ISSN (Online): 2367-6957 ISSN (Print): 2367-6361

Izvestiya Journal of Varna University of Economics 2 (2020)

IZVESTIYA
Journal of Varna University of Economics
http://journal.ue-varna.bg

DYNAMIC LINKS BETWEEN FINANCIAL DEVELOPMENT AND CARBON EMISSION IN NIGERIA

Adedayo Emmanuel LONGE[1], Tolulope Oluwatosin BOLAJI[2], Caleb Olugbenga SOYEMI[3], Emmanuel Olajide ADEBAYO[4]

[1] Center for Petroleum, Energy Economics and Law (CPEEL), University of Ibadan, Nigeria. E-mail: longeemmanuel28@gmail.com
[2] Center for Petroleum, Energy Economics and Law (CPEEL), University of Ibadan, Nigeria. E-mail: tholuebj@gmail.com
[3] Department of Economics, Olabisi Onabanjo University, Ago-Iwoye, Nigeria. E-mail: caleb.soyemi@oouagoiwoye.edu.ng
[4] Economics Programme, College of Social and Management Sciences, Bowen University, Iwo, Nigeria. E-mail: emmanuel.adebayo@bowen.edu.ng

JEL M30, M31, M37

Abstract

The study investigates the dynamic link between financial development and carbon emission in Nigeria from 1971 to 2017 using the Vector Error Correction Model (VECM) approach. The study specifically aims at examining the short-run and long-run impact of financial development on carbon emission and examines the causal linkage between financial development and carbon emission in Nigeria. From the findings, it was revealed that financial development had a positive impact in the short-run and negative impact in the long-run on carbon emission in Nigeria, while Gross Domestic Product (GDP) and Energy consumption had a negative impact in the short-run and positive impact in the long-run on carbon emission. The causality test revealed that jointly, financial development, output and energy consumption causes carbon emission, while no direction of causality was found between financial development and carbon emission in Nigeria. The study therefore concludes that financial development is an important determinant of carbon emission and government should work towards increasing investment financial capacity in the economy.

Key words:

CO2, Financial Development, Energy Consumption, GDP, VECM.

Citation: LONGE, A. E, BOLAJI, T. O., SOYEMI, C. O., ADEBAYO, E. O. (2020). Dynamic Links Between Financial Development and Carbon Emission in Nigeria. *Izvestiya Journal of Varna University of Economics*, 64 (2), p. 214 - 229.

1. Introduction

Over some years in the literature, many researchers have made efforts to investigate the linkages that exist between financial development and carbon emission. This attention is due to the pros and cons in the use of fossil fuel as a source of energy in the developed, developing and less developed economies. The links between financial development and carbon emission is widely documented in recent and past literature, such as Ayeche, Barhoumi, and Hammis 2016; Abdoulaye, Diatlo, and Masih 2017; Shahbaz, Adnan Hye, Tiwari, and Leitao 2013; Corazza 2014; Bekhet, Matar, and Yasmin 2016; Omri, Daly, Rault, and Chaibi 2015. However, the possible relationship that exists between financial development and carbon emission is uncertain as a result of divergence discoveries in the literature review.

Corazza (2014); Bekhet, Matar, and Yasmin (2016); Omri, Daly, Rault, and Chaibi (2015); Sadeghieh (2016); Soheilakhoshnevis, and Bahram (2014); Ali, Law, Yusop, and Lee (2015) have all asserted that there is an existence of positive link between financial development and carbon emission. Based on this assertion, the likely justifying instances on how financial development could result in carbon emission are: Firstly, the desire of a firm to increase its finance for business expansion in the face of high competition in the market will attract more energy consumption which leads to rises in carbon emission. Secondly, actions taken by the financial sector to increase direct foreign investment to encourage economic growth will trigger carbon emission. Thirdly, uses of high technology in homes and industries and automobiles can also lead to carbon emission. Lastly, the improvement of the stock market leading to cost minimization and maximization of profit by the listed company with the desire to expand investment promotes energy consumption and possibly increases carbon emission (Ali et al 2015; Sadorsky 2010; Zhang 2011; and Gokmenoglu et al 2015).

On the other hand, Ayeche, Barhoumi, and Hammis (2016); Abdoulaye, Diatlo, and Masih (2017); Shahbaz, Adnan Hye, Tiwari, and Leitao (2013); Dong (2013) Dritsaki and Dritsaki (2014) Shahbz, Tiwari, and Nasir (2013); Maji, Habibullah, and Yusofsaari (2016) all posited that there is no link between financial development and carbon emission. The reasons for their assertions are: firstly, financial sectors seek to improve the quality of the environment by promoting the uses of environmentally-friendly technologies and machines that leads to less carbon emission. Secondly, financial development promotes the use of renewable source of energy equipment which lessens carbon emission. Thirdly, financial development and trade openness sustain technological innovations by increasing spending on energy conservation

which results in energy efficiency and lower carbon emission. Lastly, financial development aids science research on innovation of environmentally-friendly technologies, lower cost of energy and creation of renewable sources of energy which leads to lower carbon emission (Dritsaki, Dritsaki (2014); Coraza (2014); Omri, Daly, Rault, and Chaibi (2015); and Masih (2017).

The econometric approach of empirical studies is frequently based on Auto Regressive Distributed Lag (ARDL) bounds (Abdoulaye Diallo & Masih, 2017; Bekhet, Matar, & Yasmin, 2016; Shahbaz, Adnan Hye, Tiwari, & Leitão, 2013), Co-integration (Bozkurt & Akan, 2014; Omri, Daly, Rault, & Chaibi, 2015; Al-mulali & Che Sab, 2012), Granger Causality Test (Soheilakhoshnevis & Bahram, 2014; Hu, Xie, Fang, & Zhang, 2017), General Linear Model (Ayeche, Barhoumi, & Hammas, 2016), Augmented Dickey-Fuller (Dong 2013; Corazza 2014; Lin, Omoju, & Okonkwo, 2015), Unit Root (Sadeghieh 2016; Shahbaz, Tiwari, and Nasir 2013; Ertugrul, Cetin, Seker, & Dogan, 2016).

However, the recognized studies that were carried out within the framework of Nigeria are Ali, Law, Yusop, and Lee (2015); and Lin, Omoju, and Okonkwo (2015). They both capture the short-run and long-run relationship impact of financial development on carbon emission using Auto-regressive distributed lag (ARDL) in both the sub sector and aggregate sector of Nigerian economy. However, this study differs from the other literature by focusing on the dynamic links that exists between financial developments and carbon emission in the aggregate sector of the Nigerian economy using the VECM Granger causality test.

The rest of the study is divided into four parts. Section two captures the literature review, section three holds the data source and model specification, section four handles the analytical framework, while section five contains the conclusion and recommendations.

2. Literature Review

The theoretical relation of most of the empirical studies on the link between financial development and carbon emission is showed in various theories that argued on the influence of financial development on economic growth. Among the theories are the seminal work of Schumpeter (1911), Goldsmith (1969), McKinnon (1973), and Shaw (1973) and keep on gaining the attention of many researchers in the economic theory literature. On the empirical position, in developed, emerging, and less developed countries, studies such as Corazza (2014) find out that in the developed countries there is an adverse effect of trade openness and Gross Domestic Product (GDP) on carbon emission, while financial development and energy

consumption bring about positive impact on carbon emission; whereas trade openness, GDP, financial development and energy consumption have a positive impact on carbon emission in both emerging and developing countries. Taking a sample of 25 developing countries with the highest rank of global carbon emission, Hu, Xie, Fang, and Zhang (2017) identified a long-run equilibrium relationship among energy consumption, economic growth, commercial services, and carbon emission; they also establish that a positive relationship exists between economic growth and carbon emission. Ertugrul, Cetin, Seker, and Dogan (2016) took a sample of top 10 carbon emitters in developing countries. Their findings indicated that there is co-integration between carbon emissions, real income, quadratic income, energy consumption and trade openness for Thailand, Turkey, India, Brazil, China, Indonesia and Korea. They also establish that environmental pollution is aided by energy consumption in most of the analyzed countries, and trade openness results in carbon emission upsurges in Turkey, India, China and Indonesia. Their results also establish the EKC hypothesis in India, China, Turkey and Korea in the long-run. They confirmed a causal link between carbon emissions, real income, quadratic income, energy consumption and trade openness.

Bekhet, Matar, and Yasmin (2016) in Gulf Cooperation Council (GCC) countries, finds existence of a long-term equilibrium relationship among carbon emission and real GDP per capita, energy consumption, and financial development in all GCC countries except UAE. They noted that the causal link between carbon emission and energy consumption is otherwise as carbon emission causes energy consumption in Saudi Arabia, UAE, and Qatar while bidirectional causality was found from Oman and Kuwait. Abdoulaye Diallo, and Masih (2017) while incorporating carbon emission into financial development model in United Arab Emirates (UAE) submitted that a long-run co-movement exists between GDP, FDI, domestic credit provided by financial sector, domestic total credit to private sector, carbon emissions, and oil rents which implies reduction of carbon emission in the long run.

Taking a sample of 40 European countries, Ayeche, Barhoumi, and Hammas (2016) discovered bidirectional relationship between carbon emissions and economic growth, financial development and economic growth, trade openness and economic growth, trade openness and financial development, and carbon emission and trade openness. So also, they argued that the existence of a significant relationship between financial development and carbon emission in European countries is not valid. They also argue that there is a positive link between carbon emission and economic growth, and carbon emission and trade openness. In Brazil, Russia, India and China (BRIC)

countries, Xu (2014) argued that the relationship between environmental degradation and economic growth is not clear, and further on confirmed the establishment of Environmental Kuznets Curve (EKC) which is influence by income elasticity, economic scale, international trade, market mechanism and environmental regulation.

Omri, Daly, Rault, and Chaibi (2015) used a sample of 12 Middle East and North Africa (MENA) countries to analyse the causal link between carbon emission, financial development, trade, and economic growth in MENA countries. They confirmed a strong bidirectional causality between economic growth and carbon emission and a positive relationship between economic growth and trade openness. There is also unidirectional causality running from financial development to economic growth and from trade openness to carbon emission, and further on confirmed the existence of Environmental Kuznets Curve in MENA countries. In Sub Saharan African countries, Al-mulali, and Che-Sab (2012) discovered a positive shortrun bi-directional relationship between total primary energy consumption and carbon emission, GDP per capita and investment, broad money and carbon emission, broad money and investment, total primary energy consumption and domestic credit to private sector, domestic credit to the private sector and carbon emission, domestic credit to the private sector and investment. So also, there is a one way positive causal relationship from broad money and domestic credit to the private sector to GDP per capita.

In Indonesia, Shahbaz, Adnan Hye, Tiwari, and Leitao (2013) discovered that economic growth influences carbon emission while financial development reduces carbon emission in which there is establishment of an upset U-shape relationship between financial development and carbon emission. Dong (2013) realised that in China, there is a negative sign in the coefficient of financial development measured using bank loans and money supply to GDP. This implies that financial development in China does not lead to environmental pollution. Nasir, and Rehman (2011) discover that in Pakistan, per capita energy consumption and foreign trade contributes to carbon emission in the long run, and none of the variables significantly contributes to carbon emission in the short run. They however, concluded that Environmental Kuznets Curve (EKC) is a long run occurrence while in the short run there is no occurrence of Environmental Kuznets Curve (EKC). Shahbaz, Solarin, Mahmood, and Arouri (2013) also confirmed in the Malaysian economy that economic growth, energy consumption, and foreign direct investment lead to an increase in carbon emission, whereas financial development lessens carbon emission. Boutabba (2013) argued that in India carbon emission reduction policy will not retard economic growth but it can lead to sustainable economic development in the long run.

In Turkey, Bozkurt, and Akan (2014) revealed that energy use exhibits positive impact on economic growth meanwhile, economic growth is adversely affected by carbon emission. Dritsaki and Dritsaki (2014) in Greece discovered that energy consumption and economic growth are the main promoters of carbon emission and there is no relationship between financial development and carbon emission. In the analysis of linkages between financial development and carbon emission in Turkey, Sadeghieh (2016) noted a long-run equilibrium relationship among the carbon emission, gross domestic product, fossil fuel consumption and financial development. There is also a long-run causal relationship running from financial development, carbon emission to economic growth. Shahbaz, Shahzad, Ahmad, and Alam (2016) submitted that carbon emission is caused by financial development in the banking sector.

In South Africa, Shahbaz, Tiwari, and Nasir (2013) confirmed a long-run relationship between economic growth and carbon emission and an inverse relationship between financial development and carbon emission, arguing that an increase in financial development leads to environmental quality and lessened energy pollutants. There is also an existence of Environmental Kuznets Curve (EKC). In Iran, Soheilakhoshnevis, and Bahram (2014) in the same vein confirmed that a causal direction runs from per capita real income, per capita energy consumption, increase in per capita income, financial development and openness to carbon emission.

In the analysis of the dynamic connection between carbon emission, trade openness, energy consumption, economic growth and financial development in Nigeria, Ali, Law, Yusop, and Lee (2015) using the variable of Domestic credit to private sector, carbon emission, fossil fuel consumption, real GDP per-capita, export and import as a ratio of GDP spanning from 1971-2010 noted that in the long-run, carbon emissions, economic growth and energy consumption have significant positive impact on financial development, whereas trade openness sustains a negative impact. However, in the short-run financial development is significantly affected positively by carbon emission. Disagreeing with the above result, Maji, Habibullah, and Yusof-Saari (2016) discovered a negative relationship between financial development and carbon emission. The disagreement that exists among these studies could be the result of objectives, methodology, scope and data used in each study. This study, however, adds to the existing research findings by evaluating the dynamic links between financial development and carbon emission in Nigeria between the year 1971 and 2015 using the Vector Error Correction Method (VECM).

Sulaimon and Abdul-Rahim (2018) investigated the impact of population growth on CO_2 emissions in Nigeria. While their study is recursively based on 3 scenarios

within a time span (1971 to 2010, 1971 to 2005 and 1971 to 2010), they observed that population is not a significant determinant of CO_2 emissions in all three periods in the long-run but economic growth was found to be the only long-run CO_2 emissions significant determinant for the periods.

Jakada, Mahmood, Ahmad, Farouq and Mustapha (2020) examined the asymetric effect of financial development on the quality of environment in Nigeria from 1970 to 2018. They employed the techniques of non-linear ARDL approach. Their study revealed that financial development in Nigeria impedes the quality of the environment.

3. Data Source and Methodology

This study used a secondary data which spans from 1971 to 2017. The data are sourced from World Development Indicators (WDI) (2016). The data used include Carbon emission (Ct) per capita, calculated by dividing Carbon emission by the total population. Energy Used (kg oil equivalent per capita) used to capture energy consumption, Domestic credit to private sector by banks per capita. This was arrived at by multiplying domestic credit to private sector by banks as a percentage of GDP by GDP and divided by the total population. GDP per capita was used as a proxy for economic growth. This study followed the model of Nasir and Rehman (2011) which specified energy consumption and economic growth as a function of GDP. The model in its estimable form is presented below as;

$$C_t = f(E_{t,}\, Y_t) \tag{1}$$

Where C_t is carbon emission, $E_{t,}$ is energy consumption, and Y_t is output per capita.

The model was extended by Shahbaz et al (2016) by incorporating financial development into the model, considering it as an important determinant of carbon emission. This we replicate for Nigeria. The model is stated as;

$$C_t = f(F_t\, E_{t,}\, Y_t) \tag{2}$$

C_t, explained as carbon emission, $E_{t,}$ - energy consumption, $Y_t -$ is output per capita, and F_t as financial development.

We assess all variables in logarithmic transformations. To validate the existence of long-run cointegration relationship among the variables, we used the Johansen system equation. This is because it is permitted for variables that are cointegrated at order of integration one [i.e I(1)]. Also, to estimate the long-run and short-run dynamic effect of financial development on carbon emission, we used the Vector Error Correction model to estimate the parameters. The major merit lies in the fact

that it is justifiable for variables that are cointegrated after their stationary is being confirmed at I(1). The VECM model is specified below as;

$$\Delta InCO_{2t} = \delta_0 + \sum_{i=1}^{\rho} \theta_i \Delta In(CO_{2t-i}) + \sum_{j=0}^{\rho} \beta_{1j} \Delta In(F_{t-j}) + \sum_{j=0}^{\rho} \beta_{2j} \Delta In(E_{t-j}) + \sum_{j=0}^{\rho} \beta_{3j} \Delta In(Y_{t-j}) + \gamma ECT_{t-1} + \mu_t \quad (3)$$

To capture the dynamic causal link between the variables, we used the VECM Granger causality model. The VECM Granger causality permits variables to be endogenised in a vector. The VECM Granger causality model is specified as;

$$\Delta X_t = \mu_t + \sum_{i=1}^{\rho-1} \Gamma_i \Delta X_{t-1} + \Pi X_{t-\rho} + \varepsilon_t \quad (4)$$

X_{it} is a 4x1 vector matrix of the endogenous variables (C, F, E, and Y). C is carbon emission, F is financial development, E is energy consumption, and Y is gross domestic product. $\Gamma_i \Delta X_{t-1} + \Pi X_{t-\rho}$ is a vector of country specific effects with a lag operator and ϵ_t is a vector of idiosyncratic errors.

4. Analytical Framework

The study first subject the data used to some pre-estimation tests which include Correlation test to avoid multicollinearity problem, descriptive statistics to explain the behaviour of the key variables over the years.

The multicollinearity test revealed that there is a weak negative correlation between financial development (F), energy consumption (E) and gross domestic product (GDP). This implies that the variables are good enough to be included in the model and there is no multicollinearity problem. The result is presented below in Table 1

Table 1

Correlation Matrix Test

Variables	***InE***	***InF***	***InE***	***InY***
InC	1	-0.37693	-0.25563	-0.40822
InF	-0.37693	1	0.916574	0.992063
InE	-0.25563	0.916574	1	0.896882
InGDP	-0.40822	0.992063	0.896882	1

Source: *Authors' Computation (2017).*

The average mean of the result revealed that the trend of carbon emission over the years had been negative on an average of 7.38%. This implies that on an average carbon emission falls by 7.38% between 1971 and 2017. The average mean of financial development and energy consumption ranges between 6.93% and 6.54% respectively. This implies that financial development and energy consumption increased on an average of 6.93% and 6.54% between 1971 and 2017. Gross domestic product also increased on an average of 9.02%. This implies that output in Nigeria over the years grows on an average of 9.02% between 1971 and 2017. The spread of the variables as revealed by the skewness result revealed that carbon emission between 1971 and 2017 has a long tail to the left (i.e. negatively skewed), while financial development and gross domestic product have a long tail to the right (i.e. positively skewed). The Jaque-Bera test revealed that the distribution of the variables is normal over the years under study since they have a probability value greater than 10%.

Table 2

Descriptive Statistics

	InE	***InF***	***InE***	***InY***
Mean	-7.37714	6.9332	6.543063	9.022599
Median	-7.31684	6.753806	6.542152	8.847963
Maximum	-6.89779	11.2211	6.682488	13.17176
Minimum	-8.08543	2.278469	6.361469	5.198976
Std. Dev.	0.30407	2.853261	0.079838	2.624536
Skewness	-0.67574	0.062108	-0.46609	0.141417
Kurtosis	2.60221	1.704452	2.742008	1.584009
Jarque-Bera	3.721334	3.176016	1.754114	3.909424
Probability	0.155569	0.204332	0.416005	0.141605
Sum	-331.971	311.994	294.4378	406.017
Sum Sq. Dev.	4.068181	358.2083	0.280463	303.0804
Observations	47	47	47	47

Source: *Authors' Computation (2020).*

The unit root test result in Table 3 revealed that the stationary of all the results are in the same order. The variables are found to be stationary at order of integration one [I(1)]. This implies that the null hypothesis of no presence of unit root is rejected. Therefore, we conclude that there is unit root problem among the variables. As a

result of this, the Johansen Cointegration test was carried out to check if a long-run cointegrating relationship exists.

Table 3

Unit Root Test Result

		Level		First Difference		
Ince		None	trend and intercept	None	trend and intercept	Stationarity
T.stat		-0.08336	-2.5218	-6.94781	-6.77636	
C.V	1%	-2.61858	-4.18091	-2.61985	-4.18648	I(1)
	5%	-1.9485	-3.51552	-1.94869	-3.51809	
	10%	-1.61214	-3.18826	-1.61204	-3.18973	
Prob.V		0.6494	0.3167	0.0000	0.0000	
InF		None	trend and intercept	None	trend and intercept	
T.stat		5.793232	-1.59866	-2.89765	-4.77846	
C.V	1%	-2.61858	-4.18091	-2.61985	-4.18648	
	5%	-1.9485	-3.51552	-1.94869	-3.51809	I(1)
	10%	-1.61214	-3.18826	-1.61204	-3.18973	
Prob.V		1	0.7775	0.0048	0.002	
InE		None	trend and intercept	None	trend and intercept	
T.stat		2.369383	-2.79496	-5.35027	-5.89502	
C.V	1%	-2.61858	-4.18091	-2.61985	-4.18648	I(1)
	5%	-1.9485	-3.51552	-1.94869	-3.51809	
	10%	-1.61214	-3.18826	-1.61204	-3.18973	
Prob.V		0.995	0.2067	0.0000	0.0001	
InY		None	trend and intercept	None	trend and intercept	
T.stat		6.303687	-1.95671	-3.54404	-6.03213	
C.V	1%	-2.61858	-4.18091	-2.61985	-4.18648	I(1)
	5%	-1.9485	-3.51552	-1.94869	-3.51809	
	10%	-1.61214	-3.18826	-1.61204	-3.18973	
Prob.V		1	0.6081	0.0007	0.0001	

Source: *Authors' Computation (2020).*

Since the unit root test turned out to be stationary at first difference, the Johansen Cointegration test was carried out to check if a long run cointegrating relationship exists.

From the Johansen Cointegration test we found that there are at least two cointegrating factors which imply a linear long run cointegrating relationship exist among the variables at 10% level of significance. The result is presented below in Table 4**.**

Table 4

Johansen Cointegration Result

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.1	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.466251	54.50709	44.49359	0.0104
At most 1 *	0.312536	28.13821	27.06695	0.0767
At most 2	0.227058	12.39889	13.42878	0.1388
At most 3	0.03696	1.581723	2.705545	0.2085
Trace test indicates 2 cointegrating eqn(s) at the 0.1 level				
* denotes rejection of the hypothesis at the 0.1 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.1	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.466251	26.36887	25.12408	0.0709
At most 1	0.312536	15.73932	18.89282	0.2404
At most 2	0.227058	10.81717	12.29652	0.1636
At most 3	0.03696	1.581723	2.705545	0.2085
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.1 level				
* denotes rejection of the hypothesis at the 0.1 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Source: *Authors' Computation (2020).*

The long-run result revealed that financial development impacted negatively on carbon emission. This implies that as financial development increases, carbon emission decreases. Energy consumption impacted positively on carbon emission.

This implies that a percentage change in energy consumption results in 12.7% increase in carbon emission. In the same vein, gross domestic product had a positive impact on carbon emission. This implies that as the output of the economy increases by one percent, carbon emission increases by 1.57%. The result is presented below in Table 5.

Table 5

VECM Long-run Estimation

Variables	InC(-1)	InF(-1)	InE(-1)	InY(-1)
CointEq1	1	-1.7535	12.64347	1.565406
S.E		-0.443	-4.3017	-0.43238
T-stat		[-3.95821]	[2.93918]	[3.62041]

Source: *Authors' Computation (2020).*

In the short run, the equation conforms to the a-priori expectation of a negative sign of the error correction term value. The result showed that divergence of carbon emission from the expected equilibrium in the short-run is corrected by 10.2% back to equilibrium in the long-run. The result is presented below in Table 6**.**

Table 6

VECM Short-run Result

Error Correction:	D(InC)	D(InF)	D(InE)	D(InY)
CointEq1	-0.10244	0.147054	-0.00815	-0.06585
	-0.05319	-0.04923	-0.0057	-0.04792
	[-1.92578]	[2.98731]	[-1.42826]	[-1.37401]

Source: *Authors' Computation (2020).*

Vector Error Correction Model (VECM) Granger causality test revealed that there is no direction of causality between financial development and carbon emission. A unidirectional causality runs from energy consumption to carbon emission. This implies that energy consumption causes carbon emission. The result also reveals no direction of causality between GDP and carbon emission. But, overall, all the variables Granger causes carbon emission. The implication of this is that all the variables jointly cause carbon emission. The result is presented below in Table 7**.**

4.1. VECM Granger Causality Test Result

Table 7

Dependent variable: D(InC)

Excluded	Chi-sq	df	Prob.
D(InF)	1.005782	1	0.3159
D(InE)	5.844818	1	0.0156
D(InY)	1.786586	1	0.1813
All	8.141504	3	0.0432

Source: *Authors' Computation (2020).*

4.2. Discussion of Findings

The study result confirms that at the early stage of finances in the Nigerian environment, there are tendencies that the environment is affected negatively due to the financial capacity of investors below what is required for a sustainable environment. As financial development remains low, economic activities and the energy consumption does not increase emission in the environment. However, in the long run where the economy experiences some development in its finances, emission is reduced, but its economic activities and the energy consumed increase emission in the environment. This can be traced to the deficient development experienced in the energy sector of the economy and slow growth in the level of the country's economic activities. Many businesses and households see fossil fuel as the cheapest alternative energy means to consider, therefore contributing to the degradation of the environment through their emissions.

5. Conclusion and Recommendations

The study analysed the dynamic effect of financial development on carbon emission in Nigeria using Vector Error Correction Model (VECM). The data used spans between 1971 and 2017. From the results, a long run cointegrating relationship was found between financial development and carbon emission in Nigeria. The VECM result showed that in the short-run about 10.1 percent of divergence of carbon emission in the long-run as result of an increase in financial development is corrected. Also, in the short-run, financial development impacted positively on carbon emission, while output and energy consumption had a negative impact on carbon emission. In the long run, it was revealed that financial development had a negative impact on

carbon emission in Nigeria, while energy consumption and GDP impacted positively on carbon emission. This implies that in the long-run increase in financial development reduces the amount of emission, while GDP and energy consumption increase emission. The findings are in consonance with the a-priori expectation of Shahbaz et al (2013) that the relationship between financial development and carbon emission is U-shaped in the long-run, while increase in output induces more energy consumption which increases carbon emission in the economy. The causality result on the other hand also revealed that there is no direction of causality between financial development - output and carbon emission in Nigeria, but a unidirectional causality runs from energy consumption to carbon emission. However, considering all the variables together, the result revealed the existence of a causal relationship running from the variables to carbon emission. This implies that financial development solely does not imply carbon emission, but explains carbon emission through other variables such as energy consumption and GDP, because it is an investment decision which improves the production capacity and energy demand. We therefore concluded that financial development is an important factor that should be included in the model of determining the factors that contribute to emission in Nigerian economy. From the findings, we recommended that to achieve a sustainable environment, there is the need to increase access to credit by the private sector which will influence their consideration for environmentally-friendly energy resources.

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