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An Asymmetric Effect of Economic Growth, Foreign Direct Investment and Financial Development on the Quality of Environment in Nigeria

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Abstract
Environmental degradation is anticipated to cause a loss of 6 percent to 30 percent of GDP in Nigeria by the year 2050, converting to US$ 100 billion to US$ 460 billion also Nigeria may face the risk of temperature increase between 2.5°c and 4.5°c by the year 2100 in the absence of mitigation action. As such the study aims at investigating the asymmetric impact of macroeconomic variables on quality of environment in Nigeria. The analysis incorporates data from the annual time series covering the 1970-2018 periods and applies the non-linear ARDL method for the empirical analysis. The findings show that negative and positive GDP escalates the quantity of carbon emissions, thereby worsening environmental sustainability. Through positive as well as negative shocks, FD leads to carbon emissions and FDI increases carbon emissions through positive shocks and decreases them by negative shocks. The positive shock from the FDI increases the CO2 emissions in Nigeria, resulting in environmental degradation. The research suggests implementing technology to promote the productive use of resources that would help boost environmental efficiency, increase long-run productivity and save energy. The lenders will ease financing for the energy sector and devote financial resources to ecologically friendly companies, rather than investing them in financing customers. FDI inflows should be tracked to curb CO2 emissions.

Keywords: Environmental Quality, Economic Growth, Financial development, FDI, Asymmetric, and Non-Linear ARDL

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INTRODUCTION

Climate change as well global warming happened to be among the utmost severe problems apparently the international community is facing recently. The influence of the human activities on the climate is apparent; as well the recent anthropogenic GHGs (Green House Gases) are the maximum in history, predominantly carbon dioxide emissions. According to the World Bank (2007), carbon dioxide emission accounted for 58.8 percent of GHGs emissions, among all the other pollutants that cause climate change. The activities of macroeconomics such as the energy use, manufacturing, economic growth, FDI (foreign direct investment) as well as development of financial sector contributes to large amount of carbon dioxide emissions, leading to an increase in atmospheric concentration within the environment (Environmental Protection Agency (Epa), 2017)). According to statistics, carbon dioxide emissions contributed most to climate change between 1750 and 2005 (Cosmas, Chitedze, & Mourad, 2019). Besides, carbon dioxide emission is expected to continue its influence on global warming in the future.

International organizations have, therefore, concentrated their struggles to lessen the adverse effects of global warming through the enacting and implementing policies of reducing carbon dioxide emissions (Acheampong & Boateng, 2019; Jakada, Mahmood, Ahmad, Farouq, & Mustapha, 2020; Tamazian, Chousa, & Vadlamannati, 2009). Global emissions of carbon dioxide escalate in spite of the global efforts of reducing it. According to IEA (International Energy Agency (2018) report in the year 2017 global carbon emissions born by use of energy escalate by 1.4%, it symbolizes the extraordinary escalation of 460 Mt (million tonnes) attaining a notable high of 32.5 Gt (gigatons) after being stagnant for almost three sequential years. This extraordinary escalation of carbon dioxide emissions clashes with the agreement of Paris climate change that have the goal of reducing the amount of carbon discharges. The IEA (2018) advocates that the excessive escalation of global carbon discharge emanates from the robust economic growth experienced across the globe, lack of efficient management of energy, as well fall in the price of fossil-fuel experienced recently.

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When considering its potential effect on the activities of the economy, climate change is no longer be well-thought-out just as an issue of environment, it turn to be part of developmental issues. In relation to sustainable development, it causes an exponential threat to many developing economies, remarkably Nigeria. For instance, environmental oxidization is anticipated to cause a forfeiture of 6 percent to 30 percent of GDP in Nigeria via the year 2050, converting to US$ 100 billion to US$ 460 billion in the absence of mitigation action also if the current trend is not reversed, Nigeria may face the risk of temperature increase between 2.5°c and 4.5°c by the year 2100 (Cosmas et al., 2019). International Agencies like that of UNDP (United Nations Development Program) as well as GEF (Global Environmental Facility) are working in Nigeria currently through their programs that support low carbon dioxide emissions undertakings. For instance, the renewable energy master plan is funded in Nigeria UNDP, whereas the World Bank currently is executing a project through its fund of sustainable project (Eleri, Onuvae, & Ugwu, 2013). In spite of these efforts, the country happened to be ranked as the world 44th on the list of the most emitted countries over 200 countries (Sulaiman & Abdul-Rahim, 2018). In the same vein, carbon dioxide emissions in Nigeria rose form 68.04mt to 107.30mt form the year 1980 to 2017 (IEA, 2019).

There is no uncertainty that if the mitigation as well adaptive policies were not put in place to curb this trend, quality of environment, health, economic growth as well as the ecosystem will surely be affected. Consequently, given its negative consequence on human as well as natural system, a considerable effort have been given in reducing the amount of carbon emissions as well as creating an economy with low carbon across the globe. Energy consumption as well as economic growth are the most significant variables that relate with the quality of environment. Henceforth, they have turn to be the most essential factors in degradation of environment; previously studies mostly restrict their studies to pollution of the atmosphere only, especially carbon dioxide emissions, which associate with consumption of energy as well as economic growth. These two variables alone cannot explain the emissions of carbon dioxide (Ozturk & Acaravci, 2013). We must, therefore, consider other variables relating to carbon emissions.

The previous studies on environmental degradation and economic growth revealed inconsistent outcome, as well several studies have focused on comparison between long term as well as short impact of economic growth. Particularly, the notion that economic growth will in the long run enhances the quality of the environment given the degradation of environment in the short run. Nonetheless, there are contradictory results to the observed evidence on this dimension of economic growth as well as the quality of environment (Apergis & Ozturk, 2015). In a similar vein, Atasoy (2017) reports an outcomes that are conflicting in different economies. One might contend that there might be dissimilarities between developing as well as developed countries. Quietly, such an assertion would be over-simplification as the empirical evidence advocates that there are substantial dissimilarities even within developing as well as developed economies (Al-Mulali & Ozturk, 2016; Özokcu & Özdemir, 2017). Accordingly, it necessitates an in-depth analysis, particular to the concerned economies. Formerly a conclusion can be drawn on the ecological as well as environmental consequences of economic growth in Nigeria.

Nevertheless, the upward influx of FDIs into developing economies resulted to an essential question as whether this has any effect on the quality of environment (Zeng & Eastin, 2012). Studies regarding the effect of FDI on the quality of environment are essential, looking at the fact that Nigeria is vigorous in fascinating FDI, and earlier studies are lacking in terms of the of the complex investigation regarding the association between FDI and the environmental quality as well as causality, leading to worse discernment in the hypothesis of pollution haven. The conformist view may advocate that FDI can increase the amount of carbon dioxide emissions thereby deteriorating the quality of environment as a result of weak environmental regulation in developing economies (Pao & Tsai, 2011). Developing economies intend to disregard environmental concerns through the non-enforced or unperturbed regulation in order to fascinate foreign investment; this trend in economic theory is regarded as the hypothesis of pollution haven. Conversely, when technologies with emissions of carbon dioxide are presented to minimize the amount of carbon dioxide emissions from the inflow of FDI, or when the inflow of FDI focuses primarily on service industry, the FDI influence on the quality of environment tend to be upturned. Foreign multinational are thought to apply better practices of management as well as technologies that are advanced and favorable for clean environment in the host economies (Zhu, Duan, Guo, & Yu, 2016) that are regarded as the hypothesis of halo effect. In a similar vein, Abbasi & Riaz (2016) discover that inflow of FDI are significantly enhancing the quality of environment in less developing economies.

Lastly, development of financial sector is regarded to have a significant effect on the quality of environment, but its effect on the amount of carbon dioxide emissions is considered controversial. Some categories of studies are on the opinion that development of financial sector reduces the amount of carbon emissions thereby enhancing the quality of the environment. For instance, Dogan & Seker (2016) argued that enhancement in the development of financial sector attracts foreign investment as well as higher rate of R&D that will enhance the rate of economic growth and thus escalates the quality of environment. Such researcher argued often that development of financial sector offers opportunities for developing economies to apply new form of technology that will help with environmentally friendly and sustainable production, and at the same time improve regional and global environmental sustainability. Conversely, another segment of researchers contends that development of financial sector raise the amount of carbon emissions thereby degrading the quality of the environment. According to Al-Mulali, Ozturk, & Lean (2015) when the financial sector is developed it would be easy for producers and consumers to access cheap credit that would help them in patronizing large-ticket commodities and magnify their prevailing businesses or come up with a new ventures that would increase the consumption of energy and hence increase the amount of carbon dioxide emissions thereby deteriorating the quality of the environment.

The quest for growth and development drive developing economies to escalates the demand of energy for the purpose of meeting their targeted production that will increase the consumption of energy as well as the amount of carbon dioxide emissions (Ozturk & Acaravci, 2010; J. Park & Hong, 2013). For instance, after the Nigerian independence in the year 1960, the country start diversifying its economic base with increasing agriculture, financial, manufacturing as well as tourism sectors. The enhancement for the demand of power generation from fossil fuels has escalates the amount of carbon dioxide emissions in the country. Additionally, consumption of fossil fuel, human activities like construction, ranching, bush burning as well as deforestation are thought to escalate the level of emissions of carbon dioxide constantly in the atmosphere.

According to Liddle (2015) the growth of the population will upsurge the consumption of energy and thus lead to an escalation in the amount of carbon dioxide emissions. Nigeria is recognized to be the top country in Africa with highest volume of population that count to be more than more than 186 million, with a yearly rate of growth of 2.6 percent in 2019 (Cosmas et al., 2019).

Similarly, looking at the current trend of the population in Nigeria together with the increase in macroeconomic activities like financial development, FDI, GDP energy consumption, the concern about the amount of carbon emissions that would be continuously increasing an thus affecting the Nigerian quality of environment is of greater significant particular to government and the policy makers as well. Still, in spite of the growing momentum, the best set action required to minimize the dependence on fossil fuel in Nigeria is still slightly agreed. It was stated by Jiang, Zhou, & Li, (2018) that upsurge in the emissions of GHGs postures a menace to any economy, causing a huge decrease in agricultural output and endangered habitats and health.

A study on the macroeconomics determinants of the quality of environments in Nigeria is essential in relation to the current circumstances of the country as mitigation strategy and comprehensive policy recommendation would be provided. In line with the above evidence coupled with recent literature, this study considers three macroeconomics determinants of the quality of environment that is economic growth, foreign direct investment as well as financial market development. The current study contribution to the existing literature can enumerated as follows: First, to the best knowledge of the researcher, there is no study that consider the asymmetric effect of economic growth, foreign direct investment and financial market development on the quality of environment in Nigeria, it is essential to study asymmetries, as disregarding them can lead biased results. Second, few of the previous studies that was able to make a construction regarding the index of financial development through the use of PCA (Principal Components Analysis), as a result the study make a contribution to the prevailing literature by cooperating five essential indicators of financial development such as broad money supply, lending rate, market capitalization, domestic credit to private sector provided by the bank, as well as domestic credit provided by the private sector for the purpose of avoiding the problem of multicollinearity as well as obtaining empirical evidence that is credible.

The current study is categorized into four phases. The next section summarized the literature. The methodological aspect is presented in the third phase. The fourth phase describes the model as well as the methods of analysis. The results as well as the discussions should be enumerated in fifth phase of the research. The last phase closes with the conclusion as well as the policy implication.

LITERATURE REVIEW

An appraisal concerning the previous studies shown that association that exist between the development of financial sector, economic growth, FDI as well as the quality of environment can categorized into three segments of studies. Firstly, the observed literature that centers on the association between the quality of environment and the development of financial sector. Secondly, literatures that emphasizes on the association between the environment quality and FDI. Thirdly, encompasses on economic growth and the quality of environment that examine the validity of the EKC (Environmental Kuznet Curve) theory. Concerning the above-mentioned group of studies, only limited researches that consider Nigeria, in spite of the environmental challenges facing the country.

Recently, researchers paid more attention in analyzing the association between the development of financial sector and the quality of environment. Several researches reveal a clear evidence that development of financial sector increase the amount of carbon emissions thereby deteriorating the quality of the environment (Dar & Asif, 2017; Haseeb, Xia, Danish, Baloch, & Abbas, 2018; Paramati, Alam, & Apergis, 2018; Sehrawat, Giri, & Mohapatra, 2015; Yazdi & Beygi, 2017). These categories of studies found an explanation concerning the positive association between the development of financial sector and the environmental degradation. First, the stock market development can aid the companies that were listed to enhances their networks of finance, minimalize the cost associated with finance, lessen the risk associated the operation, makes new form of investment and thus escalates the energy use and increase the amount of carbon emissions thereby deteriorating the quality of the environment. Second, by increasing the net inflow of foreign direct investment, the financial sector development can enhance the amount of carbon emissions and deteriorates the quality of the environment. Ultimately, when the financial sector of a country is well established, it would be easy for consumers to have access with credit facilities that will enable them to buy consumer goods that are durable and may emanates in a high amount of carbon dioxide emissions and thus poor quality of environment (Raza & Shah, 2018).

In the same vein, another category of researchers revealed that the financial sector development boost the efficient use of energy in industries by helping them to have access with the renewable energy and also reduce the consumption of energy as a result the amount of carbon emissions would be less and the quality of environment would be enhance (Ghorashi & Rad, 2018; Gokmenoglu & Sadeghieh, 2019; Park, Meng, & Baloch, 2018; Saud, Chen, & Haseeb, 2019; Zafar, Saud, & Hou, 2019; Zaidi, Zafar, Shahbaz, & Hou, 2019a). As well, in the instance of the states of (Organization for Economic Cooperation and Development) OECD (Katircioğlu & Taşpinar, 2017) confirm a one way causal association between the development of financial sector and the quality of environment. On the other hand (Zaidi, Zafar, Shahbaz, & Hou, 2019) revealed a bidirectional causal relationship between the environment degradation and the development of financial sector in the group of countries for APC (Asia Pacific of Cooperation). In a similar tone, a unidirectional causal relationship running from financial development to environmental degradation by Farhani & Ozturk (2015) regarding Tunisia. Henceforth, (Zafar et al., 2019) consider countries of OECD and the discoveries of their study revealed a way form of association moving from the development of financial sector to environmental degradation.

However, depending on what form of channel or dimension is governing, previous evidence have been empirically suggested that in diverse region as well as countries, FDI is bound to have different form influence on the that has to do with the quality of environment, For instance, (Abdouli, Kamoun, & Hamdi, 2018) investigates the impact of FDI on the quality of environment in China and the results of the study revealed that FDI escalates the emissions of carbon dioxide and thus deteriorate the quality of the environment. The findings of the study contradicts the arguments laid down by (Zhu et al., 2016) in the case of ASEA-5 countries that indicates that FDI enhance the quality of environment in developing countries through the provisions of greener technology to the host countries. Nonetheless, (Bokpin, 2017; Hao & Liu, 2015; Liu, Wang, Zhang, Zhan, & Li, 2018; Seker, Ertugral, & Cetin, 2015; Zakarya, Mostefa, Abbes, & Seghir, 2015; Zhang & Zhou, 2016) reported that increase in FDI escalates the carbon dioxide emissions and the degrades the environment. The arguments put forward had been confirmed by the studies from developing economies, these studies include a study for Malaysia

conducted by Hitam & Borhan (2012) as well as another one by Lau, Choong, & Eng (2014) which indicate that although the development of FDI lead higher economic growth but it has a negative effect of deteriorating the quality of the environment. In a similar vein another category of studies contradicts the arguments and reported the outcomes that increase in FDI lead to efficient use of energy through the transfer of greener technology to the host countries, studies that are in support of this arguments include (Hille, Shahbaz, & Moosa, 2019; Pazienza, 2015; Sung, Song, & Park, 2017; Tang & Tan, 2015; Zhu et al., 2016) who stated that FDI enhance the quality of environment through the reduction of the amount of carbon dioxide emissions.

Another category of literature revealed that there exists a relationship between the quality of environment and economic growth. They contended that the amount of carbon emission increase and deteriorate the quality of environment when the country is at the early phase of its economic development, nonetheless the carbon dioxide emissions will turn to decline couple with the increase in economic growth after a certain level of economic growth is achieve, this form relationship is endorse by studies conducted previously such as (Dong, Sun, & Dong, 2018; Heidari, Katircioğlu, & Saeidpour, 2015; Omri, Daly, Rault, & Chaibi, 2015). However, earlier researches describe the form of relationship between the quality of environment and economic growth is conflicting for the case in point, a conducted study for Taiwan via Yeh & Liao (2017), with regard to USA by Boufateh (2019), in relation to China by Ma & Jiang (2019), regarding the case of 31 developing economies by Aye & Edoja (2017) and hence in the case of a sample of 116 countries that cut across the globe by Acheampong (2018) revealed that intensification in economic growth serve to be one the reason for decline in the amount of carbon emissions thereby enhancing the quality of the environment. Equally, Ozcan (2013) also found an evidence that revealed that carbon dioxide emissions decline when the real GDP increase. Conversely, in the case of MENA countries by Omri, Daly, Rault, & Chaibi (2015) and Charfeddine & Mrabet (2017) , regarding the Malaysian economy by Begum, Sohag, Abdullah, & Jaafar (2015), in relation to Croatia by Ahmad et al., (2017), in relation to China by Dong, Sun, & Dong (2018), and hence for Vietnam economy by (Al-mulali, Saboori, & Ozturk, 2015), the studies revealed an empirical outcome that specify that increase in level of economic growth is capable of increasing the use of energy then escalates the emissions of carbon dioxide thereby deteriorating the quality of the environment.

RESEARCH METHODOLOGY

Data Description

The data used in this study as a proxy for the quality of environment is emissions of carbon dioxide (in metric tons per capita), for foreign direct investment the study use total inflow of FDI (US$ million), the proxy for economic growth is represented by real GDP (per capita), concerning the financial development index the lending rate, broad money supply, market capitalization, domestic credit by the bank as well as domestic credit to private sector were used and the data for this study is time series form of data that enclosed the span period from 1970 to 2019 and were obtained from the data base of the WDI (World Development Indicators) (2019).

Methodology and Model Specification

Following the previous studies, the association between financial development, foreign direct investment, economic growth and the quality of environment usually is studied by applying the conventional time series approach of ARDL (Auto Regressive Distributive Lag) techniques of cointegration analysis that modeled the EC (Error Correction) as well as granger causality. However, the conventional methods of econometrics permit the examination of the of long run relationship as well as short run association while taking into account the symmetric relationship among the variable of study. For this reason, prior studies failed to take into account the asymmetric features that is bound to exist among the macroeconomic variables. The current research then intend to look at the short run asymmetric relationship and also the long run asymmetric form of relationship between the development of financial sector, FDI, economic growth and the quality of the environment by applying the NARDL (Non-linear Autoregressive Distributive Lag) techniques of analysis that was introduced via Shin, Yu, & Greenwood-Nimmo (2014), the method contained the negative as well as positive disintegration partial sum of the dependent variables. At the same time the techniques possessed the advantage of discerning the independent variables of concern between the state of short-run period as well as the state of the long-run asymmetric reactions to changes in the quality of environment. The variation in the analyzed variables is characterized by changing the initial variable into a logarithmic form. The asymmetric form of cointegration association can be articulated as follows:

$$CO_{2t} = F(FD_t, FDI_t, GDP_t) \quad (1)$$

All the series of concern are converted for the purpose of transforming them into a logarithm form. The functional form of the log-linear of this empirical equation is presented as follows:

$$lnCO_{2t} = \beta_1 + ln\beta_2^+ lnFD_t^+ + \beta_3^- lnFD_t^- + ln\beta_4^+ lnFDI_t^+ + \beta_5^- lnFDI_t^- + ln\beta_6^+ lnGDP_t^+ + \beta_7^- lnGDP_t^- + \mu_t \quad (2)$$

Where CO_2 emissions is demonstrating the quality of the environment, FD elucidates financial development, FDI stipulates the foreign direct investment, GDP symbolizes the growth of the economy, and $\beta = (\beta_1, \beta_2^+, \beta_3^-, \beta_4^+, \beta_5^-, \beta_6^+, \beta_7^-)$ is an unknown vector of the parameters. Correspondingly,

$FD_t = FD_0 + FD_t^+ + FD_t^-$, $FDI_t = FDI_0 + FDI_t^+ + FDI_t^-$ $GDP_t = GDP_0 + GDP_t^+ + GDP_t^-$ where FD_t^+ and FD_t^- , FDI_t^+ and FDI_t^-, GDP_t^+ and GDP_t^- are partial sum procedures of positive as well as negative variation in FD_t, FDI_t , GDP_t:

$$FD_t^+ = \sum_{j=1}^{t} \Delta FD_j^+ = \sum_{j=1}^{t} max\emptyset(\Delta FD_j, 0), FD_t^- = \sum_{j=1}^{t} \Delta FD_j^- = \sum_{j=1}^{t} max\emptyset(\Delta FD_j, 0) \quad (3)$$

$$FDI_t^+ = \sum_{j=1}^{t} \Delta FDI_j^+ = \sum_{j=1}^{t} max\emptyset(\Delta FDI_j, 0), FDI_t^- = \sum_{j=1}^{t} \Delta FDI_j^- = \sum_{j=1}^{t} max\emptyset(\Delta FDI_j, 0) \quad (3)$$

$$GDP_t^+ = \sum_{j=1}^{t} \Delta GDP_j^+ = \sum_{j=1}^{t} max\emptyset(\Delta GDP_j, 0), FD_t^- = \sum_{j=1}^{t} \Delta GDP_j^- = \sum_{j=1}^{t} max\emptyset(\Delta GDP_j, 0) \quad (3)$$

As fragment of the relationship that is non-linear, the equation stated on the above is made base on the partial disintegration that take into account the asymmetric form of cointegration. The ARDL model can be used to accommodate equation (1) following (Pesaran, Pesaran, Shin, & Smith, 1999; Pesaran, Shin, & Smith, 2001) as:

$$\Delta CO_{2t} = \rho_0 + \omega_1 CO_{2t-i} + \emptyset_2^+ FD_{t-i}^+ + \cap_3^- FD_{t-i}^- + \emptyset_4^+ FDI_{t-i}^+ + \cap_5^- FDI_{t-i}^- + \emptyset_6^+ GDP_{t-i}^+ + \cap_7^- GDP_{t-i}^- + \sum_{i=1}^{d} \cap \Delta CO_{2t-i} + \sum_{i=0}^{e} (\vartheta_i^+ \Delta FD_{t-i}^+ + \gamma_i^- \Delta FD_{t-i}^-) + \sum_{i=0}^{f} (\vartheta_i^+ \Delta FDI_{t-i}^+ + \gamma_i^- \Delta FDI_{t-i}^-) + \sum_{i=0}^{g} (\vartheta_i^+ \Delta GDP_{t-i}^+ + \gamma_i^- \Delta GDP_{t-i}^-) + \emptyset_t \quad (4)$$

Where d, e, f, and g represent the lags of the orders. The unknown problem of cointegration may come up in Eqt.(1) when estimated, as a result it would be difficult to provide reliable interpretation concerning the outcome of the asymmetric results, as such a constrained is imposed into the coefficient of Eqt.(1) such as:

$\beta_2^+ = -\frac{\emptyset_2^+}{\omega_1}$ and $\beta_3^- = \frac{p_3^-}{\omega_1}$, $\beta_4^+ = -\frac{\emptyset_4^+}{\omega_1}$ and $\beta_5^- = \frac{p_5^-}{\omega_1}$, $\beta_6^+ = -\frac{\emptyset_6^+}{\omega_1}$ and $\beta_7^- = \frac{p_7^-}{\omega_1}$

The equation $\sum_{i=0} \vartheta_i^+$ examines the conceivable influence of financial development, FDI, as well as economic growth upsurge the emissions of carbon whereas $\sum_{i=0} \gamma_i^-$ processes the short-run influence of financial development, FDI, and economic growth reduction on emissions of carbon dioxide. Consequently, the asymmetric short-run effect variations of financial development, foreign direct investment and economic growth on carbon dioxide emissions is taken also in this arrangement along with long-run relationship asymmetric. The (ECM) Error Correction Model of the preceding equation is portrayed as:

$$\Delta CO_{2t} = \sum_{i=1}^{a} \sigma_i \Delta CO_{2t-i} + \sum_{i=1}^{b} (n_i^+ \Delta FD_{t-i}^+ + n_i^- \Delta FD_{t-i}^-) + \sum_{i=1}^{c} (n_i^+ \Delta FDI_{t-i}^+ + n_i^- \Delta FDI_{t-i}^-) + \sum_{i=1}^{d} (n_i^+ \Delta GDP_{t-i}^+ + n_i^- \Delta GDP_{t-i}^-) + \exists_i ECT_{t-i} + \emptyset_t \quad (5)$$

Where, σ_i, p_i, and z_i signify the coefficient of short-run as well p_i^+, p_i^- are the symmetric modification of the short-run, while $\exists_i$ specifies the coefficient concerning the error term. The techniques of NARDL estimation contains the ensuing steps: Firstly, the method of ARDL is appropriate regardless of whether all the concern variables are collectively contained order zero or order one or revealed results that is mixed. It is very significant to apply the test of unit root to certify that none of the concern variables that is stationary at the second difference or is in order that is two, ever since the occurrence of a series that have an order up to two I(2) turn the predictable F-statistics to be void and null while determining cointegration. To avoid the occurrence of this problem, the study applied the techniques of ADF (Augmented Dickey-Fuller) as well as the techniques of Phillips-Perron (PP) test of unit root that are applied while determining the integration order of the variables. Subsequently, by applying the procedure of standard OLS (Ordinary Least Squares), Eqt.(3) is enumerated. The approach of general as well as specific is applied to improve the model that characterizes NARDL last condition through depressing the lags that are insignificant. Afterward, the NARDL estimation, a test is executed to confirm if long-run association among the comprised variables is present in the concerned model through the use of bound test procedure (Pesaran et al., 2001). This involves the null hypothesis of the Wald F test, H_0: $\omega_1 = \emptyset_2^+ = p_3^- = \emptyset_4^+ = p_5^- = \emptyset_6^+ = p_7^- = 0$ contrary to the null hypothesis, H1: $\omega_1 \neq \emptyset_2^+ \neq p_3^- \neq \emptyset_4^+ \neq p_5^- \neq \emptyset_6^+ \neq p_7^- \neq 0$. In due course, with the presence of cointegration, in the associations between financial development, FDI, economic growth and the quality of environment, an examination of the long-run as well as short-term form of asymmetries is shepherded; as well interpretations are certain to be completed. Additionally, the dynamic asymmetric aggregated multiplier impact of 1% disparity in ΔFD_{t-i}^+ and ΔFD_{t-i}^- ΔFDI_{t-i}^+ and ΔFDI_{t-i}^- ΔGDP_{t-i}^+ and ΔGDP_{t-i}^- respectively were computed as:

$G_h^+ = \sum_{j=0}^{h} \frac{\partial CO_{2t+j}}{\partial FD_{t-i}^+}$, $G_h^- = \sum_{j=0}^{h} \frac{\partial CO_{2t+j}}{\partial FD_{t-i}^-}$, h = 1,2,3…….. …….. It should be noted that as $h^{\emptyset\infty}$ $G_h^+ \emptyset \beta_2^+$ and $G_h^- \emptyset \beta_3^-$, $h^{\emptyset\infty}$ $G_h^+ \emptyset \beta_4^+$ and $G_h^- \emptyset \beta_5^-$, $h^{\emptyset\infty}$ $G_h^+ \emptyset \beta_6^+$ and $G_h \emptyset \beta_7^-$.

RESULTS AND DISCUSSIONS

The results concerning the descriptive statistics as well as the correlation of the pairwise matrix is presented in Table1. The results from the table revealed that FDI when compared with GDP is more volatile, emissions of carbon tend to be less volatile when compared with GDP and FD that are highly volatile. On the other hand, the FDI standard deviation is higher than that of carbon emissions. Kurtosis as well Skewness reveals the latent asymmetry in the data distribution. The study focuses empirically on the analysis regarding the asymmetric other than the non-asymmetric. The analysis of the correlation reveals that FD and emissions of carbon, GDP and emissions of carbon, as well FDI and the emissions of carbon are associated negatively with each other. Conversely, FDI and FD, GDP and FD as well as GDP and FDI correlate with one another positively.

Table 1. The Descriptive Statistics and Correlation Matrices Results

	lnco2	lnfd	lnfdi	lngdp
Mean	0.452	5.950	92.054	12.659
Median	-0.482	-0.247	92.023	12.738
Standard Dev.	0.145	1.443	4.668	1.057
Skewness	0.240	1.132	-0.106	-0.215
Kurtosis	1.719	3.980	2.080	1.650
Jarque-Bera	3.041	9.901	1.446	3.258
Probability	0.218	0.007	0.485	0.196
Sum	-17.629	2.850	3590.143	493.716
Sum of Square Dev.	0.807	79.193	828.180	42.515
lnco2	1.000			
	-----			
lnfd	- 0.432**	1.000		
	0.006	-----		
lnfdi	-0.538*	0.449*	1.000	
	0.000	0.000	-----	
lngdp	-0.529*	0.678*	0.581*	1.000
	0.000	0.000	0.000	-----

** And * infer significance at level of 5% and 1%.

The study will start with identifying the stationary of the series before intending to identify the dynamic form of the relationship financial development, FDI, economic growth and the emission of carbon dioxide. The model of ARDL is regarded as the as the dynamic cointegration techniques of econometrics, as it is suitable for the combination of variables that are mixtures of I (1), I(0) or I(1) and I(0). The limitation of this technique, however, is impossible to apply if one of the variables has been integrated by order two I(2) (Ibrahim, 2015). For this purpose, to circumvent enclosure of variables that are I (2). The test of ADF as well as PP unit root are used to identify stationarity properties of the concern variables that are considered for examination. The results from the test of unit root are summarized in Table2 which indicates that all the variables are not stationary at level but turn to be stationary after taking the first difference, meaning that all the variables are in order one I (1) for the both of the test.

Table 2: The Test of Unit Root Results

	At level		At first difference		
Series	ADF	PP	ADF	PP	Verdict
lnco2	-1.404	-1.729	-5.189*	-5.183*	Integrated (1)

	(0.843)	(0.718)	(0.000)	(0.000)	
lnfd	-3.292	-2.909	-4.486*	-4.669*	Integrated (1)
	(0.083)	(0.170)	(0.005)	(0.003)	
lnfdi	-1.247	-3.094	-10.917*	-10.748*	Integrated (1)
	(0.885)	(0.122)	(0.000)	(0.000)	
lngdp	-1.262	-1.578	-7.872*	-7.014*	Integrated (1)
	(0.882)	(0.782)	(0.000)	(0.000)	

** And * infer significance at level of 5% and 1%.

Consequently, the analysis estimates Eqt.2 via the selection of the correct specification of ARDL by a general-to-specific process. Numerous studies such as Ibrahim, (2015) and Shin et al., (2014) adopted the general to particular ARDL specification protocol. In addition, the Schwarz Information Criterion (SC) is set to use for determining the respective order of lags. The F-statistics values of the asymmetric test of ARDL bound techniques are listed in Table 3, and the asymmetric results of the ARDL are displayed in Table 4.

Table 3: The Bounds Test of nonlinear cointegration Results

	F. Statistics	Lower Bound (95%)	Upper Bound (95%)	Verdict
Asymmetric ARDL	5.555	2.56	3.49	Cointegrated K=3

Nonetheless, the asymmetric bound test of ARDL outcome advocates the presence of co-integration in the midst of the concern variables of the study as the value of calculated asymmetric ARDL F-statistic (5.55) surpasses the upper as well the lower bound tabularized value at a five percent level of significance.

Table 4: The Asymmetric ARDL Estimation Results

Series	Coefficients	Standard Error	T-Statistics
LFD^+	0.602*	0.054	-11.061
LFD^-	-0.134*	0.019	-6.993
$LGDP^+$	0.305**	0.031	9.651
$LGDP^-$	-0.682	1.403	-0.486
$LFDI^+$	0.896*	0.076	-11.737
$LFDI^-$	0.181**	0.048	3.757
ΔFD^+	0.355*	0.034	10.180
ΔFD^-	-0.391*	0.042	-9.175
ΔGDP^+	0.407*	0.115	3.522
ΔGDP^-	-0.445**	0.132	-3.375
ΔFDI^+	0.678*	0.067	9.989
ΔFDI^-	0.4434**	0.132	-3.348
F-statistic	[0.000]		
R-squared	0.665		
Adjusted R-squared	0.519		
X^2_{Norm}	0. 660[0.718]		
X^2_{sc}	0.486[0.526]		
X^2_{Het}	0.305[0.580]		

** And * infer significance at level of 5% and 1%

After ratifying that none among the variables that are bound to be integrated at I(2), as well the bound test of cointegration ratifies the presence of long-term connection among the study variables concerned. The research then uses the NARDL methodology to investigate the impact of financial development, FDI as well as economic growth on the quality attached to environment. The study's short run and long-term outcomes are reported respectively in Table 3.

In the long run, the study shows that the positive shocks in FD are positively related to carbon emissions and the relationship is statistically significant at a level of 1 percent, signifying that an increase of 1 percent in FD^+ would to lead to the sum of carbon emissions to increase by 0.60 percent. The shocks that is negative on FD is negatively and strongly linked to carbon emissions at a level of 1 percent, causing a 1 percent decrease in FD+ leading to a rise in carbon emissions by 0.13 percent, this finding is aligned with Shahbaz et al. (2016) findings for Pakistan. The outcome entails that a raise in the positive FD increases the amount of carbon emissions and thus worsen the quality attached with the environment while decreasing negative FD escalates the amount of carbon emissions thereby declining the quality of the environment. The study states that, in Nigeria case, financial institutions are mainly vigorous in the allocation of lower-cost financial capital to investors/firms and to households for the purpose of purchasing household related products through consumer finance. However, auto-financing is a more rewarding consumer option of finance for sale to the developing Nigerian middle class. Because of the environmental regulations that are lax, companies / investors are using technology to boost their efficiency, which leads to increased energy use and environmental degradation.

Moreover, the positive shocks that is in GDP is positively connected with carbon emissions as well is statistically significant at a point of 5 percent, meaning that a 1 percent rise in GDP+ will result in an increase of 0.31 percent in the amount of carbon emissions, thus worsening the environmental standard. At the other hand, negative shock that is in GDP is negatively linked to carbon emissions and the relationship is statistically negligible, which means that a 1% decrease in GDP will increase the sum of carbon emissions by 0.68%, thus worsening environmental efficiency. Considering that negative shock in the outcome of GDP is not significant, the relationship is dominated by the positive impact of GDP on carbon emissions, while growing economic growth in Nigeria is worsening environmental quality. These findings are in line with the Cosmas et al. (2019) findings regarding Nigeria and Atil et al., (2019) for China which refer to the contribution of economic growth to environmental degradation.

Finally, the asymmetric impact of FDI on carbon emissions is positive for the FDI with positive shock and is statistically significant at a level of 1 percent, demonstrating that an increase of 1 percent in FDI+ will lead to an increase of 0.89 percent in the amount of carbon emissions and therefore reduce the environmental efficiency. In the same way with the negative FDI, the relationship is positive for the sum of carbon emissions and is also statistically meaningful at a level of significance of 5 percent, signifying that 1 percent shrinkage in FDI- will cause in a decrease of 0.18 percent in carbon emissions. FDI's positive robust part specifies that FDI reduces Nigeria's CO2 emissions and apparently supports the hypothesis of pollution haven (which advocates that FDI is damaging the environment of the home country). The outcomes supported by other studies such as the findings of Haug and Ucal (2019). This means that lax environmental laws and as well as regulations in the hosting economies are likely to draw a greater inflow of FDI from international companies facing tight regulations in their home nations to unclean industry sectors. Nigeria has rules and legislation, but the companies do not obey such laws because of its deprived political and judicial system.

Positive and negative financial development shocks in the short run, however, increase the sum of carbon emissions thereby worsening environmental efficiency. Because of their positive impact on carbon emissions, a positive as well as negative shock of GDP effects on carbon emissions is degrading the environmental standard. In fact, positive shocks upsurge the sum of carbon emissions for the FDI while the negative shocks shrinkage carbon emissions and accordingly upsurge environmental efficiency in the state of short term.

However, to discover the precision of functional forecasting as well as the parameters of decision-making, the analysis continues with the test of diagnostic statistics such as Normality, serial correlations, as well as heteroscedasticity form of test. Table 4 displays the outcomes of these studies, the estimated model passes these categories of diagnostic criteria as there is absence of the heteroscedasticity, the autocorrelation as well as the non-normality that is achieved at the significance point of 5 per cent.

The graphical study of an asymmetric relationship between the variables under investigation is also illustrated in Figure 1 & 2.

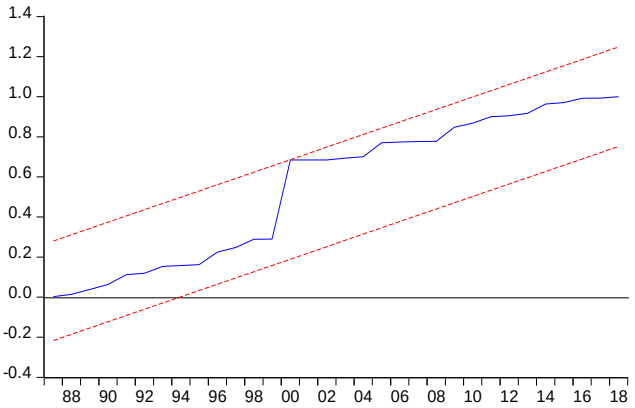

Figure 1.

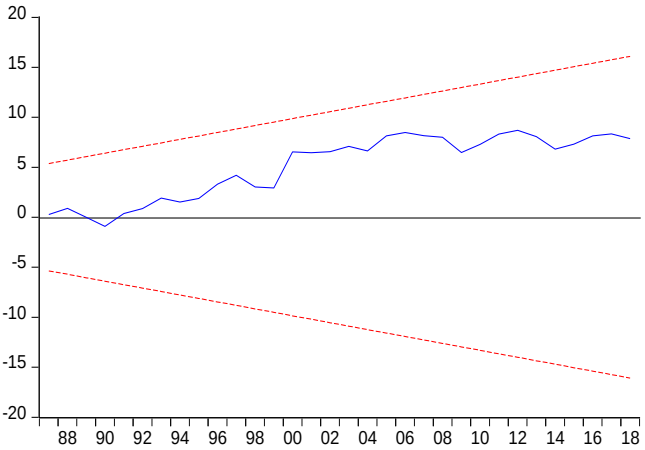

Figure 2.

The reliability of the model for NARDL is appraised by means of the CUSUM as well as the CUSUMSQ consistency method put forward by work of Brown, Durbin, & Evans (1975). When the line that is blue touches the upper or else the lower confines, the conclusion should be that the model is not stand to be stable. Looking at the CUSUMSQ figure as well as figure of the CUSUM the blue line is situated in between the lower as well upper confine line that is the red lines, on this basis the study concludes the model is certainly stable and is also appropriate for forecasting as well as the decisions making.

CONCLUSION AND POLICY IMPLICATIONS

A lot of economists, policymakers and environmentalists generally look at oil use, free trade, financial progress, FDI as well as progress in the economy as the prime causes of carbon emissions, contributing to environmental issues. While several studies have been carried out on the role of the variables of macroeconomic on the quality attached to environment, most have studied both country and region but few considerations have also been devoted to evaluating the positive as well as negative shocks of macroeconomic variables via NARDL model procedures.

The present study examines the asymmetric effect of macroeconomic variables on carbon emissions to determine their effects on environmental quality in Nigeria by incorporating development of financial sector index, FDI as well as GDP into the functions of carbon. The analysis employs data from the annual time series covering the 1970-2018 periods. The research performs the unit root test of ADF and PP methods to check the degree of integration of the variables and then to facilitate the empirical analysis of non-linear ARDL statistical techniques. Additionally, the asymmetric ARDL cointegration techniques are used to measure the effect of positive and negative financial progress, GDP as well as FDI on carbon emissions.

Based on the empirical result, the study states that the variables investigated reveal an evidence of a strong asymmetric cointegration. Financial advancements contribute to the amount of carbon emissions by both positive and negative shocks, as the growth of Nigeria's financial sector deteriorates the environmental standard. Positive shocks in economic growth have a positive effect on carbon emissions while negative shock on economic growth have a negative impact on carbon emissions, meaning that both negative and positive shocks in economic growth increases the amount of carbon emissions, thus decreasing environmental quality. Foreign direct investment raises carbon emission levels through positive shocks, and through negative shocks. The FDI's positive robust portion specifies that FDI reduces Nigeria's CO2 emissions and thus prevents environmental degradation.

An apparent implication of various outcomes is that FDI and financial development are commonly regarded as the engine of growth in developing countries, both contributing positively to a nation's development but also undermining the environment, as our study suggests. So, our study further suggests that by introducing environmental regulations to limit CO2 emissions, the Nigerian government will identify the attractiveness of FDI. Nonetheless, stringency in environmental legislation could probably lead to a decrease in FDI which is a crucial determining factor of growth; hence, it should be supported to encourage more FDI to service sectors, labour-intensive industry or green energy sectors and to also reinvest in renewable energy. Furthermore, FDI should then be geared toward research and development (R&D), as well as clean technology for CO2 emission mitigation should be expanded to R&D.

The study revealed that economic growth is positively related to CO2 emissions by positive shocks, which indicates the negative consequences of economic growth on environmental damage. Such environmental degradation can affect public health that in the longer-term lowers productivity and in doing so lowers the speed of development. Therefore, the technology that is energy-efficient should be applied not only on the production level, and also at the transport as well as household level. Implementing environmentally friendly technology can help boost the standard of the environment, improve sustainability in the long term and conserve money for future generations. Furthermore, attempts must always be undertaken to plant trees rather than participating in lengthy-term economic growth deforestation, and the use of renewable sources of energy such as wind, hydropower and solar power to reduce pollution. Efficient measures are also to be levied on vehicles to enforce a carbon tax and minimum fuel quality requirements.

We notice that efficient technology performs a double function, that is, to boost productivity for long-term economic growth and also to reduce

pollution in order to enhance environmental quality. Financial development can help finance the purchase of modern and energy-efficient equipment, as it is possible to obtain financial resources at lower cost. Nonetheless, our empirical evidence shows that financial development hampers environmental quality via positive shocks that occur in financial sector growth. In this regard, as it corresponds to economic growth, the financial system can also be formed with new instruments and regulations. The government should, for example, guide the Nigerian central bank to control the financial institutions 'financial resource allocation process, and the financial institutions should control the companies after allocating financial resources to ensure that credit is not provided at the expense of environmental sustainability. If any corporation is involved in that environmental destruction, it will be punished by cuts in tax holiday, or increases in interest-rate loans. The government will also allow the financial sector to invest in the sector of energy in general as well as the renewable energy sector in particular. In this respect, the finance sector should devote financial means to R&D for energy-efficient technology and secure patents for such technologies so as to produce the same lifespan of income instead of just lose financial means on consumer lending, which is, car leasing or household product loans.

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