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Sectoral Analysis of Carbon Emission Level: Evidence from Nigeria Economy

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Abstract:

This study through trend analysis, focusing on 8 productive sectors as well as their corresponding activities examined the emission contribution of each sector to the total carbon emission of Nigeria. Our results show that Service, Transport, Oil & Gas and Manufacturing Sector are the major contributors to the total emission of Nigeria as a whole. The paper concluded that the effects of carbon taxes is expected to varies on different types of energy sources, intensity among sectors and attempts at reduction CO₂ emissions. The success or failure of carbon emission reduction strongly lies in the attitude and commitments of the government at addressing the issues. It was recommended that government should create enabling environment and opt for policy that strengthens the productive sectors and reduce their emission level.

Keywords: Carbon emission, Carbon emission tax, Gross domestic product, Trend analysis and Fossil fuels

1. Introduction

Economic growth is essential at global level to mitigate poverty, create jobs, increase social development (i.e. primarily education and improve life quality). During the past decade, Africa as a continent has had some of the fastest economic growth rates in the world. According to Tani, (2018) in the period from 2001 to 2010, the African real GDP growth was 5.5%, which is few percent more than Europe and both American continents, but a bit less than Asia Pacific. Moreover, the nominal GDP as at 2017 stood at \$2.19 trillion, with a current growth rate of 3.7%. Negative externalities as a result of corporate and individual's activities is increasing the rate of environmental problems being experienced globally, this continues to raise concerns for policy makers and experts in their quest to achieving sustainable development goal. United Nations Environment Programme, (2018) and Akinyemi, Alege, Ajayi and Okodua (2017) asserted that these problems vary and different strategies are currently being employed in providing solution to these challenges.

One of the sectors recognized in the developed countries to have contributed to this problem, especially climate change and global warming, is the energy sectors. These sectors' contribution is said to be as a result of their production and consumption of fossil fuel which results in increased emission of carbon dioxide (a greenhouse gas (GHGs)). The vital role played by these sectors in enhancing the prosperity and development of an economy had led to a much more dilapidation of the environment. As an important factor in the development process of an economy which is required for economic development, road transport sector was said to be the most energy intensive of all the sectors in Nigeria and also important sources of revenue for government, especially for oil-producing countries like Nigeria (Akinyemi, *et.al*, 2017). The growth in African economy led to increase in foreign investments as well as improvement in macro-economic trends from 2010 to 2018. Unfortunately, this recent growth didn't result in much poverty alleviation and improved livelihood. This is because the growth was irregular and unequal, focusing on few chosen sectors e.g. energy intensive industry and agriculture. Likewise, all the benefits deriving from the increased investments were not fairly distributed (African Development Bank, 2018). Furthermore, a new threat to Africa's economic growth has appeared in recent years. According to African Ministerial Conference on the Environment (AMCEN, n.d), African continent will be affected severely by the impacts of Climate Change. Compared to other continents, suggesting that Africa will be affected the most.

The absent of adequate/effective environmental policies which most often results to environmental pollution is now a solemn problem in many developing countries particularly in Nigeria (Earth File, 2017). Literature also revealed that imposition of a carbon tax significantly decreases carbon emissions and does not dramatically reduce economic growth. Since prior study from Nigeria are yet to examine the sectorial contribution to the total emission level, the present study therefore seek to examine the contribution of each sector to the total carbon emission level in Nigeria. The remainder of the paper is structured as follows. The second section reviews the related literature. The third section contains the methodology. The fourth section deals with data analysis and presentation as well as discussion of findings. And the fifth section provides conclusions and recommendations.

2. Literature review

2.1. Policies for controlling Carbon Emission/Greenhouse Gases

One of the major environmental challenges that will in future affect everyone globally is climate change as a result of global emission. The emitters and producers of greenhouse gases have seldom been held accountable for their actions i.e. the cost of their emissions. This is further made worse due to the fact that these costs will become obvious in the nearest future. Davis Tax Committee Report (2002) identified that climate change is an evidence of market failure because the costs of greenhouse gas emissions are not included in the final prices of goods and services.

Market-based instruments and Regulations are always used to correct this market failure to influence the decisions taken by producers and consumers. Policies to restrict or promote reduction in greenhouse gas emissions fall into two categories which are command-and-control approaches and market-based approaches.

2.1.1. Command-and-Control Approaches

This approach consists of both emission legislation for the command approach and banned and preferred technologies for the control approach. Emission legislation is the regulatory measures put in place to correct environmental failures such as emissions standard which place quantitative restrictions on the allowed pollution level. Banned and preferred technologies on the other hand include banning of harmful goods, practices and services and promotion of beneficial and mitigating activities and technologies, such as mandated levels for the inclusion of renewable fuels.

2.1.2. Market-Based Approaches

Practice has shown that command-and-control approaches are most often not economically efficient because firms will need to adhere with specific restrictions, irrespective of the costs of compliance or mitigation to the individual firms. Command-and-control approaches limit investment incentives because companies have no motivation to go beyond compliance as this is assumed to result to stricter regulations in future. Hence, Market-based approaches were introduced which operate through price mechanism, through this approach firms gain flexibility in minimizing their pollution tax liability. The two main market based policy instruments used in placing price on greenhouse gas emissions to reduce the rate of emission are carbon emission trading (CET) and carbon taxes.

Carbon emission trading sets a standard for the level of allowed emissions through trade in emissions' allowance, and carbon tax sets a price for emission directly. A price on greenhouse gases is intended to bring about changes in consumer and producer behaviour, thus mitigating climate change. The approach should inspire a shift to less carbon-intensive production technologies by modifying the prices of goods and services based on their carbon intensity. Likewise, the introduction/implementation of a carbon price is expected to reduce the price difference between conventional, carbon-intensive technologies and low-carbon alternatives.

Preferably, a carbon price should reflect the marginal external damage costs of carbon emissions. It has been attempted in several studies to quantify the costs of climate change to society. The levels of carbon prices required to achieve a certain desired level of emissions reduction vary widely from an estimated US\$8 to over US\$300 per ton depending on the country implementing the policy and its level of development (National Treasury, 2013). Market-based approaches should ideally be coupled with revenue recycling through reductions in other taxes and targeted support to households as well as incentives for research and development, energy efficiency savings, and the use of renewable energy.

2.2. Carbon Emissions Trading

The emissions trading system works by setting a cap on the level of emissions allowable. Companies are then allotted allowances which they may trade with other companies. Emissions trading system ensures certainty about the emissions reduction levels to be achieved but not as regards the resulting carbon price. It was introduced by the European Union (EU) in 2005. This emission trading system covers approximately 45% of GHG emissions (EU Publications Office, 2013). Another emissions trading system is in operation in Alberta, Canada while seven local pilot cap-and-trade schemes have been in operation in China since 2013 (Munnings, Morgenstern, Wang, & Liu, 2014). In order to work successfully, an emission trading system needs a large enough number of firms participating in the scheme and adequate trading volumes to generate an appropriate carbon price. It is not suited to oligopolistic markets.

Although an emissions trading system provides certainty about reduction levels, it is subject to imperfections such as over-allocation of allowances. In order to realize the full benefits of the system, emissions allowances should be auctioned, rather than allocated for no cost. United Nations Environment Programme, (2010) posited that over-allocation may drive down prices, cause price volatility and create longer-term market distortions as observed in the case of the European Union emission trading systems. As a result of this, firms may delay investment decisions such as the choice of emissions reduction technologies, as well as reducing necessary research and development of alternative goods, processes and services.

Literature posits that Emission Trading Systems tend to be administratively complex and involve relatively high transaction costs. They require an oversight body to serve as the regulator that sets emissions baselines, allocates emissions rights and enforces compliance. A market platform for trading must also be established.

2.3. Greenhouse Gases and Climate Change

United Nations (1992) defines climate change as a change which is attributed directly or indirectly to human activity that changes the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. It is highly probable that global climate change has occurred as a result of increase in anthropogenic greenhouse gas (GHG) emissions and will continue to increase perpetually (IPCC, 2013). To ease the effect of climate change, a decline in the emission of these greenhouse gases will be required (Davis Tax Committee Report, 2002). A greenhouse gas is any gas in the atmosphere which absorbs and re-emits heat, thereby making the planet's atmosphere warmer than it otherwise would be (Brander, 2012).

Review on the Economics of Climate Change argued that policies be adopted that would lead to no more than 550 parts per million (ppm) CO₂ equivalent in the atmosphere (Stern, 2006). A CO₂ equivalent or carbon monoxide equivalent describes different greenhouse gases in terms of a common unit. For a particular type of greenhouse gas, a carbon emission equivalent signifies the amount of carbon emission which would have the same global warming impact (Brander, 2012).

It is anticipated that climate change will place serious pressure on Africa (Boko, Niang, Nyong, Vogel, Githeko, Medany, & Yanda, 2007). Because of the continent's high reliance on agriculture, changes in climate that impact on temperature and rainfall may affect crop yields significantly. Also, warming would extend the range of mosquitoes responsible for the transmission of malaria, with a corresponding rise in the disease cause by them (Boko, et al., 2007). Importantly, Africa as a continent would also be hindered from adopting the carbon intensive industrialization path which has increased economic growth in the developed countries as well as China and India. The sources of greenhouse gas emissions differs, they include emissions from agriculture, industrial processes, transportation and waste. Emissions that arise from the activities of an entity, such as a company, are often classified according to where these emissions arise from.

2.4. Green Growth

The Green Growth concept is suitable for African continent as they have an infrastructure deficit, which can be overcome with the investments in the environmentally sound technologies (EST). Otherwise, it would be very expensive to replace already existing unsustainable infrastructure forced with years. Furthermore, shortage of the natural resource management leaves space for introduction of environmentally sound management (ESM). If Africa continues to abuse its natural resources at this rate, it would soon reach the limit to its natural system destruction.

Finally, the biggest motivation to go with the Green Growth in Africa is Climate Change. Mitigating emissions by using carbon efficient technologies could be Africa's major contribution to meet the global targets in this area. On the other hand, there are some unavoidable threats deriving from the Climate Change. Here, the efforts need to be focused on adaptation. (African Development Bank, 2012)

The starting cost of promoting growing a green environment will, of course, be really high. This is probably the main reason why countries were avoiding this until they really felt endangered. Even though today's change will bring cost savings in the long term, not many people are able to realize that. Moreover, lack of information and knowledge about environmentally sound options is also one of the reasons why this transition hasn't been done earlier. African countries have been traditionally choosing technologies with the lowest investments, as their focus at the time was on more existential problems. (African Development Bank, 2012) For African Countries to afford greening, they will need assistance of proper international organizations as well as financial institutions.

The African Development Bank (AfDB) is currently playing a fundamental role in greening Africa's growth by helping countries to overcome this transition. AfDB's strategy for 2013-2022 is achieving high quality, inclusive and sustainable growth in Africa. According to them, the Green Growth is about reaching development targets while maximizing efficiency of natural resources, minimizing pollution and waste and building resilience of economies and people (AfDB, 2014). In order to support strategic planning and operational work on the Green Growth concept, a special team is created within AfDB. The team is connecting few departments and is chaired by the Climate Change Coordination Committee (CCCC) and the Energy, Environment and Climate Change Department (ONEC).

3. Methodology

This study employed *ex-post facto* research design, focusing on 8 productive sectors as well as their corresponding activities (Agricultural, Oil & Gas, Petroleum, Electricity, Manufacturing, Transportation, Non-Tradable, Services and Other sector). This is because any policy measure taken to discourage carbon emission from these sectors is likely to be a preamble to economic growth on the long-run. The present study made use of non-probabilistic sampling techniques. The reason for this technique is because we intend to select our samples based on specific characteristics as regards to their rate of carbon emission. Carbon Emission data were obtained from International Energy Agency/World Energy Balances (2018), SAM 2014, and World Bank Indicator (2018) from 1970 to 2018. The study used trend analysis to achieve the objective of this paper.

4. Data Analysis, Interpretation and Discussion

This study through its model estimated the carbon emission based on each sector and how they have contributed to the overall emission in the economy. For simplicity, all the emission generated in the economy are directly attributed to the primary input which is also associated to their energy input expenditure (amount spent is procuring those energy inputs) as reflected in the SAM 2014.

Sectors	Natural gas	Petroleum	Electricity	Total CO ₂ Emissions	Total Emissions (%)	Rank
AGR	0.22	0.47	0	0.69	0.86	7 th
NGAS	8.1	3.21	0	11.31	14.12	3 rd
PET	4.2	0.66	0	4.86	6.07	6 th
ELEC	6.35	2.46	0	8.81	11.00	5 th
MANU	9.1	1.52	0	10.62	13.26	4 th
TRAN	7.8	10.26	0	18.06	22.54	2 nd
NTR	0	0.5	0	0.5	0.62	8 th
Ser	2.1	16.08	0	18.18	22.69	1 st
All Sectors	40.97	39.15	0	80.12	100	

Table 4.1: Sectorial Carbon Emissions by Energy Type (Million Metric Tones)

Source: Author, 2020.

Based on the sectors within our SAM, table 4.1 shows that Service, Transport, Oil & Gas and Manufacturing Sector are the major contributors to the total emission of Nigeria as a whole. This is because they are the major productive sectors in the economy. However, Oni and Oyewo (2016) also opined that most of the carbon emissions generated in the economy are usually on the productive sectors (which include Transportation, Manufacturing, and Oil & Gas) which are associated to the energy input used up in the production line, hence the justification of our finding which is in-line with prior literature.

A further analysis as shown in figure 4.1 shows the real movement in the emission rate of each of these major emitters in the economy. The result shows that Services sector, Transportation Sector, Oil and Gas Sector, Manufacturing sector and Electricity sector still maintain the ranking as reported in table 4.1 of 1st, 2nd, 3rd, 4th and 5th respectively.

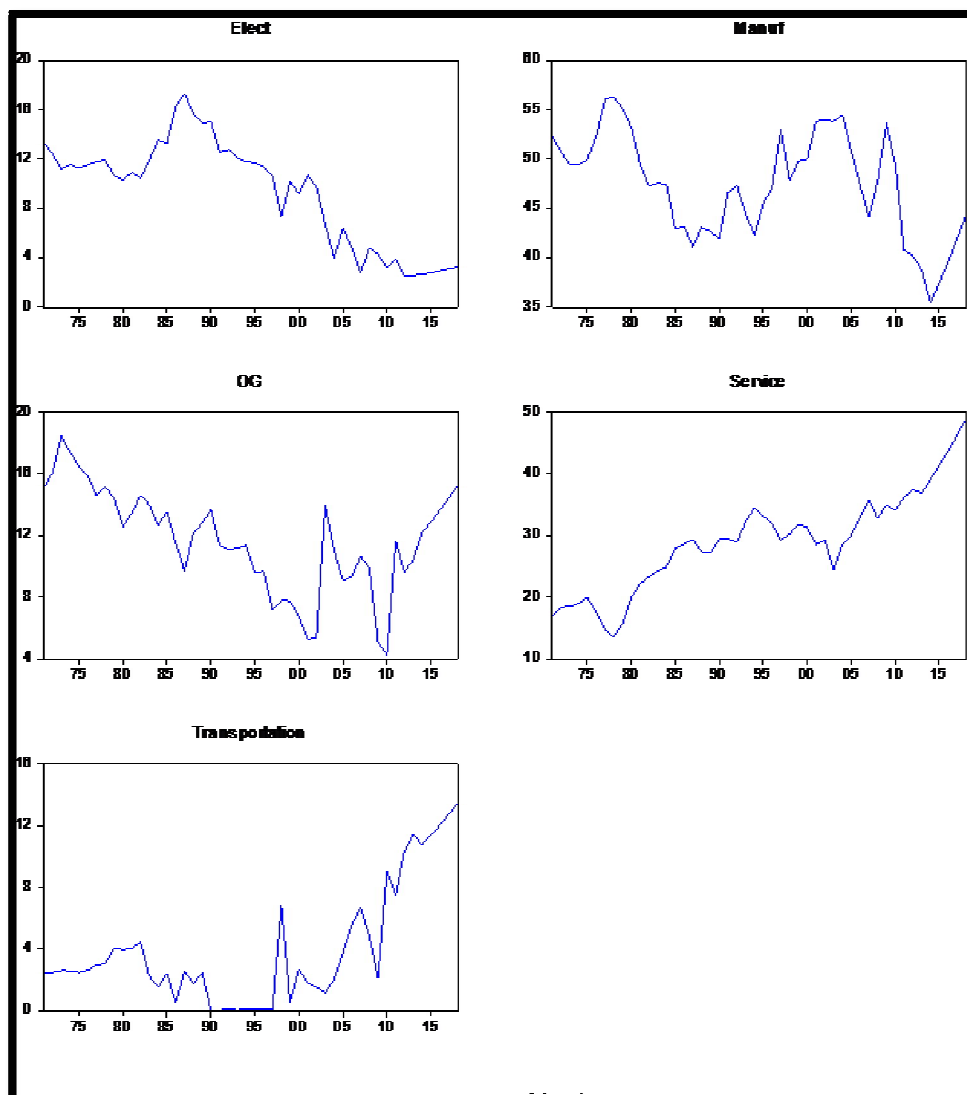


Figure 4.1: Graphical Illustration of Major Emitters of Carbon Monoxide (1971-2018)

Source: Author, (2020)

The above computation on table 4.1 and figure 4.1 has helped to satisfy the objective one by identifying the contribution of each sector to the carbon emission level in Nigeria. Although, the Nigeria emission is related to the energy consumption which is one of the lowest when compared to other developing countries in the world.

The study found that Services sector, Transportation Sector, Oil and Gas Sector, Manufacturing sector and Electricity

sector are the major emitters in the Nigeria economy. It is not surprising that some of these sectors are inclusive, most especially the transportation sector. Out of all the five sectors transportation contributes almost the least to the gross domestic product of the economy and yet it is the 2nd highest source of environmental pollution to the economy. Evidence from vehicles on the road will convince that our findings are appropriate and in line with the reality. The findings of our study is in line with the work of Oni and Oyewo (2016) where they also identify transport sector as one of the major pollutant of the economy.

It is believed that the imposition of carbon emission tax will help reduce energy consumption by this sector; the sector will see the need to reduce their rate of emission through regular services and maintenance of engines. This will help improve the social wellbeing of individual which is in agreement with the assertion of Alnail, Zhihui, Arowolo, Hongbo, Xiangzheng, Omaid, and Zhang (2019), in their study explored the drivers of carbon dioxide (CO₂) emission (million metric tons) in the top 10 emitting countries (China, United States, India, Russian Federation, Japan, Germany, South Korea, Iran, Canada, and Saudi Arabia) with the use of logarithmic mean Divisia index (LMDI) method from 1991 to 2014 through panel model. Their results showed that the CO₂ emission change has a significant effect by population and income, especially in China and the United states. Also, there is a strong relationship between human development index, economic growth, as well as Healthy Life Expectancy (HLE) with sector CO₂ emission for most of the investigated countries.

5. Conclusion and Recommendation

In summary, the effects of carbon taxes is expected to varies on different types of energy sources, intensity among sectors and attempts at reduction CO₂ emissions. The success or failure of carbon emission reduction strong lies in the attitude and commitments of the government at addressing the issues. This calls for the policy of carbon emission tax. Based on the outcome of this study the following policy recommendations are proposed:

- Individual companies from each sector should work on reducing their energy consumption by procuring the most energy-efficient equipment so as to reduce power consumption and emission. This can also be achieved through a green financial system, which seeks to aggressively invest in infrastructures which are low carbon and environmental friendly.
- The government should create enabling environment and opt for policy that strengthens the productive sectors and reduce their emission level.
- The government also needs to develop the gas industry as soon as possible, promoting its usage widely in all households, companies, even in transport (as adopted by Dangote group of company). Introduction of gas for electricity production instead of fossil fuels is also recommended, as this has low carbon emission level in the process of power generation.

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