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THE IMPACT OF ENVIRONMENTAL REGULATION ON COMPETITIVENESS IN SELECTED SUB-SAHARAN AFRICAN COUNTRIES

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Abstract

The research assessed the impact of Environmental Regulation Stringency on Competitiveness in 16 sub-Saharan African countries from 2006-2019. The study used secondary from world development indicator, world economic forum's global competitiveness reports of the world competitiveness yearbook, international human development indicator, global economy and CEPII's GeoDist Datasets. The analysis was based on the Spatial Durbin Model (SDM). The dependent variable used was the global competitive index (GCI) as a proxy for competitiveness and the independent variables were; environmental regulation stringency index (ERI), Population (POP), Gross Domestic Product (GDP), human development index (HDI), Foreign Direct Investment (FDI), and Globalization nature of the country. The results showed that, *population, Foreign Direct Investment and Human Development Index had a direct effect on Global competitive index (GCI) in the Sub region under the SDM and the neighbourhood effect. Whereas, the variables Environmental Regulation had a direct effect on GCI in the sub region however the neighbourhood effect has an indirect relationship with GCI.GDP equally exhibited an indirect effect on GCI both in the SDM and neighbourhood effect. Therefore, it can be recommended that there is a need for countries in the region to stay abreast with the changing world trend through trade on the level of competitiveness in the sub–Saharan African region taking into consideration the measures to protect the environment.*

Keywords: Environmental regulation stringency, competitiveness, Spatial Durbin Model, Neighbourhood Effect and Sub-Saharan Africa

INTRODUCTION

Since the last half of the 20th century, environmental protection and sustainable development have flooded every aspect of human social and economic activities (Spyridon et al., 2018). Environmental problems are usually caused by the negative externalities of economic activities. So, there is a need to reduce these negative externalities which affects health and welfare of mankind. This can be done through the implementation of environmental regulations. The absence of regulation, individuals tend to overexploit the environment to their own advantage. Therefore, environmental problems cannot be solved by simple market mechanisms. Thus, strengthening environmental protection and reinforcing environmental regulations have become key issues, especially in developed countries (Vogel, 2009).

From the 1970s when the first major environmental regulations were enacted, there has been much debate about their potential impacts on the competitiveness of affected countries and firms (Antoine et al., 2017). It was during those periods that the western world was in a transition process in which they were growing in environmental awareness. One of this was: rising pollution levels due to the development of heavy industries have increased the interest in cost-effective regulation. As result they had to implement strict environmental policies to protect their environment (Guglielmo et al., 2010). On the other hand, protecting their environment meant that they had to seek for different areas to establish companies which had less stringent environmental policies and Africa as one of the developing continents with less stringent environmental policies was the final hideout.

For the past 15 years, Africa has been growing rapidly, second only to emerging and developing Asia. The main factors driving this increasing growth were high demand for Africa's exports, relative ease of access to finance, macroeconomic reforms and an improvement in the business environment. Despite high growth rates, competitiveness in the region has remained low, a message highlighted by the Africa Competitiveness Report series since its inception in 1998 and so have levels of overall productivity. Low productivity undermines competitiveness and leaves countries vulnerable to adverse shifts in global economic conditions (An Action Agenda for Africa's Competitiveness, 2016). Therefore, there is a need to framework policies which will regulate the economy and one of those regulations is environmental regulation.

To control the effects of negative externalities in the African region a number of conventions had been held on environmental conventions which have taken place over the years. These include; Phyto-Sanitary Convention for Africa 1967, African Convention on the Conservation of Nature and Natural Re-sources 1968, Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa 1991, African Mari-time Transport Charter 1994, The African Nuclear-Weapon-Free Zone Treaty (Pelindaba Treaty) 1996, African Convention on the Conservation of Nature and Natural Resources (Revised Version) 2003, African Union Convention for the Protection and Assistance of Internally Displaced persons in Africa 2009 , Revised African Maritime Transport Charter 2010, African Charter on Maritime Security and Safety and Development in Africa (Lomé Charter, 2016; Oliver, 2018).

One of the most important environmental policies done in the world was the Kyoto protocol which was aimed at reducing the amount of gas emitted as a result of increase productivity (competitiveness). A sub environmental law under it was the Clean Development Mechanism (CDM). More than 80% of CDM projects had been carried out in the Asia Pacific region, with less than 3% taking place in Africa (UNEP Risoe Centre, 2012). Since, most of these environmental laws enacted in Africa were not implemented, they affected the competitive nature of the continent especially in sub-Sahara Africa (Fullerton and Heutel, 2007). Building on these arguments, the research seeks to investigate the findings of Fullerton and Heutel using recent data to assess how environmental regulation stringency affects competitiveness in selected Sub-Sahara African countries.

LITERATURE REVIEW

OECD defined Environmental Regulations as one which consists of policies implemented by the government to oversee market activity and the behaviour of private actors in society (OECD, 1996). The World Economic Forum in 2006 defined and measured competitiveness as the Global Competitiveness Index (GCI). It is defined as a set of institutions, policies and factors that determine the productivity level of a country. The GCI is an aggregated rating of 12 pillars. The first 4 pillars are the basic requirements that lay the foundation for a competitive economy. They/There are quality of institutions, infrastructure, macroeconomic environment, health and primary education. The following 6 pillars are sources of efficiency that boost competitiveness: higher education, efficiency of product markets, efficiency of the labor market, development of financial markets, technological readiness, and market size. Finally, the last two pillars relate to innovation and business sophistication. It should however be noted that the importance of these factors varies according to the country's level of development (Regional Conference on Competitiveness, 2016).

A number of theories have showed the effect of environmental regulation stringency on competitiveness, amongst which are; The Pollution Haven Hypothesis, The Porter Hypothesis, Heckscher-Ohlin Model and The Environmental Kuznets Curve (EKC) which are explained as follows;

The Pollution Haven Hypothesis or Pollution Haven Effect

Which refers to the idea that polluting industries will relocate to jurisdictions with less stringent environmental regulations (McGuire, 1982) this theory predicts that if competing companies differ only in terms of the environmental policy stringency they face, then those facing relatively stricter regulation will lose competitiveness.

The Porter Hypothesis

The hypothesis explains that, the more stringent the environmental policies it will trigger greater investment in developing new pollution-saving technologies. Porter and van der Linde (1995b), went further to argued that environmental regulations can “trigger innovation that may more than fully offset the costs of complying with them,” i.e., lowering overall production costs and boosting the competitiveness of firms (Ambec et al., 2013).

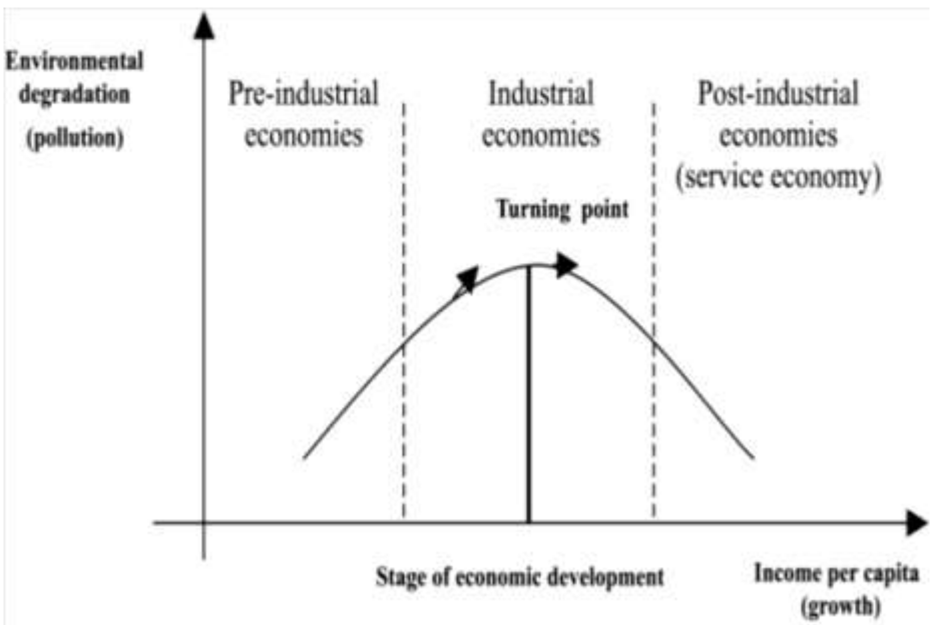
Heckscher-Ohlin Model

The Heckscher-Ohlin (H-O) theory in trade economics postulates that nations will gain a comparative advantage in those industries where they are factor abundant. Applying the H-O theory to pollution then, it could be argued that a country with less stringent environmental standards would be factor abundant in the ability to pollute. Therefore, trade liberalization between a developed and a developing nation when the developed nation has more stringent regulations may lead to an expansion in pollution-intensive economic activity in the developing country with the weaker regulations.

The Environmental Kuznets Curve (EKC)

It investigates the relationship between the level of inequality and per capita income by Kuznets (1955) in his presidential address entitled by “Economic Growth and Income Inequality” (Lemtaouch et al., 2013). The EKC hypothesis suggests that developing economies must face environmental degradation at the initial stages of economic development (Adu et al., 2017). He hypothesized an inverted U- income – inequality relationship that when per capita income increases, the inequality also increases until at a certain point “income turning point” after, the inequality starts to decrease while the per capita income keeps increasing. This can be represented in figure 1.

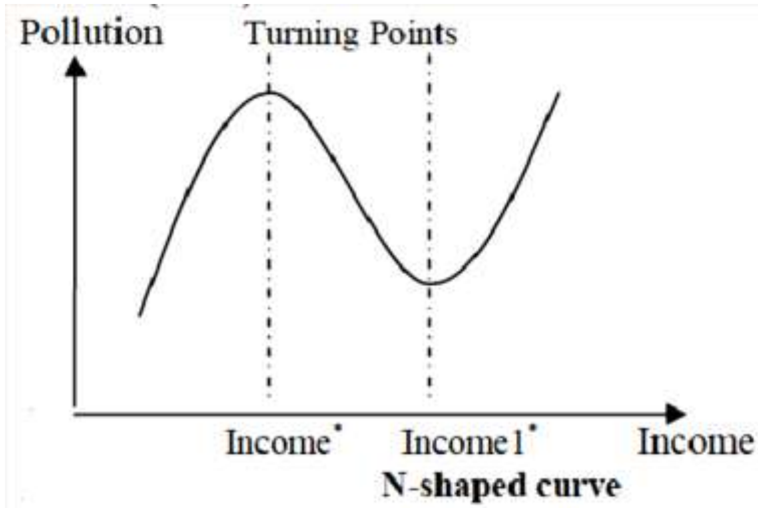
Figure 1 The inverted U income inequality EKC



Source: Panayotou (1993)

In the environmental discipline, Environmental Kuznets Curve could be used to describe the relationship between environmental regulation and competitiveness (Shafik, 1994). It describes the U-relationship between economic development level and environmental quality. It demonstrates that environmental degradation worsens as economy develops until the average income reaches a certain threshold (Shafik, 1994). This theory can also be used in the analysis on environmental regulation and competitiveness. Competitiveness would expectedly worsen as environmental regulations are strengthened, until the stringency of environmental regulations (SER) reaches a turning point. The N shape can be used to explain this relationship as seen figure 2.

Figure 2 Cubic N-shaped relationships between GDP and CO2 emissions



Source: Panagotou (1993)

A number of studies have assessed the effects of environmental regulation stringency on competitiveness. One of such studies was one conducted by Jaffe et al. (1995) on the competitiveness effects of environmental regulation. They suggested that the lack of apparent relationship between environmental regulation and trade flows could be due to poor data and lack of environmental accounting. Similarly, Ankai (2016) provided empirical evidence in support of the Porter hypothesis using Chinese firm level data covering a ten-year period. The results showed that the tighter environmental regulations can increase productivity under certain circumstances.

On the other hand, the work of Cole and Elliott (2003) found no evidence that proxies of environmental regulation stringency were significant determinants of 'dirty' net exports at international levels.

Furthermore, a study conducted by Dean (2003) examined a new test on trade liberalization if it harms the environment? His paper brought together the literature on openness and growth, and on the environmental Kuznet's curve, to demonstrate that the opposite may be true. His findings suggested that freer trade aggravates environmental damage via the terms of trade, but mitigates it via income growth.

Kozluk and Timiliotis (2016) investigate whether the Pollution Haven Hypothesis in countries with more stringent environmental policies lose out in terms of competitiveness and exports. Using the extended EPS (environmental policy stringency) indicator which covers BRIICS (Brazil, Russia, India, Indonesia, China and South Africa). They found no evidence that stringent environmental policies harm aggregate trade and overall country competitiveness.

In the same light, Johnstone et al. (2017) explored the relationship between environmental regulation, innovation, and competitiveness using environmental patent data for 20 countries from 1990 to 2009. Their results showed that the stringency of environmental regulations was a significant determinant of productive efficiency with respect to pollutant emissions as well as fuel use. However, these effects turn negative once the level of stringency leaps over a certain threshold.

Most of the reviewed studies above were done in the European and Asian countries, as a result there is a need to investigate on the African continent. This will enable policy makers make informed decisions that takes into consideration the pros and cons on environmental regulations stringency.

METHODOLOGY

The research is out to investigate the spatial effect of environmental regulation on competitiveness in selected countries of sub-Saharan Africa from 2006-2019. The time interval from 2006-2019 was chosen because the main variable of interest competitiveness was gotten from world economic forum's global competitiveness reports which had data from 2006. Again, since it is a time series data most countries in the selected area had a lot of missing in the main variable in the years before 2006.In order to minimize this problem, we had to start from 2006 which was up to date in their data collection. The data used is secondary data from world development indicator, world economic forum's global competitiveness reports of the world competitiveness yearbook, international human development indicator, global economy and CEPII's GeoDist Datasets. Sixteen (16) sub–Saharan African countries were used; Chad, Benin, Ethiopia, Kenya, Gambia, Senegal, Tanzania, Zimbabwe, Cameroon, Nigeria, Ivory Coast, Lesotho, Zambia, Gabon, Botswana and South Africa. The dependent variable used was the Global Cmpetitive Index (GCI) as a proxy for competitiveness and our independent variables include; environmental Regulation Stringency Index (ERI), Population (POP), Gross Domestic Product (GDP), Human Development Index (HDI), Foreign Direct Investment (FDI), globalization and landlocked nature of the country. The analysis for the research was based on a "mixed" Spatial Durbin Model (SDM) introduced by Anselin (1988a) which offers a more flexible alternative and might be more appropriate to apply by including the "inherent spatial autocorrelation" and "induced spatial dependence" simultaneously (Osland, 2010). Osland (2010) argued that this SDM could be developed from either a spatial error model (SEM) (Anselin, 2006) or from a Spatial Autoregressive Model (SAR) (Bivand, 1984), and this "mixed" model can be viewed as an unrestricted model of either SEM or SAR. According to LeSage and Pace (2009), SDM is the only model that will produce unbiased estimates regardless of the true data-generation process (i.e., whether it is a spatial lag or a spatial error model). Furthermore, the reasons why SDM was used is because, the residuals (ε) which are the unexplained variation in one country may affect the residuals in another country. Thus, it is called spatial autocorrelation. Finally, it provides information about which observations are considered neighbours and also how their values relate to each other and the spatial weight is based on distance. The results of the analyses include the neigbourhood effect and the countries being studied in the sub region are located to each other.

When $\theta = 0$……………………………………………………………………………………(1)
It is the SAR;
when $\theta + \rho\beta = 0$.. (2)
It is the SDM model.

Therefore;
$GCI = \alpha + \alpha_i + \rho WGCI + X\beta + \varepsilon$...(3)
$\varepsilon \sim NID(0, \sigma^2 I)$
$GCI = \alpha + \alpha_i + X\beta + \varepsilon; \quad \varepsilon = \lambda W\varepsilon + \varepsilon$...(4)
$\varepsilon \sim NID(0, \sigma^2 I)$
$GCI = \alpha + \alpha_i + \rho WGCI + X\beta + WX\theta + \varepsilon$...(5)
$\varepsilon \sim NID(0, \sigma^2 I)$

Where X is the vector of control variables, ρ and λ are the autoregression coefficient, W is the spatial weight matrix, ε is the error term, α is the common intercept and i is individual effect. The selection of the model was based on a series of statistical tests, including Lagrange Multiplier (LM) tests and its robustness tests, Anderson-darling z-test (normality test), Breusch-Pagan LM Test and Farrar-Glauber multicollinearity chi^2 test.

The econometric equation is as follows;
$$\mathbf{GCI_{it} = \alpha_0 - \alpha_1 LERit + \alpha_2 LMARS\_POP_{it} + \alpha_3\ LGDP_{it} + \alpha_4 HDI_{it} + \alpha_5 FDI_{it} + \alpha_6 GI_{it} + \varepsilon_{it}} \quad (6)$$
with a priori expectation
$\mathbf{\alpha_1 < 0, \alpha_1 > 0, \alpha_3 > 0, \alpha_4 > 0, \alpha_5 > 0, \alpha_{6} > 0}$

The spatial econometric model is specified as follows:

$$GCI_{it} = \alpha_0 - \alpha_1 LERit + \alpha_2 LMARS\_POP_{it} + \alpha_3\ LGDP_{it} + \alpha\ _4 HDI_{it} + \alpha\ _5 FDI_{it} + \alpha\ _6 GI_{it}\ + \delta W^* GCI_{it} + y_1 W^*\ LERit + y_2 W^* LMARS\_POP_{it} + y_3 W^*\ LGDP_{it} + y_4 W^* HDI_{it} + y_5 W^* FDI_{it} + y_6 W^* GI_{it} + \varepsilon_{it} \quad (7)$$

Where, W represents the weights matrix. According to the definition of weight matrix

"δ" presents the spatial dependency of GCI between the countries

"γ's" represent the impact of adjacent countries explanatory variables on GCI

"β's" show the direct impact of ER, POP, GDP, HDI, FDI, and GI on GCI.

ANALYSIS AND DISCUSSION OF RESULTS

Table 1 Presentation of Results of Different diagnostic test

Test	Coefficient	P value
LM lag (Anselin)	832.0956***	0.0000
LM lag (Robust)	1.86***	0.0000
LM SAC	1.86***	0.0000
Global Moran MI	0.0631	0.2229

Source: Computed by Author (2021) Using Stata 14

Note: *=10%, **=5% a and ***=1% level of significance

Based on the statistics on the table above, both the LM Lag (Anselin) and LM Lag (Robust) tests reject the hypothesis that; the spatial lagged dependent variable has no spatial auto correlation and as such we establish that the spatial lagged dependent variable has spatial auto correlation across countries in the region. Furthermore, the fact that the LR Test is significant confirms the fact that estimates from SDM are more efficient than those of the OLS (Ordinary Least Square). This implies that, the GCI of one country affects or influences that of other countries, especially those contiguous to it. The positive coefficient of the Moran's I (Global MI) statistics shows that the values in the dataset tend to be cluster spatially (high values do not cluster near other high values; low values do not cluster near other low values), so giving a positive Moran's Index. That is high income and high-income countries do not cluster together and low and low-income countries do not cluster together. But it is insignificant so we cannot reject the null hypothesis. It is quite possible that the spatial distribution of feature values is the result of random spatial processes. The observed spatial pattern of feature values could very well be one of many possible versions of complete spatial randomness (CSR).

The table below presents the SDM results for the effect of environmental regulation on competitiveness in selected countries in sub-Saharan Africa.

Table 2 Comparative Analysis Results of SDM

	SDM	Weighted SDM	
Variables	**Coefficient P>|z|**	**Weighted variables**	**Coefficient P>|z|**
Lpop	0.6339373*** (0.000)	**w1x_lpop**	0.21026** (0.021)
Lgdp	-0.9671713*** (0.000)	**w1x_lgdp**	-0.2721264*** (0.003)
Global	0.3573763*** (0.000)	**w1x_global**	0.08780*** (0.010)
Leri	0.1894365*** (0.000)	**w1x_leri**	-0.0184169 (0.526)
Hdi	0.4299078 *** (0.000)	**w1x_hdi**	0.0003274 (0.989)
Fdi	0.0015423 (0.737)	**w1x_fdi**	-0.003991*** (0.0023)
Landlock	Omitted	**w1x_landlock**	Omitted
_cons	1.40758*** (0.005)		
Log likelihood	36.4737	45.5472	
P-Value > F (14 , 203)	0.0000	P-Value > F (7, 210) (0.0000)	
R2a (Adjusted R2)	0.4945		
Raw Moments R2 Adj	0.9750	0.9943	
Rho	-0.0475 (0.124)	0.01624*** (0.0000)	
Stigma	0.0564*** (0.0000)	0.1973*** (0.0000)	
Sample Size	224	224	
Cross Sections Number	7	7	

Source: Computed by Author (2021) Using Stata 14

Note: *=10%, **=5% a and ***=1% level of significance

Table 2 presents the SDM results for the effect of environmental regulation on competitiveness in selected countries in sub–Saharan Africa. The Spatial Durbin Model (SDM) results come with the weighted nature of the variables; these weighted aspect of the variables shows the spatial aspect of the model. The spatial aspect of the model is what describes the weights which shows the neigbourhood effect. The constant term is positive under SDM (1.407). It shows that there are other variables which have not been included in the model which affects GCI positively and they are significant at 10% level.

The variable population (LPOP) was logged is a proxy for market share and it has a positive coefficient (0.6339373). This means a 1% increase in the market share will increase GCI by 0.63% (SDM) in sub–Saharan Africa. The weighted variable (w1x_lpop**)** which is the neigbourhood effect shows that variable has a positive sign (0.210) meaning the neigbourhoods with an increase market share will lead to an increase in the global competitiveness amongst the countries in the study. This implies that neighbourhoods in Sub Saharan African countries (Chad, Benin, Ethiopia, Kenya, Gambia, Senegal, Tanzania, Zimbabwe, Cameroon, Nigeria, Ivory Coast, Lesotho, Zambia, Gabon, Botswana and South Africa) are competitive (global competitive index) amongst them.

On the other hand, Gross domestic product (GDP) has a negative coefficient of -0.967. This means a 1% increase in GDP will lead to a decrease in GCI by 0.967% in sub-Sahara Africa. The neighbourhood effect weighted variable (w1x_lgdp) has a negative coefficient (-0.272). This implies that an increase in the GDP of neighborhoods in the sub-Saharan African countries leads to a decrease in GCI. This is contrary to the concept of competitiveness whereby one of factors which increases competitiveness in a country is a positive GDP.

Globalisation has a positive coefficient of 0.3574. An index increase in Globlisation will increase GCI in sub-Saharan Africa by 0.3574. Under the neigbourhood effect (w1x_global) the coefficient is equally positive with the value 0.08780. This means that the neigbourhoods of sub-Saharan African countries are positively associated with GCI. This is in line with the Heckscher-Ohlin Model which stated that factors such as capital and labour can freely move between industries (countries) and this will improve on the competitiveness of each country (firm). This is because each firm in each country will want to produce quality goods and this will increase competitiveness amongst the countries in the sub region.

The log of Environmental Regulation Stringency (ERS) has a positive coefficient of 0.1894. An increase in the ERS by 1 index will increase GCI by 0.189 in sub-Sahara Africa and it is significant. It confirms the Porter Hypotheses in which lays emphases on the fact that, the introduction of an environmental regulation would induce firms to switch to the new, cleaner technology, which will intend improve environmental quality and eventually increase productivity (competitiveness) amongst other countries by increasing their market share. This work is in line with the findings of Ankai (2016) in which his research findings provided empirical evidence in support of the Porter hypothesis that tighter environmental regulations can increase productivity.

Nevertheless, the neighbourhood effect (w1x_leri) has a negative relationship with competitiveness with a coefficient of -0.018. This showed that an increase in the environmental regulation stringency of the countries in the sub region will decrease the GCI of neighbouring countries in sub-Saharan Africa. This assertion is in line with the study of Metcalfe (2001) whose research results showed that pork exportation by the European Union was significantly influenced by their stringent environmental regulations, whereas regulations imposed by the U.S. and Canada had negligeable impact on their competitiveness. Equally Environmental Kuznets Curve (EKC) hypothesis also confirmed this result, which explains that competitiveness would expectedly worsen as environmental regulations are strengthened, until the stringency of environmental regulation (SER) reaches a turning point.

Human Development Index (HDI) variable also exhibits a positive coefficient under the spatial Durbin Model (SDM). An index increase in HDI will lead to an increase in GCI by 0.429. Under the neigbourhood effect (w1x_hdi) an index increase in HDI will lead to an increase in GCI by 0.0003274 % in sub–Saharan Africa. This finding is consistent with the work of Wagner (2001) who recommended that one of the determinants for competitiveness is level of education. The human development index is a weighted index made up of different variables and one of those variables is level of education. For a country to have a positive or an increase in competitiveness, it is advantageous for the countries to have a good educational system so as to build human capital.

Lastly, Foreign Direct Investment (FDI) has a direct relationship with GCI but the result is insignificant. A dollar increase in FDI will lead to an increase in GCI by 0.00154 (SDM) in the sub region. Looking at the neigbourhood effect (w1x_fdi) a dollar increase in FDI will lead to a decrease in GCI in the sub region. This is in harmony with the Pollution Halo Hypothesis which states that an increase in FDI activities in the countries where multinational companies are established will increase the level of competitiveness through green technology. In other words, FDI corporations increase the competition level in the market by producing environmentally friendly goods which are newer and encourage green technology. This will force domestic firms to imitate the production and management methods of the multinational companies, an aspect known as the horizontal technology spill over effect.

CONCLUSION AND POLICY RECOMMENDATIONS

This research assessed the impact of Environmental Regulation Stringency on Competitiveness in 16 selected sub-Saharan African countries from 2006-2019.; the countries selected were; Chad, Benin, Ethiopia, Kenya, Gambia, Senegal, Tanzania, Zimbabwe, Cameroon, Nigeria, Ivory Coast, Lesotho, Zambia, Gabon, Botswana and South Africa. Secondary data was obtained from economic global competitive index data, world development indicator, CEPII's GeoDist Datasets and the global economy database. The results showed that the variable log population and Human Development Index are positive and significant under the SDM and the neighbourhood effect whereas FDI too exhibited a positive relationship but it was insignificant. The variable GDP has an indirect effect on GCI in Sub Saharan Africa in the SDM model and neighbourhood effect on GCI in the sub region. Similarly, Environmental Regulation Stringency index had a significant positive or direct relationship with GCI. The neigbourhood effect however had a negative coefficient. The variable landlocked is a dummy variable and it was omitted in the results.

Form the results a number of policies can be put together aimed at increasing competitiveness while implementing environmental policy. Countries with high population will have an increase in global competitiveness since they will have a large market in which to compete with other countries. Therefore, there is a need for stakeholders in countries with high population to encourage them with flexible policies which can enhance trade so as to increase competitiveness. Also, more environmental policies should be implemented so as to encourage this high competitiveness in the form of globalization amongst countries to produce environmentally friendly goods. Finally, the Human development potential has to be improved so as to increase competitiveness in the sub region. In a nutshell, the world has become a global village and this is due to the fast-growing level of technology. So, there is a need for countries in this sub region to stay abreast the changing world trend of technology and so will increase the level of Competitiveness without compromising the environmental cleanliness. This will go a long way to improve on their GDP and eventually the welfare of the citizens, nevertheless this has to be done with green growth in mind since the world is a harbour for living things. It is of utmost importance that the earth has to be protected despite the fast-growing lane through technological advancement used in the production of goods and services with little or no pollution.

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APPENDIX

Presentation of the variables

Variables	Description	Measurement	Expected sign	Source of data
Global competitiveness index (GCI)	all of the factors, institutions, and policies that determine a country's level of productivity	1 (low) to 7 (best)		World Economic Forum's Global Competitiveness Reports or the World Competitiveness Yearbook
Gross Domestic Product (GDP)	Production of all goods and services in the country	US dollars	+ve	World development indicators
Environmental regulation stringency (ER)	a proxy patterning to the works of Cole and Elliot, 2003 was used	ERS = $\frac{\text{energe use}}{\text{GDP per capita}}$	-ve/+ve	world development indicator.
Population	Used as a proxy for Market structure	Total population of a country	+Ve	world development indicator data.
Human development index (HDI)	Four indicators are used to calculate the index: life expectancy at birth, mean years of schooling, expected years of schooling, and gross national income per capita	it an index with values from 0 to 1	+ve	international human development indicator
Foreign direct investment (FDI)	Foreign capital	Percentage of GDP	+ve	world development indicator data
Globalization index (GI)	covers the economic, social, and political dimensions of globalization	is measured from 1 to 100	+ve	Global Economy