit increase in GDP increases carbon emission by 0.1783 and 0.3881 in the short-run and long-run respectively. The square of GDP is not significant in explaining carbon emission in short-run and long-run in Nigeria. This implies inverted U-shape environmental Kuznet postulation is not hold for Nigeria. Interest rate has negative and significant impact on carbon emission in both short-run $(t_c = -2.42,\ P < 0.05)$ and long-run $(t_c = -2.46,\ P < 0.05)$ in Nigeria. A unit increase in interest rate reduces carbon emission by 0.4291 and 0.9282 in both short-run and long-run respectively. Energy consumption has positive and significant impact on carbon emission in both short-run $(t_c = 3.21,\ P < 0.05)$and long-run $(t_c = 2.71,\ P < 0.05)$ in Nigeria. A unit increase in energy consumption increases carbon emission by 0.3921 and 0.5911 in both short-run and long-run respectively. This result supports the fact that subsidized petroleum products consumptions dominate energy consumption mix in Nigeria, which has adverse impact on environmental health. Furthermore, this result implies that, in the context of subsidy-plagued fossil-fuel consumption and high carbon emission, an accelerated program to promote energy efficiency could reduce carbon emission in Nigeria. The share of fossil fuels out of total energy use in Nigeria in 2018 was 82%. One of the reasons of energy consumption pulling the carbon emission is lack of energy saving plans in Nigeria as government is subsidizing the fossil-fuel price.

All the diagnostic result confirmed that there is no correlation, no functional form error, no heteroscedasticity and no normality effect in the model. The statistical properties of the models as indicated by the diagnostic probability value show that the models are consistent, efficient and feasible for forecast and policy making. Also, it implying that the coefficients seem to follow a stable pattern during the estimation period; thus, one can use these coefficients for policy decision-making purposes since the model do not suffer from any structural instability over the period of study. The stability result implies that the estimated parameters were mostly stable over the period of estimation as shown by the CUSUM test and CUSUM Square test in Figure 1 and Figure 2 respectively.

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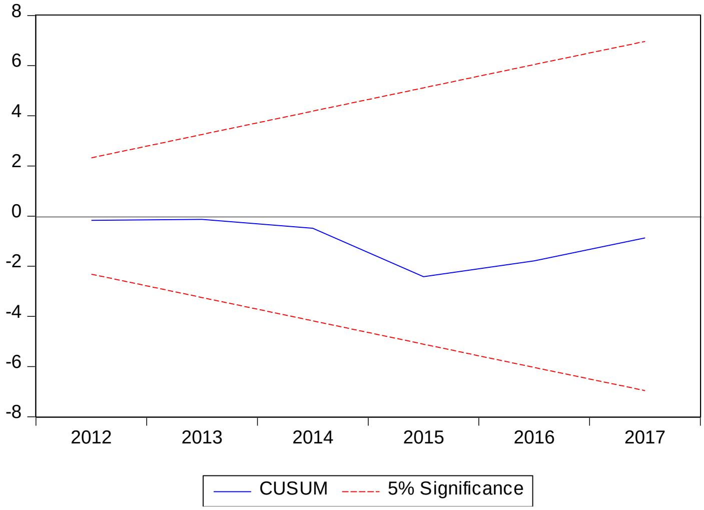


**Fig. 1. CUSUM Test**
Source: Authors' Computation

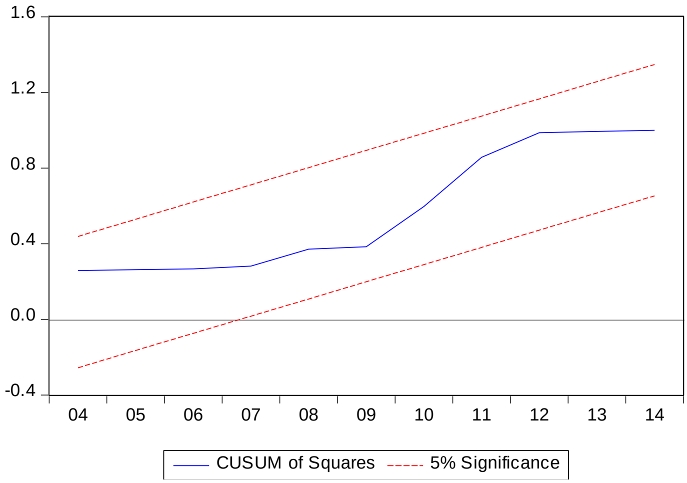


**Fig. 2. CUSUM Square Test**
Source: Authors' Computation

**Conclusion and Policy Recommendation**

Environmental health quality has always remained a topical issue among academia and researchers due to lack of consensus on this subject. A potential unresolved issue is not only the causal relationship among these variables but also the effect of population and financial development on environmental health quality in Nigeria. The present study has been an attempt to explore interlinks between these variables ARDL bound cointegration approach on time series data spanning from 1980 to 2019. Population (POP) has positive and significant impact on carbon emission in both short-run and long-run. Also, the lagged of population is significant in explaining environmental health in Nigeria. Credit to private sector has negative and significant impact on carbon emission in both short-run and long-run. Market capitalization has positive and significant impact on carbon emission in both short-run and long-run. The study concluded that while money market development proxied by credit to private sector improve environmental health, capital market development capture with market capitalization worsen environmental health situation in Nigeria. On the basis of the findings, this study recommends that there is need to impose carbon tax to improve environmental health quality in Nigeria. Also, the growing population should be educated on the need to use renewable environmental friendly energy for automobile, cooking and lighting in order to reduce carbon emission in Nigeria.

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