Effect of Africa Openness of Goods and Services Markets to Pollution Concentrations: Empirical Evidence from Rwanda.

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Abstract

The present paper attempted to examine the impact of Africa continental free trade vis-à-vis to Rwanda environments quality. Theoretical model was developed to divide influence of unrestricted trade on pollution measure or scale, methods, and composition effects. Afterwards, the theory was examined employing carbon dioxide (CO_2) concentration and emission. The model was estimated by panel data approach, the data used were extracted from World Bank datasets. The time period covered in analysis is 1990-2017 across 34 selected African countries, and East Africa block (Rwanda, Uganda, Tanzania, and Kenya). The results brought into being that continental free trade creates fairly small fluctuations in pollution concentrations as it amends the composition of national productivity. The estimate demonstrate that an increase of scale effect measured by GDP per capita by 1 unit resulted from the continental free trade would lower about 0.30578% metric tons per capita of CO_2 emission. In addition, if the continental free trade raises trade intensity by one unit, CO_2 emission would be lowered by 0.24%. Further, if the continental free trade raises gross national income per capita purchasing power parity by 1%, carbon dioxide would be upstretched about 86.54%. It is astonishing that Africa continental free trade seems to be a friend of the environment. Africa free trade definitely will raise people's welfare if proper environmental policies are in place.

Key Words: Africa Openness, Pollution Concentration, CO_2, Environment, Open Economy, Good market, Rwanda.

1. Introduction

The debate over the role of continental or international free movement of goods and services plays in influencing environmental outcomes has at times creating more heat than bright (Antweiler, Brian, and Taylor, 1998). Trade economists have established an intangible agenda for examining how trade opening influences the pollution concentration (UN, 2006). This outline, first applied to examine the environmental impact of the North American Free Trade Agreement (NAFTA). The impact of trade liberalization was alienated into three self-determining effects such as scale,

composition, and technique. The intentions were to understand the impact of trade openings on climate change.

The 'scale effect' is demarcated as the impact of free trade to greenhouse gas emission from the increased economic activities in a particular state (EPA, 2017). The general assumption was that free movements of goods and services boost economic activities and therefore energy use. In other words, the increase in the scale of commercial activities and energy uses would lead to higher level of greenhouse gas releases other facts held constant. The 'composition effect' refers to the way that free trade changes the basket of a country's goods towards those with a comparative advantage (IMF, 2011). That is to mean a variation in emission due to the change in the share of dirty goods production in gross domestic products. The re-allocation of goods within a country is the way trade ameliorates economic efficiency (WTO, 2010).

Afterwards, the composition impact results in less greenhouse gas emissions. If the spending sectors are less energy demanding than the constricting sectors. Otherwise, the effect of composition would be higher and it is difficult to predict in advance. The technique effect is the increase of emissions intensity due to access to new technologies. Trade opening can lead to improvements in energy efficiency (WTO, How does trade affect greenhouse gas emissions?, 2006). Consequently, the production of goods and services generates less gas. For instance, open trade would increase the accessibility and availability of more products (substitutes) and lower the cost of environment in terms of goods, services, and technology. The anticipation is that the scale effect will increase emission and technical effects reduce the emissions. The composition effect will depend on production mix of goods after freed trade. If manufacture of dirty produces increases in the country, then pollution will increase and if the economy produces cleaner goods it will results to a decreased level (Antweiler, Brian, and Taylor, 2001).

However, these would play a significant role for countries that do not have access to variety types of products, services, and technology as well. In addition, it will be great privileges to countries with industries that produce insufficient scale type of commodity at unaffordable price. This additional market introduction can also deliver encouragements to develop new products, services, and technology to culminate climate change issue as far as is concerned. Secondly, Free trade brings an increase in income that can lead society to request a better environmental quality thus less greenhouse effect.

In March 2018 African heads of states gathered in Kigali, Rwanda to sign the proposed agreement of continental free trade. On 21 march 2018 forty- four (44) of 55 members of the African Union signed it (Witschge, 2018). African Continental Free Trade Area (AfCFTA) is the result of the African Continental Free Trade Agreement among all 55 members of the African Union. If ratified, the agreement would result in the largest free trade area in terms of participating countries since the formation of the World Trade Organization (Justina,

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2018). The Continental Free Trade Area (CFTA) is a continent free trade agreement brokered by the African Union. The agreement initially requires members' states to remove tariffs from 90% of goods, allowing free access to commodities, goods, and services across the continent (The economics, 2018). The preliminary organization for the treaty commenced in 2013 with negotiations held in 2015 via AU summits (AU, 2013).

The first discussion forum took place in February 2016 and various meetings have been organized till the summit in March 2018 in Kigali. From 2017 technical working groups met four times, and consequently, technical problems were conversed and implemented in the 2018 draft which was further approved by the African Union Ministers meeting (Tralac, 2018). At the extraordinary summit of the general assembly of AU held on 21 March in Kigali the agreement of establishing the AfCFTA was signed, along with the Kigali declaration and the Protocol on Free Movement or Open Economy. In addition to 44 countries, five other countries signed the agreement. Those additional countries include South African, Namibia, Sierra Leone, Lesotho, and Burundi (AU, 2018). The negotiations headed on with phase II, including policies of investment, competition and intellectual property rights (AU, 2018). The AfCFTA agreements are sets for boosting intra-Africa trade which identifies seven priority action clusters: trade policy, trade facilitation, productive capacity, trade related infrastructure, trade finance, trade information, and factor market integration (Tralac, 2018).

The Nigeria head of state was reluctant to join AfCFTA, that it would offend the state industries as well as enterprises (Giles, 2018; Uwiringiyimana, 2018). If Nigeria head of state rumored that AfCFTA would affront entrepreneurship and industry, what will happen to environment of the continent, region and Rwanda as soon as it is implemented? Does the level of pollution that the continental free trade would release viable, bearable and desirable? The current paper intends to assess the influence of Africa continental free trade on Rwandan environment. It took into account the sources and determinants of environmental degradation. In addition, it identified effect of unrestricted movement of goods and services to surroundings degradation.

2. Materials and Methods

Economic globalization has brought increased prosperity to trading nations (Baldwin, 1992). In particular, trade liberalization in developing economies has made an accelerated development and rapid economic growths thus, modernization and improved living standard (Tayebi and Youmespour, 2012). The past half century was characterized by an extraordinary expansion of international trade. Since 1950 the world GDP increased by 8%, resulted from the world trade which raised more than 27 in volume. Therefore, word trade increased from 5.5% to 20.5% in 2006 (WTO, undated). The number of factors has been identified to cause such unprecedented expansion in the world trade. The foremost factor was technological change that led to a tremendous reduction of costs in terms of production, transportation, and communication. The second factor was more

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open trade and investment policies. The increase of world trade may be one motive why trade is progressively being upraised in climate change debates and may also assist in explaining the reason why there are concerns about the impact of trade on greenhouse gas emissions (Harris, Roach and Codur, 2017).

Carbon dioxide emitted from the burning of fossil fuels and the manufacture of cement incorporate CO_2 produced during consumption of gas fuels, solid, as well as liquid, and gas burning. Carbon dioxide or CO_2 is one of the major greenhouse gases and it play a central role in the global climate change debate (Nicolas, Inmaculada, and Anca 2011). One apprehension about trade contribution in greenhouse gas emission is attached to its transportation services. Cross board trade involves states concentrating in exporting goods in which they have comparative advantage and importing other goods from their trade allies (Cristea, et al., 2012). The process of multinational exchange necessitates goods to be conveyed from the production state to the country of consumption (Kozlak, n.a). Thus, international trade spreading out is likely to cause the increased use of transportation facilities.

According to International Energy Agency (IEA), (2005) quoted by Asian Development Bank, (2010), estimates displayed that transport accounted for 23% of world energy related greenhouse gas emission. About 74 % of energy correlated CO_2 emissions in the transport sector resulted from roads transport and another 12% from air transport. Holland, et al. (1999) argues that viable environmental policy has a positive impact on human health and have a wider economic benefits. They continued that it reduces health spending, and also contribute to a workforce that is more productive (because healthier), larger and therefore cheaper. Increased environmental policy could increase the health of workers which increases the efficiency of labor (Bloom, et al., 2001). On other hand, environment policy improves quality of life through increased life expectancy, improved health in general, or maintaining biodiversity.

Over time, free trade works with other market processes to shift workers and resources to more productive uses, allowing more efficient industries to thrive. Consequently, higher wages, investment in infrastructure and technology, and a more dynamic economy that continues to generate and create new jobs and opportunities (MINICOM, 2018). In other words, the prospective benefits of continental free trade area lie on lowering transaction costs to businesses, expanding markets, enabling pooling of continental resources, utilization of economies of scale in production, and more efficient allocation of resources. MINICOM, (2018) continued that it is a vehicle for overcoming the constraint of small economic size, which obstruct African countries' ability to industrialize efficiently. It will also assist to attract foreign investment and technology, precisely those interested by economies of scale.

Study curried out by Frankel and Rose (2005), examined the effect of free trade on a country's environment holding GDP constant. Their estimate helped the environmental Kuznets curve theory, that if trade rise income at low rate leads to higher environment damages and if it raises the

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income at high levels then, it helps the environment. They found that trade liberalization increases the speed of growth. Yu et al. (2010) estimated the NAFTA effects on pollution employing two countries (United States and Mexico) data. They found that pollution emission increased due to the NAFTA transportation, but the emission was large in Mexico than in US.

In 2007, IEA's study on CO_2 emissions from fuel combustion suggested that international marine transport alone counted about 8.6 per cent of the total emitted of the transport sector. In the context of the carbon footprint of international transportation, food miles are an including concept that used to estimate CO_2 emission accompanying with the transport of goods over long distances to reach at the final consumers. However, transport means (road, air, maritime or rail) of distance goods or services are not the only significant contribution to CO_2 emissions. Life cycle of the products, especially production methods also plays a big part. Hence, food miles are an issue that need for case by case analysis and empirical confirmation (WTO, n.a).

Tayebi and Youmespour (2012), assessed the impact of trade liberalization on environmental quality: evidence from Iran's relationship with diverse countries block (East Asia, Middle Asia, and Organization for Economic Co-operation and Development (OECD) countries, the results argued that GDP per capita (scale effect) had a positively correlated with carbon dioxide emitted in the first and second block. For instance, in first bock, if the trade openness raised GDP per capita by 1 unit, then pollution concentration would rise by about 0.0007133 and in second area, CO_2 would rise about 0.0002. But in the third block, GDP per capita was negatively correlated with pollution concentration. Thus, free trade was good for third area but not of first two blocks.

Nicolas, Inmaculada, and Anca, (2011), queried themselves whether free trade is good or bad for the environment in general. Author's estimates on CO_2 emission per capita demonstrated that free trade was bad for environment. In way that CO_2 emitted had a positive relationship with GDP per capita. The assessment showed, if the free trade raised GDP per capita by 1%, then the carbon dioxide emitted would increase by 1.48%.

Antweiler, Brian and Taylor (1998), projected a theory of how openness to international goods markets affects pollution concentration. They found that free trade creates fairly small changes in pollution in terms of composition and intensity. They combined scale, composition and technique effects and established that free trade appeared to be friend for the environment.

Mehdi, Wuyang, and Michael (2016) focused on the impact of free trade agreement on the environment. They found that the FTA among developing countries seems to be friend of environment with low emission of greenhouse gas. In the case of developed and developing countries, FTA effect is positive and gas emissions increases for the world. The FTA among developed countries, the emission has no significant effects on greenhouse gas emission. They concluded that FTA impact on the world environment is subject to the type of agreement. Furthermore, what might be upright for the

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economy might not essentially demonstrated in higher economic growth but only in developed welfare. The benefits of environment protection might not be seen immediately at the level of economic activity, rather the costs that fall on the economy.

Data were analyzed using distributive statistics, and econometrics method such as panel least squares regression analysis. Distributive statistics was used to analyze characteristics of observed states on the considered variables. The panel least square model was used to study and examine the impact of continental free movement of goods and services to the surroundings. The model is explicitly stated as follow:

$$CO2_{it} = \beta_0 + \mu_i + \beta_1 \ln (GDP)_{it} + \beta_2 TRADE_{it} + \beta_3 \ln (GNI)_{it} + \varepsilon_{it}$$

Where, CO_2 denotes environmental degradation in terms of carbon dioxide emission for a country i and year t, GDP is gross domestic product per capita representing scale effect, TRADE indicates the trade intensity (the sum of exports and imports divided by GDP) denoting the composition effect, GNI stand for gross national income per capita, purchasing power parity standing for technical effect, μi denote the specific fixed characteristic for each country which do not change over time, εit representing idiosyncratic error and ln is a natural logarithm.

3.Results and Discussions

Rwanda seemed like already in continental trade area, because it is a part of diverse economic communities like East African Community (EAC), Common Market for Eastern and Southern Africa (COMESA), and Southern Africa Development Community (SADC), etc. consequently, they are not big uncertainties that AfCFTA would bring to Rwanda's environment. Reasonably, the movement of goods and services increase the number of road transportations (cars) thus higher fuel consumption. Rwanda is armed with pollution control tools and measures to ensure that Rwandans live in sustained environment. For instance, there two implemented pollutions technical control such as fuels (use of less sulfur fuels) and cars engines control. The volume of waste products is expected to be more. They may not be an issue to Rwandans rather opportunities for initiating and innovate waste based businesses (recycling projects). The emission of the air pollutants such CO_2, and SO_2 may raise resulted from increment of fuels consumption and new investment like new or branch of industries due to expansion of the market. But again, Rwanda has numbers of strategies like Green Growth and Climate Resilience which is a national strategy for climate change and low carbon development, and Greening District Development Program adopted for boasting national economy with a diminishing rate of pollution emission.

It is advantageous for Rwanda to join the continental free trade area. Because it may lower transaction costs to businesses, expanding markets, enabling pooling of continental resources, utilization of economies of scale in production, more efficient allocation of resources, more preferences to consumers, improved infrastructure and technology, and new jobs and opportunities would be generated. It

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encourages competition among domestic producers, which translates into higher quality products and lower prices such as a domestic furniture manufacturer will be competing against hundreds of local and global brands. As a result, the company will strive to offer better customer experience or superior products to gain a competitive edge.

Free trade area may open up opportunities for Rwandan exporters and investors to expand their projects onto significant international markets. It may also improve market access across the area of trade and aid in maintaining and stimulating the competitiveness of local businesses which imply better quality of goods at a lower price for consumers. It may provide consumers a greater variety of goods as they can gain access to foodstuffs from different region which may leady to lower prices too. Continental free trade area encourage investment, enhance cooperation and can address other issues like e-commerce, and government procurement.

Africa continental free trade could increase national productivity and affect national income positively by permitting domestic businesses access to cheaper inputs, introducing new technologies and promoting competition and innovation.

In addition, it may stimulate regional economic integration and build shared methods of trade and investment, via adoption of common rules of origin and broader acceptance of product standards. Another advantage for Rwanda, is the ability to sell exports at higher prices and get cheaper imports. When two countries trade goods and services with each other, they'll both benefit from these differences in price. Additionally, the removal of tariffs results in lower costs for customers.

The model was estimated by panel data approach. The time period covered in the assessment is 1990 – 2017 across 34 selected African countries, East Africa. Obvious, panel data analysis suggests different ways to deal with the country specificity. Random Effect (RE) model which is a suitable estimate method that treats the level of effects as constants, while Fixed Effect (FE) model take into consideration the level of effect. In this study both FE and RE models was estimated and presented empirically in Tables (2), and (3). Hausman test was computed to indicate the best model between fixed and random effect models. On this score, FEM was preferred based on the Hausman test result.

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Table 1**:** Descriptive statistic and definition of variables

Variable	Definition	Obs	Mean	Std. Dev	Min	Max	Source
CO_2	CO_2 emission per Capita in metric tons	863	1.493	0.6733	-1.8744	6.720969	World Bank
Ln (GDP)	GDP per capita, In US dollars	952	7.003	0.5684	4.3027	9.00234	World Bank
TRADE	Trade intensity (The Sum of Export and Import / GDP)	910	79.813	28.316	-49.581	389.6593	World Bank
Ln (GNI)	GNI per capita PPP in $	940	7.951	0.4193	5.6432	9.363868	World Bank
D2	Dummy2 = 1, if the country is Tanzania = 0, otherwise						
D3	Dummy3 = 1, if the country is Uganda = 0, otherwise						
D4	Dummy4 = 1, if the country is Kenya = 0, otherwise						

Source: Researcher computation (2018)

The results for CO_2 emission was estimated and presented in the table 2 for whole sample, contained 34 African countries (Angola, Kenya, Rwanda, Cameroon, Lesotho, Swaziland, Mozambique, Seychelles, Equatorial Guinea, Mauritius, South Africa, Botswana, Algeria, Gabon, Namibia, Nigeria, Ghana, Morocco, Egypt, Tunisia, Republic Democratic of Congo, Libya, Ivory coast, Tanzania, Senegal, Ethiopia, Uganda, Madagascar, Mali, Mauritania, Burkina Faso, Chad, Zambia and Zimbabwe) with a time period of 1990 – 2017.

The FE estimates were chosen due to the result of the hausman test. GDP per capita, and TRADE intensity are negatively correlated to CO_2, whereas GNI per capita purchasing power parity was positively correlated to CO_2 emission. GNI, and TRADE intensity were significant at 95% confidence interval. At 1% GNI was once more positive and extremely statistically significant, even though small in extent or magnitude. This signifying that if the free trade increase GNI by unit, causes a rising of carbon dioxide emitted about 86.54% on average, fixing other factors constant. In addition, if free trade raises GDP per capita or TRADE intensity by one unit, CO_2 emission would be lowered by 0.3% or 0.002417.

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Table 2: Estimation results for a full sample

D. Variable	CO_2 per capita					
	Coefficient		Std. Err		t-value	z-value
I. Variables	FE	RE	FE	RE	FE	RE
Ln (GDP)	-0.0030578	-0.0138442	0.0959009	0.0957297	-0.03**	-0.14**
TRADE	-0.002417	-0.0022799	0.0007955	0.0007937	-3.04*	-2.87*
Ln (GNI)	0.8654334	0.9180293	0.134106	0.1328791	6.45*	6.91*
Constant	-5.214568	-5.492284	0.5198819	0.5695502	-10.03*	9.64*
Observations	819	819				
Hausman Test	14.13*					
(χ^2 p-value)	0.0027					
R^2 (within)	0.2595	0.3122				
R^2 (overall)	0.5182	0.6212				
F-Test	91.36*	Wald χ^2 =304.25*				
rho	0.8850	0.8503				
Groups	34	34				

***Probability lower than 5% ** Probability higher than 5%**

Source: Researcher computation (2018)

For East African Countries (EAC) block, fixed effect (FE) and random effect (RE) regressions were also estimated and demonstrated in Table 3. The RE estimates were preferred. GDP per capita showed a negative relationship with carbon dioxide, whereas TRADE intensity and GNI per capita purchasing power parity were positively correlated to CO_2 emission. All the explanatory variables were significant at 95% confidence interval but, at 1% GNI was again positive and extremely statistically significant, even though small in magnitude. Considering F-test, the repressors are high jointly significant to explain the variation in carbon dioxide emission.

Table 3: The effect of free movement of goods and services for EA (East Africa) block

D. Variable	CO_2 per capita					
	Coefficient		Std. Err		t-value	z-value
I. Variables	FE	RE	FE	RE	FE	RE
GDP	-0.0000441	-0.0001219	0.0000317	0.0000484	-1.39**	-2.52*
TRADE	-0.0003028	0.0012372	0.0003199	0.0005875	-0.95**	2.11*
GNI	0.0000737	0.000145	0.0000167	0.0000239	4.40*	6.08*
Constant	0.0682805	-0.0653282	0.0141374	0.210442	4.83*	-3.10*
Observations	112	112				
R^2 (within)	0.5178	0.4526				
R^2 (overall)	0.6280	0.6804				
F-Test	37.58*	Wald χ^2 =229.95*				
rho	0.868	0				
Groups	4	4				

***Significant at 5% ** Probability higher than 5%**

Source: Researcher computation (2018)

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The scale effect symbolized by GDP per capita, which measures the increase in pollution that would be produced or generated if the economy were raised up. In Tables 3 the negative coefficient of scale effect showed the opposite direction of GDP per capita on pollution. For example, the result from the Table 3 above showed that, if the free trade raise GDP per capita by 1 unit, the average CO_2 emission fall by 0.0001219. Thus, in case of CO_2 emission, free trade for East Africa countries is a friend of environment. Contradicting, GNI per capita purchasing power purity and TRADE intensity demonstrated a positive relationship with CO_2 emission. In other hand, if trade liberalization increases TRADE or GNI by 1 unit, then CO_2 emission rise by about 0.0012372 and 0.000145 respectively, holding other factors constant. The overall R square (R^2) which indicate the goodness of fit of the model is 0.628, this implies that the explanatory variables included in the model explain 62.8% of the variation of Carbon dioxide emission.

Table 4: The differences in CO2 emission between selected countries in EAC

Variable	Coefficient	Std. Err	t-Statistic	Prob.
GDP	-4.41E-05	3.15E-05	-1.392032	0.1669
TRADE	-3.03E-04	3.20E-04	-0.946596	0.3460
GNI	7.37E-05	1.67E-05	4.402195	0.0000
D2	0.026474	0.010159	2.605927	0.0105
D3	0.001479	0.007489	0.197507	0.8438
D4	0.146498	0.011074	13.22929	0.0000
C	0.024668	0.012539	1.967307	0.0518
R^2	0.9161			
Obs	112			
Groups	4			
Dw	0.405229			
F-statistic	191.0801 (0.00000)			
Sample	1990 - 2017			

Source: Researcher computation (2018)

To understand the differences in CO_2 emission in EAC block, dummy variables technique was employed. The techniques demonstrate only whether the categories differ without showing the source of the differences. Rwanda was considered as a bench mark category. That is to say, all comparison was made in relative to Rwanda. As the Table 4 above shows Tanzania represented by D2, CO_2 produced out was 0.026474 great than that of Rwanda. Uganda denoted by D3, was 0.001479 great than that of Rwanda. Then, Kenya was 0.146498 higher than that of Rwanda. Kenya (D4) and Tanzania (D2) were only significant at 95% confidence level. The R^2 of EAC block is 0.9161, indicating that the employed model for the block fits 91.61%. Kenya was highly significant, reflecting the differences in EAC block nominal gross domestic product GDP. For example, the 2017 nominal GDP for the four selected east African countries (Kenya,

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Tanzania, Uganda, and Rwanda) were significantly different in magnitude. Kenya was 79.511 billion US dollars, Tanzania was 51.725 billion $, 26.348 billion $ for Uganda, and 9.137 billion for Rwanda.

Table 5. Estimation Results for Rwanda

Variable	Coefficient	Std. Err	t-Statistic	Prob.
GDP	4.72E-05	3.22E-05	1.465638	0.1557
TRADE	2.04E-04	2.08E-04	0.984329	0.3348
GNI	-1.75E-05	1.41E-05	-1.245108	0.2251
C	0.060278	0.006742	8.940928	0.0000
R^2	0.13432			
F-statistic	1.241287 (0.31664)			
Dw	0.200585			
Years	1990 - 2017			

Source: Researcher computation (2018)

The positive coefficient of scale effect indicates a positive effect of increasing GDP per capita on pollution. For instance, for Rwanda, analysis demonstrated, if trade liberalization raises GDP per capita, or TRADE by 1 unit, the CO_2 emission would rise by about 0.0000472, 0.000204 respectively. GNI has a negative relationship to CO_2 emission, for example, the estimate for GNI shows that if free trade increases growth national income by 1 unit, the carbon dioxide would decrease by 0.0000175. The three included variables are not significant at 5%, counting 13.432% of the variation of CO_2 released.

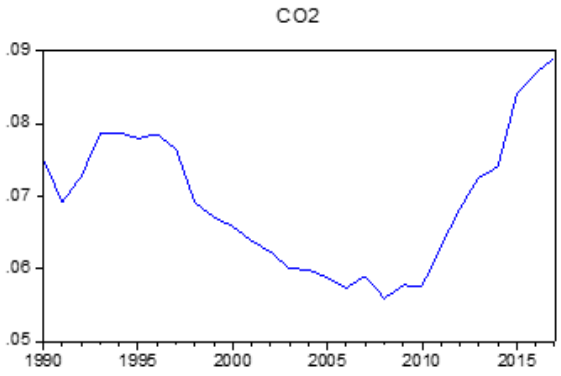

Figure 1a. Increase of CO_2 emission over time for Rwanda

Figure 3b. Increase of GDP per capita over time for Rwanda

The most important information that figure 3a and 3b hold was to demonstrate the positive relationship between CO2 emission and GDP per capita as seen in Table 5 for Rwanda estimation results. As we can see figure 3a showing the fluctuation of carbon dioxide CO_2 emission over time and it is increasing as time goes. The same as variation of GDP per capita demonstrated by figure 3b.

In short, the results demonstrate that the FTA among African countries appears to be friend of environment with low emission of greenhouse gas. In addition, EAC block free trade agreement could release fairly small fluctuations in CO_2 pollution concentrations.

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As the main objective of this assignment was to assess the impact of free trade on the Rwanda's environment quality arising from Africa continental free trade treaties. The empirical equations for the econometric analysis on the correlation between free trade and environmental quality was specified, while a negative (growth green) relationship between the scales of economic activity as measured by GDP was found. The results reveal that if AfCFTA increase GDP per capita by 1 unit, CO_2 emission would lower about 0.30578% metric tons. In addition, if the continental free trade raises Trade intensity and GNI per capita purchasing power parity by one unit or 1%, CO_2 emission would be lowered by 0.002417 or upstretched about 86.54% respectively. The samples of 34 countries of Africa over the period 1990-2017 were used in analysis.

The results also reveals that it is advantageous for Rwanda to join the continental free trade area because, it will lower transaction costs to businesses, expanding markets, enabling pooling of continental resources, utilization of economies of scale in production, more efficient allocation of resources, more preferences to consumers, improved infrastructure and technology, and a more dynamic economy that carry on generating and create new jobs and opportunities to youth and other labor force in general.

4. Policy Recommendation

Africa Continental Free Trade Area is certainly not the problem to the environment nor economic growth. However, based on the results, the current policy practitioners precisely to Rwanda ministry of environment and natural resources through Rwanda Environmental Management Authority (REMA), Ministry of trade and industry (MINICOM), Ministry of infrastructure (MININFRA) and Rwanda Transportation Development Agency (RTDA), to strongly invent resilient environmental policies in integrated economies as to ensure that Africa live in sustained environment with improved prosperity of Africans. In addition, the research recommends the continent ministries of trade and industry (external trade units) to work closely with environmental management institutes specifically department of environmental regulations and pollution control to ensure the continental's green growth is sustainably maintained. Trade definitely raise welfare if proper environmental policies were in place.

Given that this study is among the first research in the continent on the environment degradation issues that would result as far as AfCFTA is implemented. Rwanda Environmental Management Authority (REMA) together with Rwanda ministry of trade and industry are recommended to engage more empirical research on the effects of these progressions.

It also recommended the states of the continent including Rwanda to assist and encourage industries' owners or initiators who are willing to employ technology with less greenhouse gas release. To the government of Rwanda particularly REMA, Ministry of infrastructure and Rwanda Transportation Development Agency, the paper suggest to guarantee the implemented pollution technical control such as fuels (less sulfur fuels) and cars engines control are

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adapted for all continental states for green revolution. Furthermore, environmental issues would result from polluting production processes, consumption, and the disposal of waste products. These problems could be reduced through improved technology and re-initiating, enhancing and reinforce the re-cycling waste products based projects.

It also recommended to reduce transportation pollution by encouraging people to:

a. Walk or bike when they can.
b. Use the bike-share programs in plain area (city).
c. Take public transit when possible.
d. Carpool with friends instead of driving alone.
e. Work from home periodically if your job allows it.

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