

Environmental Taxation and CO₂ Emission Management

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Abstract Due to the obvious ozone layer depletion and continual contamination of the air and water, environmental protection has become a global priority. In an environmentally challenged country like Nigeria, the difficulty of having clean water and air is a significant cause for environmental taxes to become unavoidable. Although these taxes are presently levied in the form of fines for gas flaring, gas exploration tax, and petroleum profit tax, which are 85 percent more than the standard business income tax of 30 percent of revenues. The argument is based on the fact that the business operations of the oil and gas sector cause a significant degree of pollution to the environment. As a result, this research looks at the influence of environmental taxes on CO₂ emission control in Nigeria. The research spans the years 2010 to 2020. According to the regression findings, the gas exploration tax has an inconsequential negative influence on CO₂ emission management, but the petroleum profit tax has a negligible positive impact on CO₂ emission control. On the other side, the cost of environmental preservation has a large beneficial influence on CO₂ emission control. As a result, the study suggests the implementation of more suitable environmental taxes and levies in order to lower pollution levels in Nigeria.

Keywords Environmental Taxation, Environmental Protection, CO₂ Emission Control

JEL Classification Codes: H23, Q52, Q53

1. Introduction

Environmental pollution is a multidimensional and complicated problem that may have significant environmental and economic effects, as well as jeopardize a country's security [1]. Environmental policy and the conservation of living environments, aimed at reducing environmental burdens, have become a global issue and a component of national and international economic strategies [2]. Since the 1980s, developed nations have begun to introduce environmental and green levies to regulate firm-level pollution emissions [3]. For example, in 1972, the Organization for Economic Cooperation and Development (OECD) nations adopted the "polluter pays" concept, which compelled all polluters to pay taxes for pollution they directly or indirectly caused [4]. Nowadays, the rapidly expanding population and economic activities cause an increase in environmental contamination globally, as well as increased attention to this issue [1]. They have progressively garnered greater attention to economic strategies in both rising and developing nations such as China, India, Indonesia, Thailand, Singapore, and Vietnam during the last few decades. The fact that environmental issues are becoming increasingly prominent raises the issue of evaluating the effectiveness of various environmental policy tools [1]. According to Article 3 of the Treaty on European Union (EU), one of the primary priorities of the European Union is environmental protection. Furthermore, Article 191 of the Treaty on the Functioning of the European Union identifies fighting climate change as one of the European Union's goals.

The EU's environmental concerns may be traced back to 1973, when six Environmental Action Programs were established. In many respects, these initiatives prepared the way for environmental legislation like as the NEC Directive (2001/81) that established national emission limits for four pollutants and the 2003 Emission Trading Directive that established carbon dioxide emission goals for each EU member state. The EU's goal is to attain climate neutrality by 2050 [5]. This brings to the forefront the debate about how to attain this goal in the most effective way possible. The introduction of environmental fees is a commonly utilized approach for decreasing air pollution [6]. The argument behind environmental taxes is that pollution is a kind of market failure caused by negative externalities associated with certain activities (such as transportation) or the manufacturing process for specific commodities such as energy [6]. External costs must be internalized by incorporating them in the price of the item or service to solve this market failure. The European Environment Agency presently uses the same definition as the UN: "a tax whose tax base is a tangible unit (or a substitute for it) of anything that has a demonstrated, particular detrimental impact on the environment" [7].

Environmental taxes in the European Union are classified into four types: energy taxes (including CO₂ taxes), transportation charges, pollution taxes, and resource taxes. Environmental taxes are an important indirect economic instrument for attaining environmental goals through reducing environmental burden [2]. One of the environmental taxes gaining the most attention in developed countries is the carbon tax, which is a tax placed on businesses that emit carbon dioxide (CO₂) as a result of their operations, with the goal of discouraging the use of carbon-intensive energy sources [8]. Emissions taxes, payback for the use of natural resources and the environment, and product retribution are all examples of environmental taxes. Emission taxes are charged on pollutants/waste released into the atmosphere, water bodies, and/or land [9]. This charge is determined by the volume and quality of the pollutant, as well as the cost of the harm [9]. A carbon tax was first adopted in Northern Europe in the early 1990s, with Finland leading the way, and was frequently implemented alongside other carbon-pricing mechanisms, such as energy taxes, with the goal of decreasing energy use. In the 1980s, the Chinese government created regulations governing pollution discharge costs. In particular, the Provisional Regulations for the Collection of Compensation Fees for Pollutant Discharge were originally published by the Chinese State Council in 1982. A carbon tax may provide a significant incentive to decrease carbon emissions through conservation, substitution, and innovation, as shown in nations and areas throughout the world such as Australia, Sweden, and Alberta [10].

Environmentalism in Nigeria gained prominence to some extent in the early 1970s, but primarily in the 1990s, as a result of environmental degradation pressures, particularly the ozone layer, oil spillage in the Niger Delta area, pollution

by cement and textile manufacturing sectors, and so on [11]. As a means of carrying out government policy, taxes laws have been modified to reflect current policies [11]. The National Environment Standards and Regulation Enforcement Agency (NESREA) Act of 2007 is administered by the Ministry of Environment and supersedes the Federal Environmental Protection Agency (FEPA) Act. It is the manifestation of rules and regulations aimed at protecting and developing the environment and its natural resources in a sustainable manner. Another environmental policy in Nigeria is the Associated Gas Re-Injection Act, CAP 20, LFN 2004. The Associated Gas Re-Injection Act regulates the gas flaring operations of Nigerian oil and gas firms. Section 3 (1), which bans any oil and gas firm from flaring gas in Nigeria without valid authorization, is one of the provisions important for pollution control. Section 4 further specifies the penalty for violating permission conditions.

The Hydrocarbon Oil Refineries Act, CAP H5, LFN 2004 is another essential regulation to back up environmental protection problems in Nigeria. The Hydrocarbon Oil Refineries Act governs the licensing and regulation of refining activities. Section 1 bans any illegal processing of hydrocarbon fuels in areas other than a refinery. Refineries are required to maintain pollution protection facilities under Section 9. Another law to prevent pollution in Nigeria is the Oil Pipelines Act, CAP 07, LFN 2004. The Oil Pipelines Act and its Regulations govern oil operations. The sections listed below are relevant: Section 11 (5) imposes legal responsibility on the individual who owns or controls an oil pipeline. He would be obligated to compensate anyone who suffers bodily or economic harm as a result of a breach or leak in one of his pipes. Section 17 (4) states that permits must be granted in accordance with regulations governing public safety and the prevention of land and water pollution.

Regulations For Oil Pipelines (Under Oil Pipelines Act) Section 9 (1) (b) requires environmental emergency plans, and Section 26 makes any violation punishable by a N500,000 fine and/or a six-month jail term. The Petroleum Act, CAP P10, LFN 2004 remains Nigeria's principal oil and gas law. It promotes public safety as well as environmental stewardship. Therefore, Section 9 (1) (b) gives the power to impose rules on operations to avoid air and water pollution. As a result, under the Petroleum Products and Distribution Act, CAP P12, LFN 2004, any sabotage that might result in environmental contamination is punished by death or imprisonment for a term not exceeding 21 years. Regulation of Petroleum Refining Section 43 (3) requires the Manager of a refinery to take steps to prevent and manage environmental contamination. Any violation is punished under Section 45. Mineral Oil Safety Regulations and Crude Oil Transportation and Shipment Regulations specify precautions to be followed in the production, loading, transfer, and storage of petroleum products to avoid contamination. Although all environmental rules provide for the collection of fines and levies from violators when appropriate, there are fundamental environmental fees

collected at the federal level of government in Nigeria, such as fines and penalties for gas flaring [12], including other environmental protection fees. Petroleum profits tax, income tax on gas exploration, and environmental protection fees are among the ecologically linked taxes in Nigeria which are considered in this study.

2. Literature Review

Vera and Sauma [13] compared the emissions-cutting impacts of carbon taxes and energy-efficiency initiatives in Chile. The results showed that the imposed carbon price would result in a 1% yearly decrease in CO₂ emissions compared to the anticipated baseline throughout the 2014-2024 timeframe. Fan, Li and Yin [14] carried out an empirical examination of China's green development dynamical system which demonstrated the particular evolution routes of economic growth, pollution intensity, and resource intensity under various environmental tax parameters. The findings demonstrated that environmental levies had a considerable beneficial influence on green growth. Furthermore, the study disclosed that when an environmental tax is imposed, strong government supervision, active consumer awareness, and a high level of technology might enhance economic growth, reduce pollution intensity, and manage resource intensity. Valles-Gimenez and Zarate-Marco [8] investigated the effectiveness of environmental levies and regional government programs for reducing glasshouse gas radiations. The investigation utilized panel data for the 17 Spanish regions from 1999 to 2017, utilizing a dynamic Durbin model to manage the geographical nexus between areas. The findings demonstrated that there was geographical dependency and spatio-temporal persistence of greenhouse gas emissions at the regional level in Spain, and that in this setting, emissions-management levies and regulations add a minor deterrent to emitting them.

Csiksova *et al.* [2] looked at the status and significance of environmental taxation in the Visegrad area. The contribution's findings demonstrate the impact of the introduction of an environmental tax on the tax system, as well as the major impact on company behavior with an emphasis on eco-innovation processes. Esen *et al.* [1] employed a panel smooth transition regression (PSTR) to investigate the influence of environmentally relevant taxes on environmental performance in the EU-15 nations from 1995 to 2016. The research focused on total ecological balance and its primary components, which were based on the major categories of ecologically productive regions such as farmland, grazing land, forest area, and fishing grounds. The findings showed that income from environmental taxes as a percentage of GDP considerably reduced ecological deficits after a certain threshold level, but not cropland balance accounts. Tibulca [6] provided a fresh look at the efficacy of environmental fees in decreasing air pollution in the European Union. Panel data dynamic error correction

models were employed in the study to examine the influence of environmental taxes (and other explanatory factors) on carbon dioxide emissions on the one hand, and greenhouse gas emissions in general on the other hand. The findings revealed a statistically significant negative long-run connection between environmental taxes and emissions of air pollutants.

Nong, Simshauser, and Nguyen [15] studied the Greenhouse gas emissions vs CO₂ emissions: Comparative analysis of a global carbon tax. The results demonstrated that the differences in consequences between including and not including non-CO₂ emissions were more pronounced in developing countries, particularly when compared to developed ones. When non-CO₂ emissions were excluded, Iran, for example, suffered a 1.52 percentage point decrease in real GDP. These effect variations increased as economic expenses rose (e.g., more sectors involved or higher tax rates). The study discovered that emerging countries' economies shrank at a faster rate than industrialized countries' economies. Iran, Kazakhstan, South Africa, China, India, Russia, Mexico, and Indonesia all experienced 2–5.1 percent reductions in real GDP relative to business-as-usual (no carbon tax), whereas such reductions were less than 0.8 percent in Australia, the United States, and other developed nations due to relatively high emission costs in developing nations relative to economy size. Due to high emission levels and input replacement possibilities, major polluting countries such as China, the United States, India, and Russia were shown to have low marginal diminution costs when compared to other nations.

Li *et al.* [4] used panel data of 30 provinces of China to test the effectiveness of Environmental Protection Tax Law introduced in 2018 and found that, as compared to the pollution discharge fee policy, environmental taxes had a favorable influence on pollutant emission reductions in China. The study revealed that upon implementation of environmental tax laws, sulfur dioxide (SO₂), nitrogen oxide (NO_x), and dust emissions from fossil fuel power plants dropped by 2.186 (7.7%), 1.550 (6.84%), and 1.064 (16.1%) tons, respectively. Furthermore, pollutant emission reductions and tax rates had an inverted U-shape connection. The study also examined how different types of businesses reacted to environmental taxes. It was discovered that environmental taxes had a limited impact on pollution reductions in big state-owned coal power stations.

3. Research Methods

The study makes use of descriptive and causal research designs. Descriptive research design is a statistical approach to producing quantitative empirical data in a given field of study. Groves [16] claims that descriptive techniques provide accurate information about people, events, or circumstances as they occur in the real world. It enables the collection of numerical data that can be quantitatively analyzed using descriptive and inferential statistics

(Mugenda and Mugenda, [17]. The purpose of a causal research design is to determine the causation effect of the explanatory variable on the response variable. A causal study design, according to Kothari [18], aids in investigating the influence of one variable on another. The goal of this study is to investigate the impact of environmental taxation on CO₂ emission control in Nigeria. CO₂ emissions figures are derived from the World Data Atlas in Million Tonnes. Furthermore, figures on environmental protection expenses are sourced from the Central Bank of Nigeria's Statistical Bulletin, whilst information on Petroleum Profits Tax and Gas Exploration Tax is derived from the Organization for Economic Cooperation and Development (OECD). The study runs from 2010 to 2020, and the data collected is in logarithmic form.

The following is the multiple regression model for this study, which will be used to assess the influence of the

independent factors on the dependent variable:

$$CO_2 = f(EPC, PPT, GET) \tag{1}$$

The econometric form is as follows:

$$LOGCO_{2t} = \beta_0 + \beta_1 LOGEPC_t + \beta_2 LOGGET_t + \beta_3 LOGPPT_t + \varepsilon_t \tag{2}$$

Where:

CO₂ = Carbon dioxide emissions

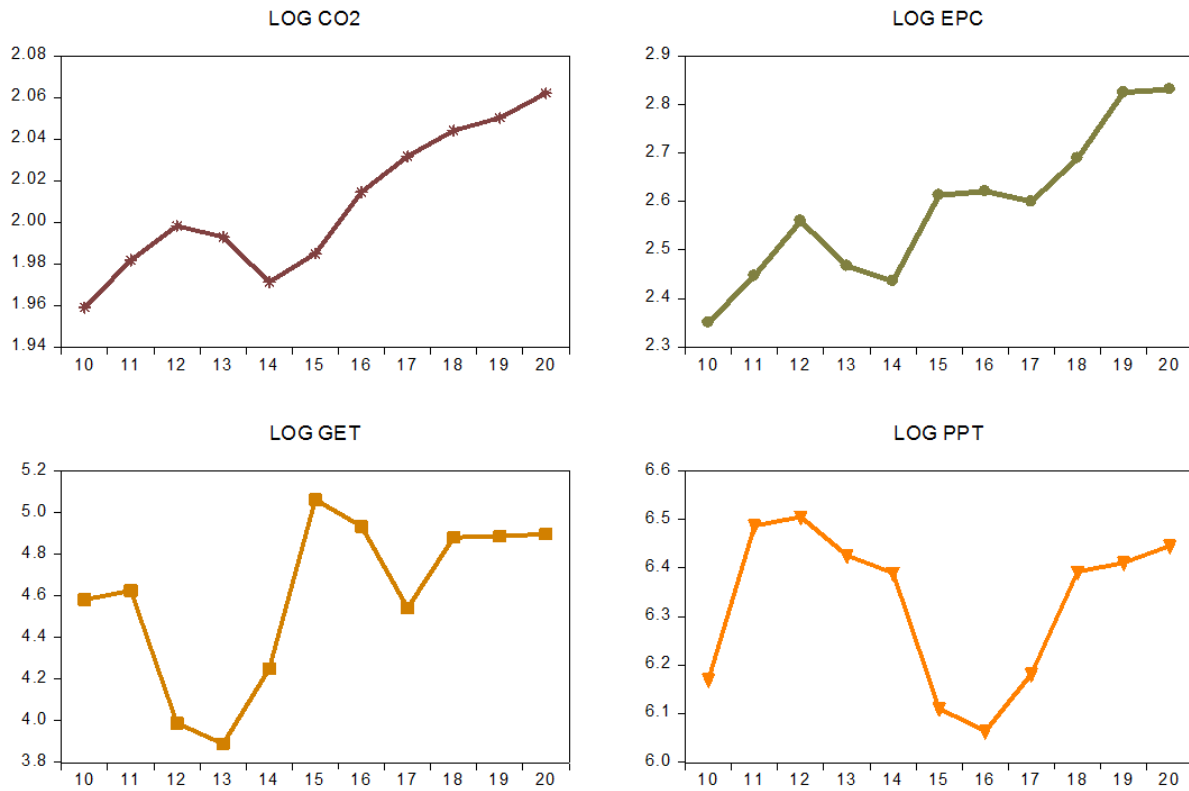
EPC = Environmental Protection Cost

GET = Gas Exploration Tax

PPT = Petroleum Profits Tax

β_0 = Constant; β_1 - β_3 = Regression coefficients; ε_t = Error term.

On the a priori, we expect; $\beta_1 > 0, \beta_2 > 0, \beta_3 > 0$.



Source of data: CBN Statistical Bulletin, OECD and World Atlas

Figure 1. Trend analysis

4. Data Analysis and Explanation

Figure 1 provides information on the trend of the data for all variables from 2010 to 2020. Looking at the CO₂ emission, the continuous upward trend signifies that the pollution in the environment is not likely to end soon as there is not yet a suitable and functional remedy. As long as the oil and gas commercial activities subsist in Nigeria, pollution increase is inevitable. The environmental protection cost is also rising because the oil and gas activities continue to strive as one of the major sources of income in Nigeria, the government is trying as much as it can to protect the environment. On behalf of President Muhammadu Buhari, Nigerian Vice-President Yemi Osinbajo announced in 2017 a \$1 billion clean-up and restoration initiative for the Niger

Delta's Ogoni land area, affirming that financial and legal mechanisms had been put in place to begin effecting the United Nations Environment Programme (UNEP) proposals to clean-up the long standing environmental pollution in the Ogoni land [19]. The sluggish pace of the clean-up, however, drew the attention of the House of Representatives Committee on Safety Standards and Regulations, which voiced concerns about the Ogoni cleanup [20]. Ogoni land is only one of the millions of contaminated Niger Delta locations where oil and gas corporations conduct upstream oil and gas exploration. CO₂ emissions are increasing as these operations continue. Furthermore, environmental taxes varied and decreased over time, indicating a lack of appropriate support for the country's needed environmental cleanup.

Table 1. Descriptive statistics

	CO ₂	EPC	GET	PPT
Mean	2.008312	2.585468	4.594143	6.325800
Median	1.998259	2.599883	4.625590	6.392271
Maximum	2.062206	2.831230	5.062834	6.505329
Minimum	1.959041	2.350248	3.888011	6.063637
Std. Dev.	0.034541	0.155711	0.397907	0.160729
Skewness	0.213521	0.254896	-0.661752	-0.526075
Kurtosis	1.711983	2.096515	2.114304	1.647212
Jarque-Bera	0.843953	0.493246	1.162389	1.346151
Probability	0.655749	0.781435	0.559230	0.510137
Sum	22.09143	28.44015	50.53557	69.58380
Sum Sq. Dev.	0.011931	0.242460	1.583298	0.258339
Observations	11	11	11	11

Source: Author's computation, 2021

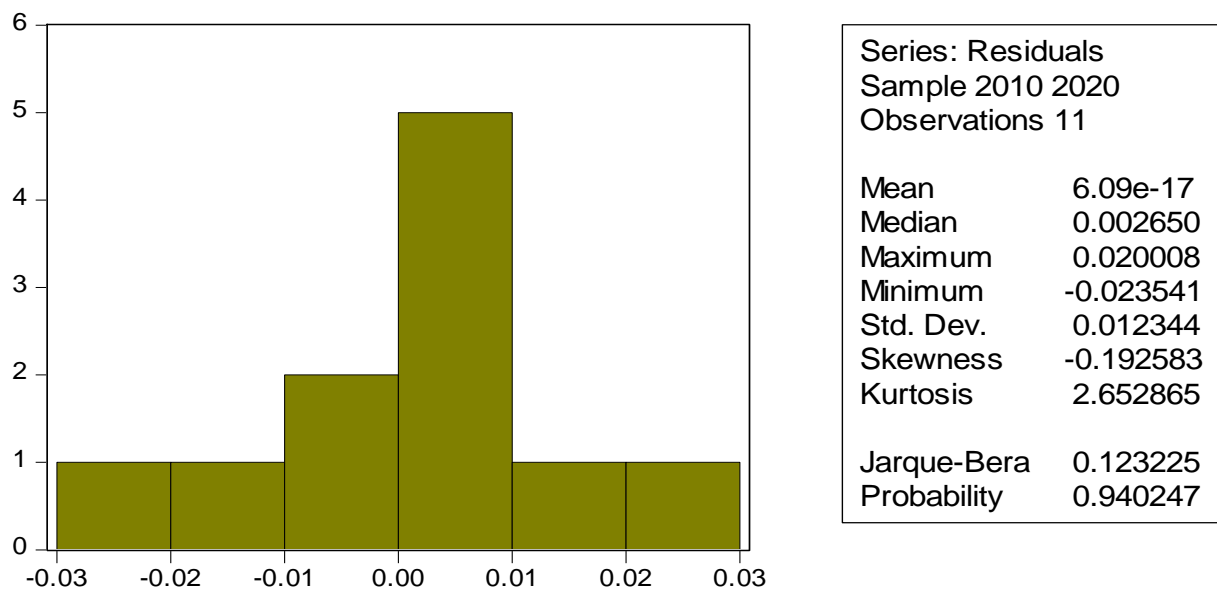


Figure 2. Histogram Normality

Table 2. Correlations analysis

		LOGCO ₂	LOGEPC	LOGPPT	LOGGET
LOGCO₂	Pearson Correlation	1	.927***	.182	.424
	Sig. (2-tailed)		.000	.592	.194
	N	11	11	11	11
LOGEPC	Pearson Correlation	.927***	1	.111	.561**
	Sig. (2-tailed)	.000		.746	.072
	N	11	11	11	11
LOGPPT	Pearson Correlation	.182	.111	1	-.464
	Sig. (2-tailed)	.592	.746		.150
	N	11	11	11	11
LOGGET	Pearson Correlation	.424	.561**	-.464	1
	Sig. (2-tailed)	.194	.072	.150	
	N	11	11	11	11

***. Correlation is significant at the 0.01 level (2-tailed).

**. Correlation is significant at the 0.10 level (2-tailed).

Table 3. Pairwise Granger Causality Tests

Sample: 2010 2020			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
LOG_EPC does not Granger Cause LOG_CO ₂	9	0.81853	0.5035
LOG_CO ₂ does not Granger Cause LOG_EPC		0.93979	0.4628
LOG_GET does not Granger Cause LOG_CO ₂	9	17.9681	0.0100***
LOG_CO ₂ does not Granger Cause LOG_GET		4.57050	0.0927**
LOG_PPT does not Granger Cause LOG_CO ₂	9	0.99437	0.4461
LOG_CO ₂ does not Granger Cause LOG_PPT		2.90477	0.1663
LOG_GET does not Granger Cause LOG_EPC	9	0.99073	0.4472
LOG_EPC does not Granger Cause LOG_GET		2.31170	0.2152
LOG_PPT does not Granger Cause LOG_EPC	9	0.73580	0.5344
LOG_EPC does not Granger Cause LOG_PPT		0.76026	0.5250

SOURCE: AUTHOR'S CALCULATION, 2021

*** Significant @ 1% level; ** Significant @ 10% level

The nature of the data obtained for this investigation is depicted in Table 1 and Figure 2. The mean values for CO₂, EPC, GET, and PPT in Table 1 are 2.01, 2.58, 4.59, and 6.32, respectively. Similarly, the maximum values for CO₂, EPC, GET, and PPT are 2.06, 2.83, 5.06, and 6.51, respectively. The median for CO₂, EPC, GET, and PPT are 1.99, 2.59, 4.6 and 5.39 respectively.

Accordingly, the minimum values for CO₂, EPC, GET, and PPT are 1.96, 2.35, 3.89 and 6.06 respectively. The standard deviation has a reducing spread, and the Kurtosis is within the normal distribution range. Although, GET and PPT are negatively skewed, but all of the variables' Jarque-Bera p-values are larger than the 0.05 level of significance. This is more proof that the data distribution is perfectly normal, and the normality of the histogram in Figure 1 backs up the claim.

The correlation analysis of the variables utilized in this

study is shown in Table 2. At the 1% level of significance, there is a substantial and positive connection between CO₂ emissions and environmental protection costs. Similarly, at a 10% level of significance, GET and environmental protection cost link strongly. Both of the correlations provided in table 2 demonstrated the existence of a link between CO₂ emissions, environmental protection, and gas and exploration operations.

Table 3 shows the Pairwise Granger Causality Tests, which are used to indicate the causality impact of one variable on another. The causality impact is measured at the 5% and 10% level of significance. Table 3 shows that GET has a causal influence on CO₂ at a 1% level of significance. This finding indicates that gas and exploration tax granger contribute to CO₂. Furthermore, CO₂ granger causes GET at a 10% level of significance. These two findings indicate that CO₂ pollution is

significantly emitted by gas exploration operations, despite the fact that the commercial activity is taxed, there is evidence of a high pollution connection. However, as demonstrated in table 3, all other factors do not granger cause one another since their p-values are larger than the 5% level of significance.

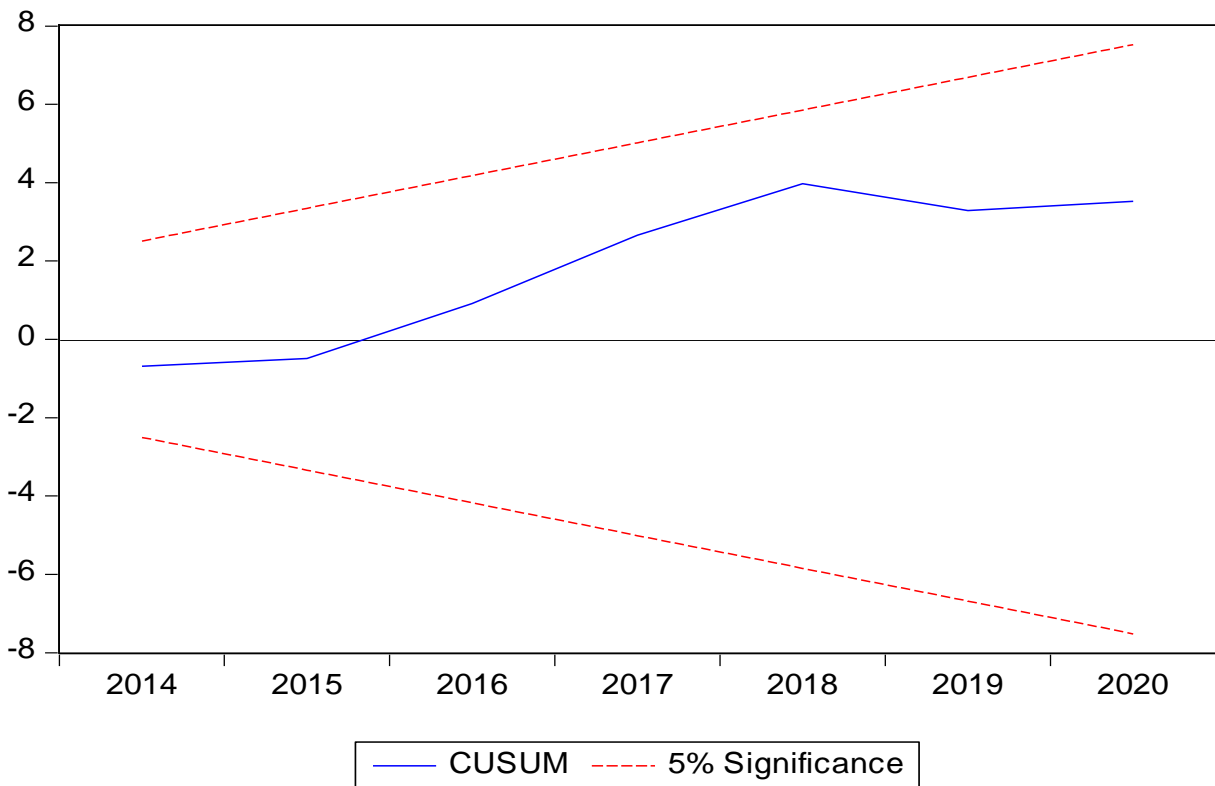
Table 4. Diagnostic tests

Type of test	P-value
Ramsey RESET Test	0.99
Breusch-Godfrey Serial Correlation LM Test	0.44
Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.61
Jarque-Bera P-Value	0.94
LOGEPC-VIF	1.96
LOGGET-VIF	2.47
LOGPPT-VIF	1.71

SOURCE: AUTHOR'S CALCULATION, 2021

The model for this investigation was evaluated for stability, normality, multi-collinearity, serial correlation,

and heteroskedasticity (see Table 4) at a 5% level of significance, and the p-values were found to be larger than 5%. So, the model is stable, normal, and devoid of heteroskedasticity and serial correlation, according to the results. In terms of interdependence, the variance inflation factor (VIF) of all independent variables is less than 10, indicating that the model is not multi-collinear [21]. The CUSUM test and CUSUM of squares (Figure 3), each with blue lines in between the red dotted lines, show that the model is stable. The Durbin-Watson result in Table 5 demonstrates that the model is rid of autocorrelation, and the standard error of regression shows that the model prediction is 99 percent correct. The F-statistic p-value of 0.00, which is less than 5%, confirms that the model is statistically significant and suitable for the research. The results also show that the independent factors have a combined impact on the dependent variable. The EPC has a substantial positive impact on CO₂ emission management, whereas the PPT has a negligible positive impact, and the GET has an immaterial negative impact on CO₂ emission management, according to the t-statistic.



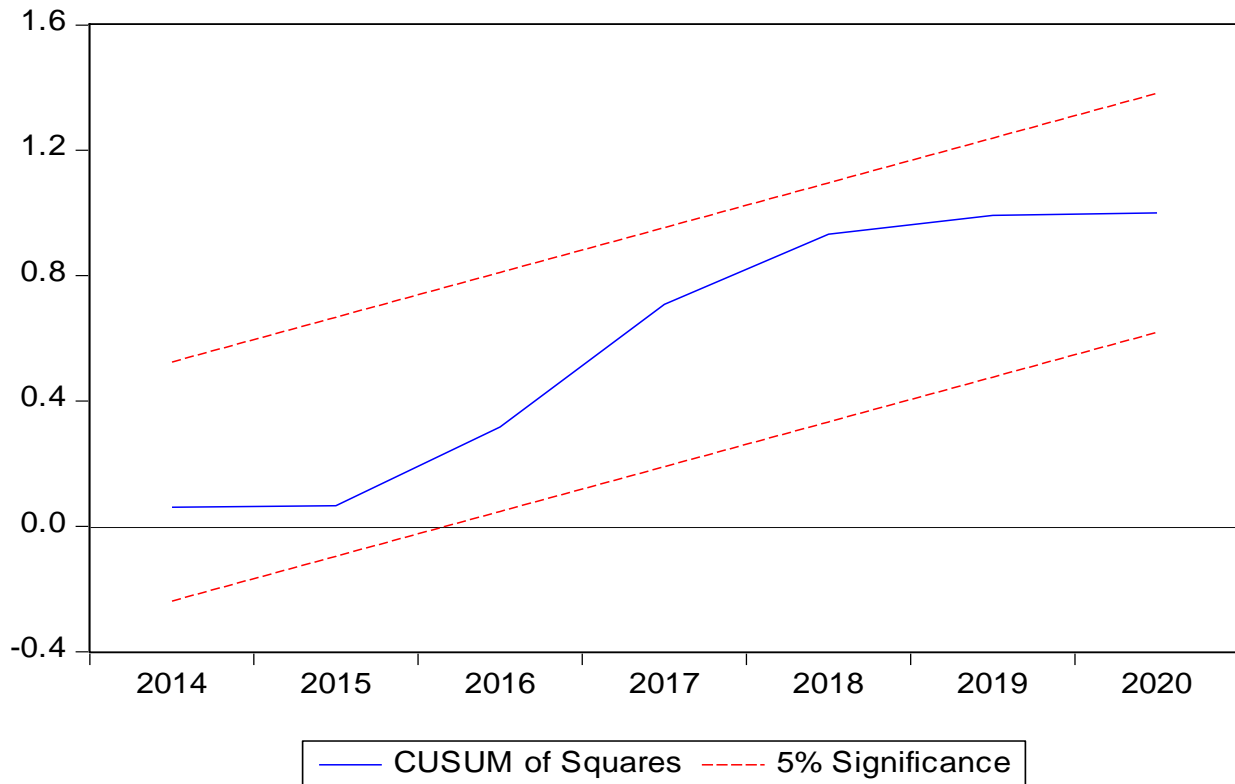


Figure 3. CUSUM test and CUSUM of squares

Table 5. Regression analysis

Dependent Variable: LOG_CO₂

Method: Least Squares

Sample: 2010 2020

Included observations: 11

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG_EPC	0.221837	0.041988	5.283386	0.0011***
LOG_GET	-0.011514	0.018436	-0.624527	0.5521
LOG_PPT	0.002124	0.038004	0.055888	0.9570
C	1.474221	0.252191	5.845642	0.0006
R-squared	0.872275	Mean dependent var		2.008312
Adjusted R-squared	0.817536	S.D. dependent var		0.034541
S.E. of regression	0.014754	Akaike info criterion		-5.319271
Sum squared resid	0.001524	Schwarz criterion		-5.174582
Log likelihood	33.25599	Hannan-Quinn criter.		-5.410478
F-statistic	15.93509	Durbin-Watson stat		1.645998
Prob(F-statistic)	0.001645			

SOURCE: AUTHOR'S CALCULATION, 2021

5. Conclusions

The research looks at the impact of environmental taxes on CO₂ emission control in Nigeria from 2010 to 2020. The study made use of environmentally related taxes and the level of CO₂ emissions as captured by the World Atlas. According to the findings, environmental taxes have not yet assisted in enhancing the Nigerian environment for healthy living. Both of the levies employed in this study do not help to regulate pollution in the environment. Rather, it is the government's efforts to control the crisis that are yielding positive results. As a result, the research proposes that the government should develop policies that would lead to introduction of more meaningful environmental levies. The government should improve environmental legislation and guarantee that it is effectively implemented where appropriate. Following the recommendation of [22], private entities should be enabled to engage in environmental management by providing them with incentives and the required technological tools. As CO₂ emissions continue to rise, the research proposes more fines and penalties. It will act as a deterrent to the companies involved to avoid careless pollution of the environment. This study suffers from a lack of local empirical investigations and suggests that researchers conduct more research on other relevant environmental fees not addressed in this study. Position papers are also recommended to enable policymakers to take a page from other nations and implement critical environmental levies that will assist to reduce the country's degree of environmental devastation.

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