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Financial Development, Foreign Direct Investment and Carbon Emissions: A Comparative Study of West Africa and Southern Africa Regions

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Abstract

The study assesses the effect of financial development and foreign direct investment (FDI) on carbon emissions by making a comparative study on West and Southern Africa regions. In a panel data analysis, the study used 10 countries from West Africa and 7 countries from Southern Africa regions respectively by applying dynamic panel data estimation methods thus generalized method of moment two-step method estimation as well as panel quantile regression method to ascertain level of effects and to make a robust inference. The results report positive effect of financial development on carbon emissions and FDI has negative effect on carbon emissions, also found that EKC hypothesis exist in the Southern Africa region thus economic growth and carbon emissions have a U-inverted relationship. The study recommends green policies to be considered in both regions since the evidence revealed that domestic credit to private sector increases carbon emissions.

Key Words: *Financial development; carbon emissions; panel quantile regression; dynamic panel data GMM estimations*
Jel Classification*: B41, E44, Q51*

1. Introduction

Global warming and climate change have increasingly affecting the life of people, animal and plants (Zhang and Liu, 2019). The main cause of global warming has attributed to greenhouse gas, most especially carbon dioxide emissions (CO_2) (Liu et al., 2016; Lin et al., 2017). The world's total economic growth increased carbon emissions significantly by 1.4% in 2011 reaching 34.5 billion tonnes in 2012 (Behket et al., 2017). Africa energy sector is very imperative to its trace to economic growth and development yet players in the sector downplay this notion which can be rated as poor recognition (AEO, 2014). In the quest to develop the African economies, the financial sector is encouraged to make the accessibility of funds to the domestic market easily. Financial development can be comprehensively measured by financialization, financial scale development and financial efficiency. However, financial scale development and financial efficiency can improve the allotment efficiency of financial assets and increase the inflow of secondary and tertiary goods when increasing the level of production. In this case, there will be availability of funds for the supply of factors of production which in the long run increases carbon emissions. Moreover, the concentration of financial efficiency improves research and development as well as innovation imitation of private owned companies which intend to reduce the opportunity cost of research and development and enhance energy efficiency (Linyun and Xiaolu, 2018). The endogenous growth theory posits that economic growth does not depends only on amassing of factors of production but also on the progress of technological advancement (Huang et al., 2017).

Economic growth is the measure of a country's total output in a period usually a year which basically computed for macroeconomic policymaking. Its computation can be found in the post-WWII capitalist economies (Raworth, 2017). It is evidenced that economic growth increases carbon emissions but according to Kuznet curve which was presented by Simon Kuznets in 1950s, the environmental Kuznets curve hypothesis suggests that economic growth relatively contribute to the increase in carbon emissions but in the long run when the economic levels of the country exceed a certain turning point economic growth then decreases carbon emissions. By review of existing literatures, it has been found that there are mixed results as to whether the EKC hypothesis exist in every situation (Narayan and Narayan, 2010; Song et al., 2013; Apergis et al., 2017; Atasoy, 2017). An evidence of no existence of the EKC was found by (Oztokcu and Ozdemir, 2017) that there is an inverted N-shaped relationship between economic growth and carbon emissions which means the continuous growth of an economy do not necessarily reflect in the reduction of carbon emissions which they used a panel data of 26 OECD countries. Moreover, Al-Mulali and Ozturk (2016) studied the effect of economic growth on carbon emissions in 26 developed countries and they found out that the U-inverted curve or relationship exist in their sample. They recommended that a comprehensive study should be conducted in developing countries to ascertain whether the EKC hypothesis exists there.

1.1 Problem Statement

In the quest to mitigate carbon emissions, many studies have been done in diverse ways to find the right measures to arrest this menace. The motivation of this study is derived from the fact that there is no concrete inference on financial development and its effect on environmental degradation thus carbon emissions (Tamazian and Rao, 2010; Ozturk and Acaravci, 2013; Shahbaz et al., 2016a, 2016b; Bekhet et al., 2017; Salahuddin et al., 2018). However, Chang (2015) argues that financial development creates vast opportunities in the areas of development of renewable energy to combat carbon emissions. Secondly, foreign direct investment contributes immensely to economic growth in countries where there is insufficient supply of funds domestically by the financial sector. Moreover, there are a lot of studies on the nexus between FDI and carbon emissions but there is no concrete direction or evidence as to the exact effect on carbon emissions. According the Pollution Haven Hypothesis and the Factor Endowment Hypothesis, in a situation where there are weak environmental regulations and policies in some countries, foreign corporations with high muscles tend to capitalize on that to set up in such countries through FDI inflows to pollute their environments. According to Chang (2015), in effect, FDI will result in environmental degradation. Again, the Environmental Kuznets Curve hypothesis suggests that economic growth relatively contribute to the increase in carbon emissions but in the long run when the economic levels of the country exceed a certain turning point economic growth then decreases carbon emissions. However the Halo Effect hypothesis posits that multinational corporations engage in sanity operations with regards to standard universal environment regulations which imply that they invest in greener technologies through FDI in their counterpart countries. In consideration of these motivates the study to assess the effect of financial development and foreign direct investment on carbon emissions.

1.2 Objective of the Study

The study intends to make significant contribution to existing literatures to help in policy formulation and academics perusal. The study tends make a comparative study between the West Africa region and Southern Africa region to ascertain the region which contribute to increase in carbon emission through financial development, foreign direct investment, trade and economic growth. To execute this objective, the study employs panel data methodologies such as dynamic panel data estimation using generalized method of moment and robust estimations as well as panel quantile regression robust method.

1.3 Research Question

In order to carefully study the nexus between financial developments, foreign direct investment and carbon emission, this present study seeks to ask;

- What role do financial development and foreign direct investment play in carbon emissions with the regulatory role of economic growth in West Africa and South Africa respectively?
- In comparison, which region do financial development and foreign direct investment increase carbon emissions?

The study comprises of five parts namely; section 1 which consists of the introduction, problem statement, research objective and questions, section 2 contains the literature review, section 3 introduces the methodology and data description and section 4 displays the results of the analysis and discussion. The last part is section 5 which concludes the study and proposes some recommendations.

2. Literature Review

2.1 Financial Development and Carbon Emission Nexus

According to Borio (2011), financial development contributes to the growth and stability of an economy. There is evidence that financial development and economic growth are on the same path where as both causes each other. In other words, an increase in economic growth means there is an increase in carbon emissions (Borio, 2011; Nasir et al., 2015). Zhang (2011) explains that financial development paves way for more FDI and promotes economic growth which in turn increases the use of energy. The development of the financial sector efficiently creates enough credit and the rise in the purchase of energy usage products and services; the development of the capital market increases the investment in the energy sector for energy production and consumption. Perhaps, as and when the financial sector develops, it is important to factor the environment into consideration to avoid degradation (Sadorsky, 2010, 2011; Shahbaz et al., 2012a, 2012b; Shahbaz et al., 2013c; Islam et al., 2013; Shahbaz et al., 2017c).

The argument on the nexus between financial development and carbon emissions comes in different ways; some studies confirms that financial development does not affect carbon emissions but help in the reduction of carbon emissions (Tamazian et al., 2009; Tamazian and Rao, 2010; Jalil and Feridun, 2011; Abbasi and Riaz, 2016; Dogan and Seker, 2016; Muhammed et al., 2018). Another section of the argument confirms that financial development has a positive effect on carbon emissions which means that it increases carbon emissions (Zhang, 2011; Shadbaz et al., 2013c, 2016a, 2016b; Javid and Sherif, 2016; Salahuddin et al., 2018). From a different perspective, some studies confirm that the nexus between financial development and carbon emissions are insignificant and there is no concrete linkage between the two (Ozturk and Acaravci, 2013; Coban and Topcu, 2013; Omri et al., 2015; Charfeddine and Khediri, 2016; Bekhet et al., 2017).

To expatiate on the diverse arguments with regards to financial development and carbon emission in previous studies, scholars on the positive linkage opined that financial development relatively increases economic growth which leads to ecological and environmental implication through energy consumption and depletion of environmental quality (Tamazian et al., 2009; Boutabba, 2014). Moreover, financial development of a country serve as stimuli for foreign direct investment which flows into productive sectors to increase growth (Shabbaz et al, 2017a). In essence, financial sector development transforms living standard of people in a country due to availability of finances and economic activities in that energy consumption increases thereby resulting in rise in carbon emission (Chafeddine & Ben Khediri, 2016; Shabbaz et al., 2013).

On the other hand, other scholars are of the view that financial development is beneficial to the environment hence affecting carbon emission negatively (Chafeddine & Ben Khediri, 2016). Tamazian et al. (2009) studied the impact of financial development on carbon emission in China, they concluded that the relationship between the two is inverse hence for the period of 1992 to 2004 financial development has contributed negatively to carbon emission in China. To support their findings, Jalil and Feridun (2011) investigated environmental quality and financial development and they concluded that increase in financial development in emerging economies decreases carbon emission. Moreover, Shabbaz et al. (2013) substantiated that financial development inversely affect carbon emissions in Indonesia and South Africa.

2.2 Foreign Direct Investment and Carbon Emission Nexus

To investigate the existence of the Pollution Haven and Factor Endowment Hypotheses, some studies have found that FDI inflow increases carbon emissions. Evidence substantiate the existence of Pollution Haven and Factor Endowment Hypotheses in the regions of China, Malaysia, Indonesia, United States of America and many others (Hitnam and Borhan, 2012; Lan et al., 2014; Chandran and Tang, 2013). On the contrary, some studies confirm the existence of the Halo Effect hypothesis in some regions which in their studies posit that FDI has a negative effect on carbon emissions by way of investment in greener technologies in those regions (Zhu et al., 2016; Jiang et al., 2017; Zhang and Zhou, 2016).

The study finds these areas of interest due to the unconvincing and mixed results revealed in existing literatures to assess the effect of financial development and foreign direct investment on carbon emissions in the Southern Africa and West Africa regions in a comparative study. In so doing, the study employs the dynamic panel data and panel quantile regression methodologies to make robustness inference by using financial development as the independent variable and carbon emissions per capita as the dependent variable as well as foreign direct investment, trade openness and financial openness as control variables to measure the effect on carbon emissions.

3. Data and Methodology

3.1 Data

The study comprises of panel data of Carbon emissions per capita, GDP per capita, financial development variables, foreign direct investment, Trade openness and financial openness for 7 southern Africa and 10 West Africa countries from the period of 1995 to 2015. The data were collected from World Bank's WDI (World development indicators database, 2017). The definition of the variables can be found below;

1. Carbon emission per capita in metric tonnes (CO2PC): represent the units of carbon emissions from the utilization of fossil fuels divided by the total population. (Dependent variable)
2. Financial development (DCP) is measured by a proxy of domestic credit to private sector as a percentage to GDP. (Independent variable)
3. Foreign direct investment refers to foreign direct investment inflows as a percentage of GDP. (Independent variable)
4. Gross domestic product per capita (GDPPC) refers to the measure of economic growth thus total GDP divided by total population in millions of dollars at constant PPP 2011 international. (Control variable)
5. Trade openness: it refers to the summation of total export and import of goods and services as a percentage of GDP. (Control variable)
6. Financial openness: refers to net foreign assets as a percentage of GDP. (Control variable)

All the variables were transformed into natural logarithm except carbon emissions per capita.

3.2 Methodology

The study employed two methodologies to assess the effect of financial development on carbon emissions per capita thus Arellano-bond dynamic panel data estimation (Generalised method of moments and robust estimations) and panel quantile regression methodology in order to make its statistical inference in the robust form. By using the dynamic GMM and robust panel methodology, the study intends to ensure that if the dependent variable has a serial correlation, the regression with the lagged dependent variable as independent variable can mitigate the depth of serial auto-correlation of the error term. Arellano and Bond (1991) recommended that the generalized method of moments (GMM) method has the capability to remove the autocorrelation of the error term and mitigate the correlation between the endogeneous variables and the error term in a dynamic panel model. The study considers the following model for panel quantile regression (Koenker and Basett Jr, 1978; Cheng et al., 2019):

$$Q\Delta c02pc_{i.t}(\tau/\cdot) = a_{1,\tau}\ \Delta lndcp_{i,t} + a_{2,\tau}\ \Delta lngdppc_{i,t} + a_{3,\tau}\ \Delta lnfdi_{i,t} + a_{4,\tau}\ \Delta lnto_{i,t} + a_{5,\tau}\ \Delta lnfo_{i,t} + \beta_i, \quad i = 1, \ldots . . N, t = 1, \ldots . , T \qquad (1)$$

Koenker (2004) proposed that the appropriate method for solving the main problem on equation (1) which is the traditional linear approach is impractical for quantile regression hence to eliminate the unobserved fixed effects, it is appropriate to use the L_1-norm penalty term. In this case, the study employs this method to estimate the model below;

$$\underset{a}{argmin} \sum_{k=1}^{k} \sum_{i=1}^{N} \sum_{t=1}^{T} w_{k\rho_{\tau k}} \{\Delta co2pci,t - a_1,\tau Lndcp_{i,t} - a_2,\tau Lngdppc_{i,t} - a_3,\tau Lnfdi_{i,t} - a_4,\tau Lnto_{i,t} - a_5,\tau Lnfo_{i,t} - \beta_i\} + \mu \sum_{i=1}^{N} |\beta_i| \quad i = 1, \ldots \ldots , N, t = 1, \ldots . , T \qquad (2)$$

In the equation (2), $\rho_{\tau\,(y)} = y(\tau - 1_{y<0})$ is the traditional check function, 1_A is the indicator function. $\Delta co2pc_{i,t}$ connotes carbon emissions per capita in country i at time t whiles K is the index of quantiles. W_k equates to 1/K which represents the relative weight on k-th quantile, and the same time used to explain the contribution of various quantiles in the estimation (Koenker, 2004; Zhu et al., 2016; Cheng et al., 2018). Furthermore, μ is equal to 1 and represents the tuning parameter (Lamarche, 2011; Zhu et al., 2011; Cheng et al., 2018).

The second methodology which is adopted for the study thus panel quantile regression investigates the driven factors of carbon emissions in the Southern and West Africa countries at different quantile levels and also check the effects and unobserved individual heterogeneity of the variables to make robust estimations. The model for Arellano and Bond dynamic panel data estimation can be found in equation (3) (Kim et al., 2018);

$$CO2PCit = \sum_{j=1}^{p} a_j\, ln.co2pc_{i.t-j} + \beta_1 lndcp_{it} + \beta_2 lngdppc_{it} + \beta_3 lnfdi_{it} + \beta_4 lnto_{it} + \beta_5 lnfo_{it} + v_i + \varepsilon_{it} \quad i = 1, \ldots \ldots , N, t = 1, \ldots . . T_i \qquad (3)$$

In the equation (3), i represent the 7 cross sectional countries in the Southern Africa and 10 West Africa countries respectfully, t represents the period of time from 1995 to 2015, v represents the panel level effect, and ε_{it} represents the independent and identically distributed (i.i.d.) over the whole data sample with variance σ_ε^2, j represents the time lag that will be determined by Arellano-Bond test for the serial correlation.

The study started by performing the unit root tests for finding stationarity in the variables in order to reject the null hypothesis which states that there is an existence of unit root in the variables. By doing so, the study employed the tests of Levin et al. (2002), Im et al. (2003), and

Fisher-ADF and Fisher PP of Maddala and Wu (1999) to find out if there is unit root in the variables in order to check for cross-section dependence, heterogeneity and homogeneity. Afterwards, panel co-integration test is performed to ascertain whether the variables are cointegrated in order to ascertain the long run relationship among the variables. Therefore, the Johansen Fisher type co-integration test is considered for the study (Zhang and Liu, 2019). After the cointegration test has proven cointegrated and the null hypothesis has been rejected, the study then run the dynamic panel data GMM methodology to establish the coefficients at which the independent variable affects the dependent variable. The study used two-step GMM method for its estimations due the effect of less propensity of an influence by heteroskedasticity than the one-step method. Furthermore, Sargan test is performed to examine the validity of instruments used in the process. Again, AR(1) and AR(2) test is also performed to check for autocorrelation of the residuals; the value of AR(2) depicts that the hypothesis of zero second order serial correlation existing among the variables cannot be rejected (Lingyun and Xiaolu, 2018). Subsequently, the panel quantile regression methodology is executed to confirm quantile levels at which the independent and control variables affect the dependent variable. Furthermore, the study intends to find the existence of factor endowment hypothesis, halo effect hypothesis, pollution haven hypothesis and the Environmental Kuznets curve hypothesis in the sample. Lastly, the study employs bivariate panel causality to test for homogenous causality test to ascertain the direction at which the variables cause each other. The causality linkage and direction of the time series data are examined by allowing for heterogeneity in the dynamic models across the cross-sections (Dumitrescu and Hurlin, 2012).

4. Results and Discussion

4.1 Summary Statistics

Table 1 depicts the summary statistics of the six variables considered for the study; the table shows the mean, median, standard deviation, Skewness, Kurtosis and Jarque-Bera test. According to the skewness, Kurtosis and Jarque-Bera tests depict that the variables are not in normal distribution hence OLS method is not suitable for the study.

Table 1: Summary Statistics (After natural logarithm)

	CO2PC	LNDCP	LNFDI	LNFO	LNTO	LNGDPPC
Mean	0.918	2.683	1.906	18.060	4.111	7.717
Median	0.249	2.679	1.539	25.391	4.122	7.513
Maximum	9.871	5.261	18.818	31.916	9.151	9.654
Minimum	0.049	-1.014	-3.177	0	-0.619	5.923
Std. Dev.	2.045	1.028	2.441	11.890	1.606	0.835
Skewness	3.411	-0.110	3.138	-0.271	-0.056	0.639

Kurtosis	13.445	4.648	17.268	1.148	5.821	2.577
Jarque-Bera	2315.174***	41.108***	3614.255***	55.3904***	118.5904***	26.969***

Note: *** indicates 1% significance

4.2 Panel Unit Root Tests

Table 2 represents the outcome of panel unit root tests for the variables adopted for the study. As the study employed four panel unit root tests; LLC, IPS, Fisher-ADF and Fisher-PP, the results that levels co2pc showed stationarity with LLC, lnto showed stationarity with LLC and Fisher-PP but lnfdi and lnfo showed stationarity with all the tests. At first difference, all the variables become stationary. Therefore, the null hypothesis that there is unit root in the variables is rejected at 5% and 1% significant level hence the alternative hypothesis is accepted because at first difference all the variables became stationary.

Table 2: Panel Unit roots test

level	co2pc	lndcp	lngdppc	lnfdi	lnfo	lnto
LLC	-1.566**	0.308	-1.157	-2.774**	-17.260***	-1.701**
IPS	-0.017	2.240	2.984	-3.193***	-8.682***	-0.450
ADF-Fisher	34.042	22.366	15.669	62.973**	293.764***	30.276
PP-Fisher	38.184	35.200	24.454	88.978***	102.625***	55.044**
First difference						
LLC	-5.991***	-6.277***	-1.910**	-8.078***	-55.530***	-5.683***
IPS	-8.727***	-7.517***	-5.671***	-11.055***	-19.902***	-8.067***
ADF-Fisher	138.860***	121.852***	95.389***	176.557***	391.482***	128.681***
PP-Fisher	237.755***	231.512***	236.171***	1066.740***	239.897***	262.339***

Note: ** indicates 5% significance, *** indicates 1% significance

4.3 Panel Co-Integration Test

Table 3 exhibits the result of Johansen-Fisher co-integration tests per the two regions thus West Africa and Southern Africa. The result which is based on trace and maximum eigenvalue statistics tests, the outcomes posit that the null hypothesis of no co-integration is rejected at 1% significance level confirming the existence of co-integration. Therefore, it is evidenced that a long run equilibrium relationship exists among carbon emissions, domestic credit to private sector, foreign direct investment, trade openness, financial openness and gross domestic product per capita.

Table 3: Co-integration Test

	West Africa		Southern Africa	

Fisher type Johansen cointegration test				
Hypothesized No. of CE(s)	Fisher Statistic Trace test	Max-eigen test	Fisher Statistic Trace test	Max-eigen test
None	428.70***	239.90***	326.20***	202.50***
At most 1	296.20***	213.40***	183.30***	125.30***
At most 2	122.80***	94.52***	90.14***	68.38***
At most 3	49.69***	43.41***	35.55***	35.23***
At most 4	22.42	22.56	13.36	11.66
At most 5	18.64	18.64	17.29	17.29

Note: *** indicates 1% significance level. West Africa countries: Ghana, Nigeria, Cote d'Ivoire, Togo, Benin, Burkina Faso, Guinea, Senegal, Mali, Niger. Southern Africa countries: South Africa, Botswana, Namibia, Zambia, Mozambique, Malawi, Madagascar.

4.4 Dynamic Panel Estimations with Arellano-Bond (GMM and Robust Estimations)

Table 4 depicts the results of dynamic panel data estimations using GMM estimation using two steps method. This methodology utilizes the dynamic effect of the dependent variable and the exogenous characteristics of the dependent variables. The dependent variable is co2pc and the time lag for each method is ascertained based on their statistical significance. In contrast, ln.co2pc showed positive and statistical significance in Southern Africa region with coefficient of 0.246 but negative and statistical significance in the West Africa region with a coefficient of -0.425.Moreover, lndcp showed positive and statistical significance in all regions with coefficients of 0.246 and 0.101 respectively. This confirms that financial development has a positive effect on carbon emissions in both regions. Economic growth consistently showed a strong and positive effect on carbon emission thereby lngdppc increases along with carbon emissions with coefficient of 0.099 and 0.347 in both regions respectively. Considering the other control variables, lnfdi showed negative and significant effect on carbon emissions in both regions which confirms that the inflows of foreign direct investment do not contribute to carbon emissions to the Southern Africa and West Africa regions. Trade openness and financial openness showed positive effect on carbon emissions but lnfo showed insignificant effect in the West Africa region. Trade openness (lnto) showed statistical significant effect with coefficient of 0.287 in the Southern Africa region and 0.073 in the West Africa region. A percentage increase in lndcp, lnfdi, lngdppc, lnfo and lnto will affect carbon emissions by 0.246%, -0.042%, 0.008% and 0.287% in the southern Africa region whiles a percentage increase in lndcp, lnfdi, lngdppc and lnto will affect carbon emissions by 0.101%, -0.005%, 0.347% and 0.073% in the West Africa respectively.

Table 4: Arellano-Bond Dynamic Panel Data Estimations

	Southern Africa	West Africa
Variables	Method	Method

	GMM (Two-step)	GMM (Two-step)
LN.co2pc	0.181	-0.425
L1	(61.40)***	(-21.66)***
lndcp	0.246	0.101
	(16.22)***	(14.69)***
lnfdi	-0.422	-0.005
	(-5.53)***	(-8.33)***
lngdppc	0.099	0.347
	(10.16)***	(105.49)***
lnfo	0.008	0.001
	(7.30)***	(1.56)
lnto	0.287	0.073
	(6.41)***	(17.11)***
constant	-2.401	-2.725
	(-16.60)***	(-67.26)***
Sargan test	18.216	20.830
P-value	0.197	0.972
AR(1)	-2.326**	-3.958***
AR(2)	-1.194	-1.943
Wald chi2	93973.62***	52978.14***

Note: *** indicates 1% significance, ** indicates 5% significance, * indicates 10% significance. Z-statistics are in parenthesis. West Africa countries: Ghana, Nigeria, Cote d'Ivoire, Togo, Benin, Burkina Faso, Guinea, Senegal, Mali, Niger. Southern Africa countries: South Africa, Botswana, Namibia, Zambia, Mozambique, Malawi, Madagascar.

4.5 Results of Panel Quantile Regression (Robust)

This section discusses the results of panel quantile regression analysis from table 5. In the table, from the Southern African region, it can be ascertained that lngdppc has an effect which significantly asymmetric and heterogenous; the coefficient increased from the 5^{th} quantile to 40^{th} quantile and decreased in the 60^{th} to 70^{th} quantiles, it then increased in the 80^{th} quantile but decreased in the 90^{th} quantile and increased in the 95^{th} quantiles. Meanwhile, it showed consistent positive effect on carbon emissions which implies that economic growth thus gross domestic product per capita increase contribute to the increase in carbon emissions in the Southern Africa region. In comparison to the West Africa region, lngdppc showed inconsistent and intermittent relationships which were significantly asymmetric as well as positive along all the quantiles. Also, it confirms that there is direct and positive impact on carbon emissions as when there is an increase in economic growth. The high quantiles stand for the countries with large changes in carbon emissions per capita (co2pc) and the low quantiles stand for the countries with small changes in carbon emissions per capita (co2pc). The countries with large changes are the ones with high gdp per capita hence consume more energy whiles the small change countries are those with low gdp per capita hence consume less energy. In the Southern Africa region, the Environmental Kuznets curve (EKC) hypothesis exist which the study tends to accept the hypothesis that there is an inverted U-curve between economic growth and carbon emissions but in the West Africa region was not obvious to accept that the EKC hypothesis exist.

Finding the effect of financial development on carbon emissions, table 5 reports that lndcp as proxy of financial development has positive and direct effect on carbon emissions. From the table, lndcp showed an intermittent and significant asymmetric relationship with carbon emissions which displayed that an increase in financial development increases carbon emissions in the Southern Africa region at significant asymmetric levels but the West Africa region depicted a U-shaped relationship between financial development (lndcp) and carbon emissions per capital (co2pc). At the 5th quantile in the Southern Africa region, lndcp increased to 10th quantile then decreased in 20th quantile, it then increased from the 40th quantile to 80th quantile and decreased from the 90th to 95th quantiles. Moreover, in the West Africa region, lndcp decreased from the 5th quantile to 50th quantile then begun to increase from 60th quantile to 95th quantile. The effect of financial development on carbon emissions per capita in the Southern Africa region exhibits that it affects both the low and high gdp per capita countries in that region but in the West Africa region, it exhibits that the effect of financial development on carbon emissions per capita is low in the low gdp per capita countries and high in the high gdp per capita countries**.**

By assessing whether the factor endowment hypothesis, halo effect hypothesis and pollution haven hypothesis exist in the Southern Africa and West Africa regions; table 5 reports that foreign direct investment (lnfdi) has negative effect on carbon emissions per capita but was significant from the 50th quantile to 95th quantile in the Southern Africa region and significant in the 10th and 70th quantiles in the West Africa region respectively. Therefore, the study rejects the existence of the factor endowment; halo effect and pollution have hypotheses in both regions. In contrast, foreign direct investments do not increase carbon emissions in the two regions which could mean that FDI in those regions do not come in the manufacturing sectors.

Trade openness (lnto) as a control variable showed negative and statistical significant in all quantiles except in 30th quantile which was insignificant in the Southern Africa region. Meanwhile, in the West Africa region, trade openness (lnto) showed positive at all quantiles but was significant at 10th, 20th, 40th, 50th, 70th and 90th quantiles. In evidence, it was established that trade openness has negative effect on carbon emissions in the southern Africa region but has positive and inconsistent effect on carbon emissions in the West Africa region. Trade openness has positive effect on carbon emissions in the lower quantiles which represents the low gdp per capita countries and steadily becomes negative in the higher quantiles. Therefore, in the low gdp per countries, trade openness (lnto) has positive effect on carbon emissions per capita. Considering financial openness (lnfo), it showed positive and significant in the lower 10th and 40th quantiles but insignificant in the other quantiles whiles in the West Africa region, lnfo showed negative and significant effect from the 5th quantile to the 50th quantile but insignificant form 60th quantile to 80th quantile and positive significant effect in the 90th quantile. In contrast, financial openness does not have a positive and consistent effect on carbon emissions per capita in the two regions

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Table 5: Results of Panel Quantile Regression (Robust)

				Southern Africa							
Variables					Quantiles						
	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th
Intercept	-1.660	-1.409	-0.920	4.424	8.657	6.731	4.961	5.465	5.255	5.832	4.762
	(-1.84)*	(-2.56)**	(-0.34)	(1.11)	(4.38)***	(4.06)***	(3.29)***	(3.50)***	(3.59)***	(3.13)**	(1.74)*
lndcp	0.502	0.556	0.550	1.042	1.847	1.943	2.104	2.204	2.112	2.097	2.214
	(6.62)***	(11.90)***	(3.32)***	(3.06)**	(5.79)***	(13.73)***	(14.30)***	(14.24)***	(16.00)***	(12.34)***	(10.22)***
lnfdi	-0.017	-0.015	-0.013	-0.049	-0.090	-0.302	-0.410	-0.379	-0.351	-0.329	-0.323
	(-0.61)	(-0.76)	(-0.18)	(-0.32)	(-0.84)	(-2.51)**	(-3.87)***	(-5.14)***	(-4.50)***	(-3.18)**	(-3.56)***
lngdppc	0.336	0.361	0.435	0.792	1.154	0.919	0.632	0.612	0.734	0.721	0.750
	(6.27)***	(14.52)***	(1.67)*	(2.10)**	(9.28)***	(4.39)***	(3.57)***	(3.88)***	(5.54)***	(5.03)***	(4.43)***
lnfo	0.024	0.021	0.019	0.054	0.041	0.029	-0.034	0.003	-0.010	-0.013	0.010
	(1.39)	(2.70)**	(0.17)	(1.27)	(1.74)*	(0.73)	(-0.91)	(0.07)	(-0.29)	(-0.33)	(0.21)
lnto	-0.518	-0.649	-0.865	-3.080	-5.129	-4.177	-3.177	-3.311	-3.350	-3.392	-3.241
	(-2.74)**	(-4.08)***	(-0.74)	(-1.80)*	(-7.67)***	(-6.91)***	(-6.37)***	(-7.37)***	(-8.26)***	(-6.37)***	(-4.13)***

Note: ***indicates 1% significance, ** indicates 5% significance, *indicates 10% significance. Southern Africa countries: South Africa, Botswana, Namibia, Zambia, Mozambique, Malawi, Madagascar.

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				West Africa							
Variables					Quantiles						
	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th
Intercept	-2.137	-2.136	-1.718	-1.762	-1.846	-1.949	-1.909	-1.904	-1.631	-1.693	-1.847
	(-14.10)***	(-7.38)***	(-7.29)***	(-21.44)***	(-24.87)***	(-16.34)***	(-15.49)***	(-10.86)***	(-7.22)***	(-7.45)***	(-3.10)**
lndcp	-0.099	-0.098	-0.026	-0.016	0.005	0.035	0.048	0.070	0.103	0.116	0.119
	(-15.94)***	(-4.85)***	(-1.41)	(-1.85)*	(0.46)	(3.11)**	(3.79)***	(5.99)***	(5.67)***	(5.06)***	(2.82)**
lnfdi	-0.004	-0.007	0.001	0.003	0.001	-0.000	-0.002	-0.005	-0.002	0.000	-0.007
	(-2.62)**	(-1.27)	(0.10)	(0.88)	(0.62)	(-0.17)	(-0.76)	(-2.24)**	(-0.63)	(0.13)	(-0.05)
lngdppc	0.353	0.32	0.266	0.259	0.264	0.272	0.261	0.251	0.270	0.321	0.339
	(44.40)***	(11.61)***	(11.12)***	(32.15)***	(20.95)***	(19.65)***	(17.99)***	(10.20)***	(8.81)***	(10.33)***	(7.99)***
lnfo	-0.007	-0.006	-0.004	-0.004	-0.003	-0.002	-0.001	-0.001	0.001	0.003	0.004
	(-1.98)**	(-4.56)***	(-7.40)***	(-10.81)***	(-5.53)***	(-2.29)**	(-1.13)	(-0.09)	(0.60)	(2.78)**	(1.12)
lnto	0.085	0.074	0.031	0.049	0.046	0.039	0.042	0.048	-0.071	-0.158	-0.155
	(3.68)***	(2.19)***	(1.14)	(2.30)**	(2.02)**	(1.39)	(1.76)*	(1.59)	(-1.49)	(-3.00)**	(-1.59)

Note: ***indicates 1% significance, ** indicates 5% significance, *indicates 10% significance. West Africa countries: Ghana, Nigeria, Cote d'Ivoire, Togo, Benin, Burkina Faso, Guinea, Senegal, Mali, Niger.

4.6 Homogeneous Causality Test

To ascertain the direction which carbon emissions per capita and economic growth have in order to validate the growth and bidirectional hypotheses; the homogeneous causality test was adopted to check the direction which the variables have with each other. Evidence from table 6 confirms that in the Southern Africa region economic growth (lngdppc) has a bidirectional linkage with carbon emissions per capita. In other words, a change in one variable will cause a change in the other in the same direction. There was an existence of unidirectional linkage from lndcp to fdi, lngdp to lndcp, lndcp to lnto, lngdppc to lnto and lngdppc to lnfo. Meanwhile, in the West Africa region, lnto and co2pc have bidirectional linkage as well as lnfo and lngdppc; a change in any of the variables will cause a change in the other variable in the same direction. There also exist unidirectional linkage from co2pc to fdi, lngdppc to co2pc, lngdppc to lndcp, lnfo to lndcp, lnto to lndcp, lnto to fdi, lnfo to fdi and lnto to lnfo which means that the first variable of each linkage causes the latter.

Table 6: Homogeneous Causality Test

	Southern Africa			West Africa		
Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.	W-Stat.	Zbar-Stat.	Prob.
CO2EPC does not homogeneously cause FDI	2.608	0.264	0.792	4.864	2.899	0.004**
LNGDPPC does not homogeneously cause CO2EPC	7.612	5.059	0.000***	4.590	2.585	0.010**
CO2EPC does not homogeneously cause LNGDPPC	4.147	1.738	0.082*	3.155	0.941	0.347
LNTO does not homogeneously cause CO2EPC	4.065	1.659	0.097*	3.902	1.797	0.072*
CO2EPC does not homogeneously cause LNFO	3.356	0.980	0.327	4.019	1.931	0.054**
LNDCP does not homogeneously cause FDI	5.686	3.213	0.001***	2.059	-0.314	0.753
LNGDPPC does not homogeneously cause LNDCP	11.289	8.582	0.000***	4.712	2.725	0.006**
LNTO does not homogeneously cause LNDCP	1.294	-0.996	0.319	3.907	1.803	0.072*
LNDCP does not homogeneously cause LNTO	8.022	5.451	0.000***	2.491	0.181	0.856
LNFO does not homogeneously cause LNDCP	3.180	0.811	0.417	7.980	6.468	0.000***
LNTO does not homogeneously cause FDI	1.8779	-0.436	0.663	5.645	3.794	0.000***
LNFO does not homogeneously cause FDI	1.911	-0.405	0.685	6.526	4.803	0.000***
LNFO does not homogeneously cause LNGDPPC	2.398	0.062	0.951	7.814	6.277	0.000***
LNGDPPC does not homogeneously cause LNFO	8.128	5.553	0.000***	7.046	5.397	0.000***
LNTO does not homogeneously cause LNFO	1.720	-0.588	0.556	0.696	-1.876	0.061*

Note: ***indicates 1% significance, ** indicates 5% significance, *indicates 10% significance. West Africa countries: Ghana, Nigeria, Cote d'Ivoire, Togo, Benin, Burkina Faso, Guinea, Senegal, Mali, Niger. Southern Africa countries: South Africa, Botswana, Namibia, Zambia, Mozambique, Malawi, Madagascar.

5. Conclusion and Recommendation

The study examined the effect of financial development on carbon emission in a comparative study between West Africa and Southern Africa in a panel study of 10 West Africa countries and 7 Southern Africa countries for the period of 1995 to 2015. The study employed dynamic panel data GMM/robust methodologies as well as panel quantile regression for robustness analysis on the effect of financial development on carbon emission in both regions. The results from the outcome of the analysis confirm positive and direct effect of financial development on carbon emissions in both West Africa and Southern Africa regions (Alex et al. 2019). From the results, it was also established that the EKC hypothesis exist in the Southern Africa region but not in the West Africa region; this findings oppose the outcome of Jiang and Vitenu-Sackey (2019). Therefore, economic growth in the Southern Africa region will decrease carbon emissions in the long run when the economic levels exceed a turning point. According to the results, Foreign direct investment has negative effect on carbon emissions in the Southern Africa region but insignificant in the West Africa region. In spite of this, the study rejects the existence of Factor Endowment Hypothesis and Pollution Have Hypothesis in both regions but accept the halo effect hypothesis. This could also mean that foreign direct investment inflows into these two regions do not necessarily go to the manufacturing sector where the consumption of fossil fuel is enormous; Fossil fuel has been ticked as the largest contribution to carbon emission.

The study recommends that stringent measures should be ensured to safeguard the environment from carbon emissions. Policies enacted to protect the environment from carbon emissions should have greener motives attached such as green credit, green investment and green taxes as the consumption of renewable energy by the private sector for production of goods and services. The promotion of green policies in the Southern and West Africa regions will protect the environments against carbon emissions because it was found that domestic credit to the private sector increases carbon emissions. The governments in these regions should steadily develop domestic carbon finance and trading markets to promote carbon emission reduction. The study also proposes the establishment and enforcement of ecofriendly and environmental institution to rigorously implement policies enacted to protecting the environments in these regions. Moreover, it would be beneficial to the countries if credit financial agencies are formed to control efficiency of credit facilities and evaluate low carbon credit policies. Financial development is a driven factor of carbon emissions therefore; sustainable and renewable energy should be the center of attention in the pursuit of industrialization in Southern and West Africa regions.

6. Limitation of the Study

As the relationship between financial development and carbon emissions have been of mixed results, the study recommends comprehensive study into the regions of Africa to unravel the true impact due to the quest of Africa to develop rapidly. However, due to data insufficiency for other countries in both West and South Africa, not all countries were sampled for the study.

References

1. Abbasi, F. & Riaz, K. 2016. CO2 emissions and financial development in an emerging economy: an augmented VAR approach. *Energy Policy,* (90), 102–114.

2. Alex, O.A., Samuel, A. & Elliot, B. 2019. Do globalization and renewable energy contribute to carbon emissions mitigation in Sub-saharan Africa? *Science of the total Environment,* (677), 436 – 446.

3. Al-Mulali, U., Saboori, B., & Ozturk, I. 2015. Investigating the environmental Kuznets curve hypothesis in Vietnam. *Energy Policy* (76), 123–131.

4. Arellano, M. & Bond, S. 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies*, 58 (2), 277 – 297.

5. AOE, 2014. African Energy Outlook: A focus on energy prospects on Sub-Saharan Africa. *World Energy Outlook Report*. Available at https://www.iea.org.

6. Apergis, N., Christou, C., & Gupta, R. 2017. Are there environmental Kuznets curves for US state-level CO2 emissions? *Renewable and Sustainable Energy Review,* 69, 551–558.

7. Atasoy, B.S. 2017. Testing the environmental Kuznets curve hypothesis across the U.S.: evidence from panel mean group estimators. *Renewable and Sustainable Energy Review,* 77, 731–747.

8. Bekhet, H.A., Matar, A., & Yasmin, T. 2017. CO2 emissions, energy consumption, economic growth, and financial development in GCC countries: dynamic simultaneous equation models. *Renewable and Sustainable Energy Review,* 70, 117–132.

9. Borio, C. 2011. Rediscovering the macroeconomic roots of financial stability policy: journey, challenges and a way forward. *Working Paper No. 354.* BIS.

10. Boutabba, M.A., 2014. The impact of financial development, income, energy and trade on carbon emissions: evidence from the Indian economy. *Econ. Modell.* 40, 33e41. https://doi.org/10.1016/j.econmod.2014.03.005.

11. Chandran, V.G.R. & Tang, C.F. 2013. The impacts of transport energy consumption, foreign direct investment and income on CO2 emissions in ASEAN-5 economies. *Renewable and Sustainable Energy Review,* 24, 445–453.

12. Chang, S.C. 2015. Effects of financial developments and income on energy consumption. *International Review of Economics and Finance,* 35, 28–44.

13. Charfeddine, L. & Khediri, K.B. 2016. Financial development and environmental quality in UAE: cointegration with structural breaks. *Renewable and Sustainability Energy Review*, 55, 1322–1335.

14. Cheng, C., Ren, X., & Wang, Z. 2019. The impact of renewable energy and innovation on carbon emissions: An empirical analysis for OECD countries. *Energy procedia,* 158, 3506 – 3512.

15. Çoban, S. & Topcu, M. 2013. The nexus between financial development and energy consumption in the EU: a dynamic panel data analysis. *Energy Economics,* 39, 81–88.

16. Dogan, E. & Seker, F. 2016. The influence of real output, renewable and non-renewable energy, trade and financial development on carbon emissions in the top renewable energy countries. *Renewable and Sustainable Energy Review,* 60, 1074–1085.

17. Dumitriscu, E.I. & Hurlin, C. 2012. Testing for Granger non-causality in heterogeneous panels. *Econometric modelling,* 2, 1450 -1460.

18. Hitam, M.B. & Borhan, H.B. 2012. FDI, growth and the environment: impact on quality of life in Malaysia. *Procedia Social Behaviour Sciences,* 5, 333–342.

19. Huang, L.Y., Xie, H.Q., & Liu, D.D. 2017. Technological progress paths and the embodied carbon emission intensity in China's manufacturing exports. *Chinese J. Popul, Resour. Environ.* 27 (10), 94 - 102.

20. Hussain, A.B., Ali, M., & Tahira, Y. 2017. CO2 emissions, energy consumption, economic growth, and financial development in GCC countries: Dynamic simultaneous equation models. *Renewable and Sustainble Energy reviews,* 70, 117 – 132.

21. Im, K.S. & Pesaran, Y.S. 2003. Testing for unit roots in heterogeneous panels. *Journal of Econometrics,* 115, 53 -73.

22. Koenker, R. & Bassett Jr, G. 1978. Regression qauntiles. *Econometrica: Journal of Econometric Society,* 33 -50.

23. Koenker, R. 2004. Quantile regression for longitudinal data. *Journal of Multivariate Analysis,* 91(1), 74 -89.

24. Jalil, A. & Feridun,M. 2011. The impact of growth, energy and financial development on the environment in China: a cointegration analysis. *Energy Economics,* 33, 284–291.

25. Javid, M. & Sharif, F. 2016. Environmental Kuznets curve and financial development in Pakistan. *Renewable and Sustainable Energy Review,* 54, 406–414.

26. Jiang, L., Zhou, H.-F., Bai, L., & Zhou, P. 2017. Does foreign direct investment drive environmental degradation in China? An empirical study based on air quality index from a spatial perspective. *Journal of Cleaner Production,* 1 – 9.

27. Jiang, H. & Vitenu-Sackey, P. A. (2019). The impact of renewable energy consumption and FDI on carbon emission: An empirical analysis for 15 African countries using panel cointegration regression model. *International Journal of Management Sciences and Business Research*, 8(7), 14-22.

28. Lamarche, C. 2011. Measuring the incentives to learn in Colombia using new quantile regression approaches. *Journal of Development Economics,* 96, 2427 – 2434.

29. Lau, L.S., Choong, C.K., & Eng, Y.K. 2014. Investigation of the environmental Kuznets curve for carbon emissions in Malaysia: do foreign direct investment and trade matter? *Energy Policy,* 68, 490–497.

30. Levin, A., Lin, C.F., & Chu, J. 2002. Unit root tests in panel data: asymptotic and finite sample properties. *Journal of Econometrics,* 108, 1 -24.

31. Lin, B. & Jia, Z. 2017. The impact of emission trading scheme (ETS) and the choice of coverage industry in ETS: A case in China. *Applied Energy,* 205, 1512 – 1527.

32. Lingyun H. & Xiaolu Z. 2018. Impact of financial development on trade-embodied carbon dioxide emissions: Evidence from 30 provinces in China. *Journal of Cleaner Production,* 198, 721 – 736.

33. Liu, Y., Hao, Y., & Gao, Y. 2017. The environmental consequences of domestic and foreign investment: evidence from China. *Energy Policy,* 108, 271–280.

34. Liu, Z., Feng, K., Davis, S.J., Guan, D., Chen, B., Hubacek, K., & Yan, J. 2016. Understanding the energy consumption and greenhouse gas emission and the implication for achieving climate change mitigation targets. *Applied Energy,* 184, 737 – 741.

35. Maddala, G.S. & Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and Statistics,* 61, 631 – 652.

36. Muhammed, S., Muhammed, A.N., & David, R. 2018. Environmental degradation in France: The effects of FDI, financial development and energy innovations. *Energy Economics,* 74, 843–857.

37. Narayan, P.K. & Narayan, S. 2010. Carbon dioxide emissions and economic growth: panel data evidence from developing countries. *Energy Policy,* 38, 661–666.

38. Nasir, M.A., Ahmed, F., Ahmed, M., & Wu, J. 2015. Financial and economic stability as 'two sides of a coin': non-crisis regime evidence from the UK based on VECM. *Journal of Financial and Economic Policies,* 7, 327–353.

39. Omri, A., Daly, S., Rault, C., & Chaibi, A. 2015. Financial development, environmental quality, trade and economic growth: what causes what in MENA countries? *Energy Economic,* 48, 242–252.

40. Özokcu, S. & Özdemir, Ö. 2017. Economic growth, energy, and environmental Kuznets curve. *Renewable and Sustainable Energy Review,* 72, 639–647.

41. Ozturk, I. & Acaravci, A. 2013. The long-run and causal analysis of energy, growth, openness and financial development on carbon emissions in Turkey. *Energy Economics,* 36, 262–267.

42. Pesaram, M.H. 2007. A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Economics,* 22, 265 – 312.

43. Raworth, K. 2017. *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist.* Random House Business (ISBN-13: 978-1847941374).

44. Salahuddin, M., Alam, K., Ozturk, I., & Sohag, K. 2018. The effects of electricity consumption, economic growth, financial development and foreign direct investment on CO2 emissions in Kuwait. *Renewable and Sustainable Energy Review,* 81, 2002–2010.

45. Shahbaz, M., Hoang, T.H.Van, Mahalik, M.K., Roubaud, D., 2017a. Energy consumption, financial development and economic growth in India: new evidence from a nonlinear and asymmetric analysis. *Energy Econ*. 63, 199e212. https://doi.org/https://doi.org/10.1016/j.eneco.2017.01.023.

46. Shahbaz, M., Tiwari, A.K., & Nasir, M. 2013c. The effects of financial development, economic growth, coal consumption and trade openness on CO2 emissions in South Africa. *Energy Policy,* 61, 1452–1459.

47. Shahbaz, M., Solarin, S.A., Mahmood, H., Arouri, M., 2013. Does financial development reduce CO2 emissions in Malaysian economy? A time series analysis. *Econ. Modell*. 35, 145e152. https://doi.org/10.1016/j.econmod.2013.06.037.

48. Shahbaz, M., Shahzad, S.J.H., Ahmad, N., & Alam, S. 2016a. Financial development and environmental quality: the way forward. *Energy Policy*, 98, 353–364.

49. Shahbaz, M., Jam, F.A., Bibi, S., & Loganathan, N. 2016b. Multivariate granger causality between CO2 emissions, energy intensity and economic growth in Portugal: evidence from cointegration and causality analysis. *Technology and Economic Development of Economy*, 22, 47–74.

50. Song, M.-L., Zhang,W., & Wang, S.H. 2013. Inflection point of environmental Kuznets curve in Mainland China. *Energy Policy*, 57, 14–20.

51. Tamazian, A. & Rao, B.B. 2010. Do economic, financial and institutional developments matter for environmental degradation? Evidence from transitional economies. *Energy Economics*, 32, 137–145.

52. Tamazian, A., Chousa, J.P., & Vadlamannati, K.C. 2009. Does higher economic and financial development lead to environmental degradation: evidence from BRIC countries. *Energy Policy,* 37, 246–253.

53. Zhang, Y.J. 2011. The impact of financial development on carbon emissions: an empirical analysis in China. *Energy Policy,* 39, 2197–2203.

54. Zhang, S., Liu, X. 2019. The roles of international tourism and renewable energy in environment: New evidence from Asian countries. *Renewable Energy,* 139, 385 – 394.

55. Zhang, C. & Zhou, X. 2016. Does foreign direct investment lead to lower CO2 emissions? Evidence from a regional analysis in China. *Renewable and Sustainable Energy Review,* 58, 943–951.

56. Zhu, H.M., Duan, L.J., Guo, Y.W., & Yu, K.M. (2016). The effects of FDI, economic growth and energy consumption on carbon emissions in ASEAN-5: Evidence from panel quantile regression. *Economic modelling,* 58, 237 – 24.