Fiscal policy and the dynamics of environmental quality in Nigeria

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Abstract

Background: Fiscal policy in terms of governments' regulation of environmental activities through spending and tax plays a significant role in the quality of the environment. Experience has shown that various emissions arise from various sectors including manufacturing, industry, construction, and transportation which need some degree of regulation through governments' spending and taxation in order to reduce the extent of damage these emissions impose on Nigeria ecosystem.

Objective: This paper evaluates the link between fiscal policy and environmental quality in Nigeria. The main objective was to examine the effects of fiscal policy tools including revenue generation and tax levied. Growing activities of the economy are also included as a factor that can regulate pollution in the environment. Also, a comparison was made to determine the response of each sectors' emission to regulatory tools.

Methodology: The theoretical model was adapted from individual preferences which are dependent upon consumption and environmental quality. Secondary data were collected from 1980-2016 on carbon-dioxide emission from various sectors of manufacturing, industry, construction, and transportation from the World Development Indicators. In the same vein, internal revenue generation and value added tax and growth data were collected. The methodology was based on the robust least square estimation due to insensitivity to violation of assumptions.

Results: The study finds out that the scale effect is identified with transport emission; composition effect with manufacturing, industry, and construction emissions; while the technique effect is partly identified by electricity and heat production and transport emissions.

Unique contribution: The paper contributes through comparison of response of various emissions from each sector to regulatory tools, and this is relatively scarce in economic literature. Also, disaggregation into the various sectors according to their relative pollution was reported.

Conclusion: Environmental pollution through emissions of various kinds need serious policy attention. The global warming symbols are threatening and known to emanate from the activities in the industry, manufacturing, and other human activities.

Key recommendation: Regulations from fiscal policy should ensure minimization of pollution which again needs to be complemented by public enlightenment on the dangers of pollution and environmental degradation.

Keywords: Fiscal policy; environment; robust least square; Nigeria

Introduction

Increasing growth due to early stages of industrialization indicates continuous environmental degradation which declines thereafter with certain threshold of income. The trend in population growth and natural resources shows that the latter causes no improvement in welfare conditions or but rather worsens it through release of emissions. Therefore, degradation through inflow of emissions calls for concern and thus, is given more attention through addressing environmental issues of concern (Islam & Lopez, 2015). Fiscal policy role which is lacking in Africa can be enhanced through encouraging positive externality, financial subsidies, and financial investment. In a broad sense, government employs economic and fiscal tools to regulate emissions, pollution from social costs to achieve a more cost-effective solution compared to those obtained through conventional command and physical control. Moreover, smooth structural changes can be brought about through economic and fiscal tools; they can also decrease transaction costs involved in exploring new pollution techniques of control. Within the framework of global warming policy, economic and fiscal tools can target market position of sources of energy that are friendly to environmental quality, particularly the ones that are renewable. For instance, tax levied on carbon dioxide emission is to give price signals in the long term in such a way as to induce economic agents, consumers inclusive, to embrace a more convenient energy sources and to foster reduction of energy sector emission, energy efficiency, and savings. While it is admitted that the benefits of economic and fiscal tools are many, it is not in every case that they are appropriately carried out. Imposition of tax incentive should involve identifying a clear policy target and applying such to those targets. For instance, a tax levied on carbon dioxide emission should be limited to those emissions beyond certain acceptable limits. Environmental regulation provides opportunities for revenue generation either for the purpose of financing the economy or protecting the environment. Government therefore, turns to the use of indirect methods of control such as the use of charges or taxes to curb acts of environmental degradation. Nigeria's notion for rapid economic development deteriorates environmental quality frequently due to system deficiencies; leading to resource depletion for productivity growth. Fiscal incentives often move to unproductive ends that further frustrate efforts at curtailing environmental pollution.

Thus, do Nigeria's fiscal policy tools effectively regulate the emissions flow? Do the activities from various sectors limit excessive emission flows? Consequently, this paper examines the role which fiscal policy tools play in regulating emission flows of the Nigeria's notable sectors. Apart from the fact that fiscal policy and environmental regulation is less researched particularly in Nigeria, the motivation for this paper follows the yearnings on issues of climate change and its potential effect on the ecosystem and the general well-being of the masses. Besides, the paper also contributes through comparing various emissions of various notable sectors. The paper is organized in the following ways: Section II provides stylized facts on fiscal policy tools and environmental regulation. Section III contains the relevant literature on the subject matter while section IV contains the theoretical framework and methodology. Estimation and discussion of results are contained in section five while section six concludes.

A stylized fact

Nigeria's environmental protection law had long been in existence in the colonial bye-laws. The policies of the 1900 in relation to conservation of natural resources and/or regulating pollution were not followed with strict rules. The Criminal Code of 1958, section 246 and the Public Health Act of 1958 were major laws for the control of water pollution and spread of diseases respectively, but still were not effective as fines and penalty for violation were liberal.

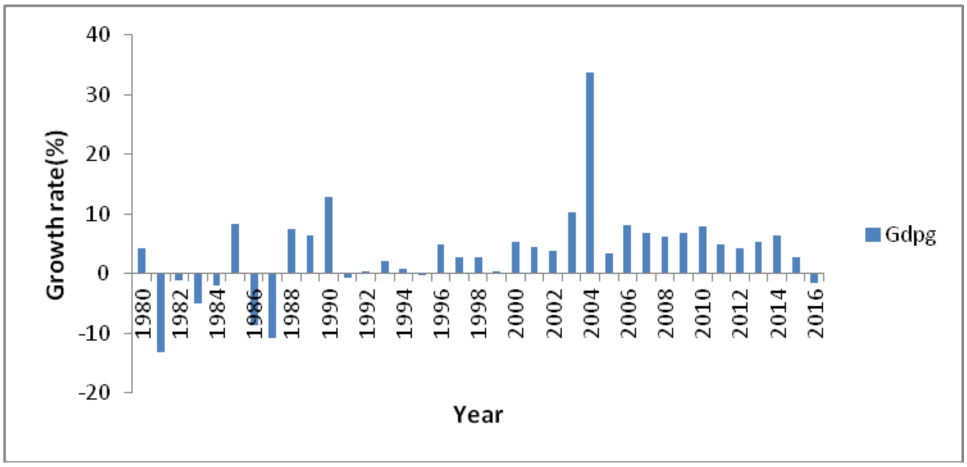
By 1964, concern rose on the rate of water pollution which gave rise to the formation of Water Pollution Act of the Federation. Thereafter, the Committee on environmental health of the National Council of Health agreed with the recommendation of establishing a sanitary inspectorate in the Federal Ministry of Health. This is with a view to minimize pollution, but with results under expectations. It then becomes quite obvious that institutional environmental regulation has been without clear scientific understanding of the wastes and level of pollution while basic environmental and household hygiene were enforced mostly through qualitative legal rules.

The Federal constitution in 1979 concentrated on environmental hygiene with the aim of clearing refuse, managing liquid and solid waste, including wastes of residential places. These were supervised by the local government councils (Ola, 1984). Federal Environmental Protection Agency (FEPA) under the Federal Government of Nigeria came into existence in 1988, which as from 1999 became Federal Ministry of Environment. This agency is to take adequate care of the ecosystem in Nigeria. In line with this, decree 58 already put in place was to create environmental guidelines through setting of rules for regulating of all forms of pollution. Trend analysis of various forms of emissions which include: emissions from transportation (co_2 trans), emission from manufacturing, industry, and construction (co_2mic), emissions from electricity and heat production (co_2ehp), emissions from building, commercial, and public services over the period 1980-2016 using natural log values (though with some missing values particularly for 2015 and 2016) has indicated that emission from transportation alone as a percentage of total fuel combustion was highest in 2002 followed by emission from electricity and heat production.

This is not surprising because the number of traffic emission increases almost on a daily basis as vehicles continue to ply the Nigerian roads. According to FU (2001) and Goyal (2006), traffic emissions constitute between 50 and 80 percentages of Nitrogen and Carbon concentrations in developing world and Nigeria is not an exception. This is highly pronounced in Nigeria where poor maintenance culture and importation of old and abandoned vehicles have been the order of the day. The result has been high emissions of pollutants that are detrimental to the living conditions and quality of the environment. In terms of value added, manufacturing value added was relatively low around this period, but agricultural value added rose. The lowest emission for the period emanated from building, commercial, and public services.

Figure 1: Emission flows in Nigeria from (1980-2016)

Source: WDI



Theoretical literature

Economic instruments bridging the gap between fiscal measures and environmental policy goals exist; one of such is the tax. Theoretical discussion centers on the idea model in which case, the rationale for environmental taxes has to be put into consideration. The idea is that given that government regulation is not in existence, then there is abuse of the environment or environmental degradation up to the point where the costs of reducing that degradation are just less than the benefits from getting the environment improved. Figure 1 below illustrates the basic idea of the model:

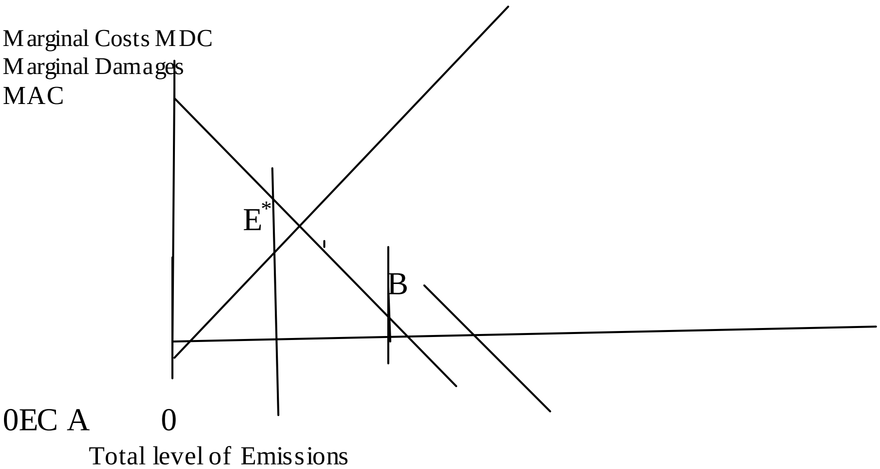


Figure 2: Marginal Costs, Damage, and Optimal Pollution Control
Source: Adapted from Environmental Taxation, pp 4

The model considers the fact that air pollution is generated from sources of fossil fuel. The level of emission on air shed is demonstrated on the horizontal axis while the vertical axis indicates additional costs incurred when pollution level is reduced by one unit on the assumption that at each stage, reduction occurs from the least cost combination source. Such a reduction may originate from changes in technology, a change within the air shed, or outright reduction in output generating the emissions. The additional cost is shown by the MAC and the shape follows from the stated assumptions. Suppose control is not in existence, the polluters are at the advantage of keeping the emissions at the level OA, since at this level, no costs are incurred for abatement. Similarly, the marginal costs of abatement are negligible as indicated by the area ABC. The other curve measures the marginal damage resulting from emission and consisting of rising incidences of respiratory disease, destruction of property, crops, and bodies of water and so forth.

The marginal damage curve MDC is drawn on the assumption that there is a high response rate by individuals to rising emission to reduce its effect on them. The shape of the curve most likely demonstrates that improvement in the environment declines the marginal value of further improvement. At point OE, the level of emission is optimal and it is at this point that the marginal cost of abatement and marginal damage are in equilibrium. A further increase in emission from OE results in greater damage to the environment than the savings in the cost of abatement and vice versa. Imposition of green tax denoted by EE^* on each unit of emission demonstrates economically optimal position. The response of polluter to this tax is such that emission would reduce up to where its MAC equaled EE^* and thus leading to reduction in optimal least costs. As long as savings in tax continues, there would be incentives to reduce emission. This is also possible if a subsidy of EE^* is given to each medium of pollution for each unit of pollution to reduce from its existing level or if emissions permit, OE are issued such that competitive market trading is allowed to ensure that each medium of pollution purchases permits up to where the price equaled its MAC which is again, equaled MD. Either the MAC or MD is without any precision, but obtaining the green tax requires estimating EE^* and that of permit system requires estimating OE. Based on the magnitude of tax, the level of pollution would either be too high or too low and thus, making it incorrect. Permits are characterized by fairly sophisticated market structures with fixed prices and trading. This case differs from the developing countries.In most case, taxes are preferred to subsidies as economic instruments because subsidies are not just automatic, but require some level of assessment of the reduction level to be paid for. This thus, appears complex due to issues of equity often raised resulting in varying effect on the profitability of operations including entry and exit from the group of firms. Similarly, revenues are obtainable through green taxes whereas subsidies depend on revenues which need to be raised within the system leading to inefficiency in all.

Practically, the kind of green tax evaluated so far appears impossible because it cannot satisfactorily measure environmental quality. Besides, it is also problematic to measure emission due to limited amount of data for pollution. On the basis of this, the notion of applying green taxes disengaged from the ideal model discussed above. Consideration is therefore given to other economic instruments known to cover the gaps between fiscal measures and the environment. OECDs classification remains one of the well known classifications of economic instruments and consists of five groups (OECD, 1992); these are: charges, subsidies, deposit-refund system, artificial markets, and enforcement incentives.

Provision of subsidies respond to motives of various kinds such as: preventing domestic distortion (Bhagwati & Ramaswami, 1963) protection of infant industries (Melitz, 2005), facilitation of innovation, support of national champions, and opportunities for redistribution (World Trade Organization, 2006). Subsidies may be extended to primary, manufacturing, and service sectors through various sources including input subsidies, output subsidies, and encouraging fair regulatory standards and reliefs from tax which may be called regulatory relief (Barde & Honkatukia, 2004; Heutel & Kelly, 2013; Fisher-Vanden & Ho, 2007).

Application of subsidies does not in every case lead to loss in the quality of environment. For instance, a well organized subsidy policy may facilitate environmental protection in various ways such as: subsidies which enhances organic farming or other substitutes which are environmentally friendly; an efficient technological support for emission reduction in industries; and so forth. Even at that, subsidies are not without some negative effects on environmental quality. According to Heutel and Kelly (2013), various environmental implications of subsidies on input have been highlighted as follows: In the first case, the demand for any subsidized input increases compared to that of the non-subsidized ones. Secondly, production increases for the benefiting firms of the subsidized inputs due to reduction in per unit cost of production, and this consequently increases the demand for input in general. Thus, this leads to transformation in terms of increase in size and also expands scale of operation leading to over-production and over-exploitation of resources. Alternatively, given that government enhances output subsidies to the producers through higher price per unit of output, such a step may foster over-utilization of productive resources, resources over-exploitation, over-production, and consequently, leading to loss in environmental quality (van Beers & van den Bergh, 2001).

In summary, while literature supports that subsidies generally create room for over use of dirty inputs for environmental degradation, they are not also without the advantage of environmental sustainability through pollution reduction and output growth. Empirical literature reviews have emerged overtime. Some evidences have shown that environmental regulation can significantly cause adverse effects on trade, employment conditions, location of plant, and productivity within the short run especially in a well- identified pollution subset and energy dependent sectors. Ambec *et al.*, (2013) illustrate causal links involved in using the Porter Hypothesis with the conclusion that given a well regulated and flexible environment, there tends to be improved performance together with innovation offsets. Fujii *et al.*, (2013) studied the varying effects of environmental pollutants. It is shown that environmental performance using the Co_2 emissions impact positively on Return on Sales and Capital Turnover as indicators for economic performance. Rassier and Earnhart (2010a) used quarterly data on 59 firms together with annual data on 73 firms to evaluate the relationship between financial performance and discharge limits. Results show a negative relationship between clean water regulation and actual profitability of firms.

Theoretical framework and the model

The modeling framework for this study emanates from the emphasis placed on labour decision as determined by individual's preferences, whose weights in the utility function varies directly as the weight placed on their consumption and quality of environment. We limit our derivation to the household decision, firm, and the natural resources law of motion.

Consider an infinitely-lived household maximization of inter-temporal utility function:

$$\rho^1 u^1(c_1, l_{s_1}, e_{q_1}) + \rho^2 u^2(c_2, l_{s_2}, e_{q_2}) + \rho^3 u^3(c_3, l_{s_3}, e_{q_3}) +, ..., + \\ = \sum_{t=0}^{\infty} \rho^t u(c_t, l_{s_t}, e_{q_t}) \tag{1}$$

Where: c is private consumption, l is leisure, e_q indicates stock of environmental quality, and $\rho \in [0,1]$ refers to the time discount rate.

The explicit form of the utility function is:

$$u(c_t, l_{s_t}, e_{q_t}) = \frac{[(c_t)^{\theta_1}(l_t)^{\theta_2}(e_{q_t})^{1-(\theta_1+\theta_2)}]^{1-\lambda}}{1-\lambda} \tag{2}$$

Where: $\theta_1, \theta_2, 1-(\theta_1+\theta_2) \in (0,1)$ are choice parameters assigning weights to consumption, leisure, and environmental quality in that order and $\lambda \geq 0$ is a constant measuring risk aversion.

The household distributes one unit of time between leisure (l_{st}) and labour (l_t) such that

$$l_{s_t} + l = 1 \tag{3}$$

Each individual household saves k_t of capital for a rate of return r_t. All households also supply one unit of labour services to earn $w_t l_t$ labour income, and they equally receive dividends η_t. Each household pays a fraction of its income to the government as linear taxes; v_t^k being the tax on capital income and v_t^l as tax on labour income. The household budget constrain flow is therefore

$$k_{t+1} - (1-\tau^k)k_t + c_t = y_t = (1-\varphi^l)w_t l_t + (1-\varphi^k)r_t k_t + \pi_t \tag{4}$$

Where k_{t+1} represents capital stock at the end of the period, k_t is capital at the beginning of the period, and $\tau^k \in (0,1)$ is the rate of capital depreciation. On the basis of the above, the household problem is to maximize.

$$^{Max} u(c_t, l_{s_t}, k_{t+1})^{\infty}{}_{t=0} = \sum_{t=0}^{\infty} \rho^t \frac{[(c_t)^{\theta_1}(l_t)^{\theta_2}(e_{q_t})^{1-(\theta_1+\theta_2)}]^{1-\lambda}}{1-\lambda}$$

$$s.t: k_{t+1} - (1-\tau^k)k_t + c_t = y_t = (1-\varphi^l)w_t l_t + (1-\varphi^k)r_t k_t + \pi_t \tag{5}$$

The First Order Conditions (FOC_S) are:

$$u_{c_t} = \mu_t \tag{6}$$

$$\frac{c_t}{1-l_t} = \frac{\theta_1}{\theta_2}(1-\varphi_t^{\,l})w_t \tag{7}$$

$$u_{c_t} = \rho u_{c_{t+1}}[(1-\varphi^k{}_{t+1})r_{t+1} + 1 - \tau^k)] \tag{8}$$

Equation (8) is essentially the Euler equation for capital, stating that at the optimum, the marginal utility of consumption in period t is just equal to the opportunity cost derived from such consumption behaviour.

Consider again a representative firm's production function which follows neoclassical form:

$$y_t = a k_t^{\alpha} l_t^{1-\alpha} = F(k_t, l_t) \tag{9}$$

Both $\alpha \in [0,1]$ and $(1-\alpha) \in [0,1]$ represents output elasticity of capital and output elasticity of labour respectively for the private firm. a is total factor productivity and is assumed constant. Taking w_t and r_t as given, the firm uses household capital and labour in each period. The firm therefore maximizes profit π in the following form:

$$^{Max}\pi_t = y_t - w_t l_t - r_t k_t \tag{10}$$

The FOC$_S$ are

$$r_t = \frac{\alpha y_t}{k_t} \tag{11}$$

$$w_t = (1-\alpha)\frac{y_t}{l_t} \tag{12}$$

So that profit $\pi = 0$

Turning to environment quality equation, the stock of environmental quality evolves in the form:

$$e_{q+1} = (1-\tau^k)\bar{e}_q + \tau^q e_{q_t} - p_t + vg_t \tag{13}$$

With $e_{q_t} \geq 0$ representing environmental quality without pollution, p_t is current flow of pollution, τ^q is degree of environmental persistence, g_t is public spending on abatement activities, and $v \geq 0$ demonstrates transformation of public abatement spending into renewable resources.

Production of output essentially causes flow of pollution:

$$p_t = \beta a k_t^{\alpha} l_t^{1-\alpha} \tag{14}$$

Equation (14) is basically useful for our purpose, but may be modified to suit the Nigeria's structural environment. The augmented pollution flow equation in logarithmic form representing our base line model is therefore:

$$\ln p_t = \ln\beta + \ln a + \alpha \ln k_t + (1-\alpha)l_t + \ln\sigma_i \sum_{i=1}^{8} X + \varepsilon \tag{15}$$

$$\ln p_t = \ln\delta + \alpha \ln k_t + (1-\alpha)\ln l_t + \ln\sigma_i \sum_{i=1}^{8} X + \varepsilon \tag{16}$$

$$\ln p_t = \alpha(1 + \ln k_t) + (1-\alpha)\ln l_t + \ln\sigma_i \sum_{i=1}^{8} X + \varepsilon$$

Aside from capital (k) and labour (l) representing workforce in urban agglomeration, X represents a vector of other key control variables and include: agricultural value added (ava), internal revenue ($\text{int\_}rev$), Gdp growth ($Gdpg$), manufacturing value added (mav),service value added (sva), and value added tax (vat). As noted in the literature, apart from government instruments of fiscal policy such as internal revenue and value added tax included as key variables, other variables too play a major role in the emission process.

It is noted in the literature that higher output volume generates higher emission of pollutants from factors including more energy use, exploitation of resources, and so forth. Hence, Gdp growth representing output growth is a good proxy for scale effect. Also, the EKC hypothesis predicts that as economy moves from primary to secondary sector (In this case, the manufacturing), industrial activities are expanded, leading to higher level of emission. Hence, the manufacturing sector is a major contributor to the rising environmental pollution such as green house emission and thus, it is considered as a good proxy for composition effect in our study and in line with Mukherjee and Chakraborty (2015). Greater importance is also attached to the service sector as it gives less pollution as further development occurs based on environmental sustainability. This stage is characterized by demand for more hygienic environment and credible environmental governance system through objective regulatory practices. Therefore, inclusion of Gdp growth, service value added, and population in urban agglomeration is to capture the technique effect already discussed.

On the dependent variable, three variants of this have been used to give room for comparison. Variants emission given are: emissions from building, commercial, and public services (co_2bcp), emissions from electricity and heat production (co_2ehp), emissions from manufacturing, industry, and construction (co_2mic), and from transportation (co_2trans), each as a percentage of total emissions.

Estimation technique is based on the Robust Least Squares (RLS). The RLS is designed to overcome some limitations encountered in the parametric and non-parametric methods. The Ordinary Least Squares (OLS) is not essentially robust due to its violation of assumptions in some cases while the RLS is not affected by violations of assumptions through the data-generating process in use. Data was obtained mostly from the World Development Indicators especially on pollution (emission) for the period 1980 to 2016. Missing data is however inevitable in some cases.

Estimation and Discussion

Table 1: Stationarity test

variable	Test statistics	Test Type	Prob.	Decision	Order of Integration
co_2bcp	Intercept, no trend	ADF	0.000	Stationary	I(1)
co_2ehp	Intercept, no trend	ADF	0.000	Stationary	I(1)
co_2mic	Intercept, no trend	ADF	0.042	Stationary	I(0)
co_2trans	Intercept, no trend	ADF	0.000	Stationary	I(1)
Ava	Intercept, no trend	ADF	0.000	Stationary	I(1)
Cap	Intercept, no trend	ADF	0.005	Stationary	I(1)
Int_rev	Intercept, no trend	ADF	0.073	Stationary@ 10%	I(1)
Gdpg	Intercept, trend	ADF	0.001	Stationary	I(0)
Mva	Intercept, no trend	ADF	0.000	Stationary	I(1)
popuag	Intercept, no trend	ADF	0.005	Stationary	I(2)
Sva	Intercept, no trend	ADF	0.000	Stationary	I(1)
Vat	Intercept, no trend	ADF	0.002	Stationary	I(0)

Source: Authors' computation.

The stationarity test is conducted to avoid violation of law of large numbers and central limit theory. Such violation may lead to spurious results in non-stationary series.This paper employs the Augmented Unit root test because it is usually valid in large samples. Hence, this is in line with the sample observations employed. Given the series, only manufacturing, industry, and construction emissions (co_2mic) and growth and value added tax variables are stationary in their level form as shown in table 1. All variables are mostly stationary in their first differences and this is in line with the fact that most economic variables are I (1) variables.

Table 2: Robust Least Square Regression –M-estimation method-

Variable	Co_2bcp (1)	Co_2ehp (2)	Co_2mic (3)	Co_2trans (4)
constant	35.305	-19.000	0.143	19.825
$cos_2bcp(-1)$	0.115	------	------	------
$cos_2ehp(-1)$	--------	-0.219	-------	------
$cos_2mic(-1)$	--------	---------	-0.017	-------
$cos_2trans(-1)$	---------	---------		0.262
Ava	-0.116	0.004	0.268*	0.079
Cap	0.035	0.022	0.415	0.003
Int_rev	0.073	0.072	0.199**	0.013
Gdp	-0.021**	-0.005**	-0.001	0.003
Mva	-0.083	-0.016	0.634**	-0.110
Popuag	-12.468	9.226**	1.627	-7.043
Sva	-0.550	0.143*	-1.841**	0.089
Vat	0.317	-0.479**	0.107	0.273
R^2	0.797	0.673	0.610	0.690
Adj.R^2	0.614	0.378	0.260	0.412
AIC	34.360	45.875	43.436	38.759
SC	51.112	63.525	62.759	50.325
Deviance	0.332	0.016	0.101	0.039

Source: Authors' computation

Starting from the co_2bcp as dependent variable (column1), its lag is positively (0.115) related to its current value, indicating that historical rise in the emissions from building, construction, and public services do not have any tendency to reduce over time. This is similar to emissions from transport (0.262). In the reverse case, lag value of emission from electricity and heat production (-0.219) and that from manufacturing, industry, and construction (-0.017) seem not to continue in same trend. This may be connected to the various technological initiatives in reducing pollution in line with development pattern. Agricultural sector only has an expected negative effect on emission from building, construction, and public services (co_2bcp), implying that increasing the primary sector activity can reduce emission flows (-0.116, column 1). Prior to the Nigeria exposition to various pollution-generating activities such as in the 80s, volume of emissions was still under regulation as concentration on building, construction, and public services was minimal. The manufacturing sector contributes positively and significantly (0.634**(column 3) only to emission from manufacturing, industry, and construction as expected and follows the composition effect. This would not be surprising as most emissions are seen to generate from manufacturing sector being a secondary stage of development. Only emissions from building, construction, and public services (-0.550) and from manufacturing, industry, and construction respond negatively (-1.841**) to the service sector and this partly follows the technique effect. At some stage, the service sector tends to bring about environmental sustainability through better environmental conditions.

Turning to other explanatory variables, the capital formation and internal revenue maintain a positive relationship with each of the emissions. It is lowest for transport emission and as for 1% increase in capital formation, about 0.3% increase in the emission is generated. Thus, increase in capital stock over time increases activities that would successfully increase emissions. It is however, surprising that internal revenue believed to have been generated from tax levied on various production activities still leave emission on the increase. Growth impacts positively (0.003) only on transport emission thereby showing scale effect. A 1% increase in growth leads to about 0.3% increase in transport emission. Thus, increasing output production only successfully increases emission from transport.

The value added tax which is one of the key variables appears only to reduce significant (-0.479) emissions from electricity and heat production over the period. It appears that there is little fiscal policy that can effect in the control of different sources of emissions in various sectors of the economy. This could be traced to some corrupt practices and subjective regulatory control.

On the average, the explanatory variables have good explanatory power in explaining the variation of each emission process, with highest coefficient emanating from building, construction, and public services emission (approximately 80%). The AIC (34.360) and SC (50.325) are lowest for building, construction, and public services emission and transport emission respectively. The deviance values are also at variance for each equation.

Conclusion and policy implication

Environmental degradation has become an issue of concern at both the national and international levels. This is important due to the adverse effect on lives, production, and development in general. This paper evaluated the role of fiscal policy in environmental quality as represented by various aspect of pollution. Literature recognizes various fiscal policy approaches to controlling environmental quality of which tax and subsidies are inclusive; each with its merits and demerits. Pollution in the form of emission was captured by emissions from: building, construction, and public services; electricity and heat production; manufacturing, industry and, construction; and transport. The key explanatory variables used were limited to internal revenue (on the assumption that revenue realized are mainly from tax) and value added tax. This limitation was due strongly to data issue which is highly inevitable.

Using the RLS approach, results show that emissions continued on similar trend based on the lag values of emission from building, construction, and public services, and transport. The scale effect was identified for transport emission while composition effect for manufacturing, industry, and construction emission. The technique effect was partly identified by the electricity and heat production and transport emissions. Given the foregoing, issues of environmental pollution through emissions of various kinds need serious policy attention. The global warming symbols are directly from the activities emanating from industry, manufacturing, and other human activities. Global predictions are therefore, further adverse effect on lives, properties, agricultural activities, etc if not put to a check. Efficient regulatory framework needs to be put in place through objective applications of fiscal policy.

Revenue from tax being levied should be utilized on emission reduction technology in a way that suits the populace. Subsidies should be applied as an encouraging tool to make life easier for market players in the manufacturing and service sectors. This would help achieve both short and long term objectives. The adverse effect of environmental subsidies needs to be contained to reduce over-production, resource exploitation, and other adverse effects. Also, Nigeria government should be proactive towards creating support programmes for more enlightenment as to discuss the adverse effects of pollution, which subsequently ensures acts of discipline.

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