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Financial development and CO₂ discharge in Nigeria

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Abstract: This study examined the effect of financial development, fossil energy use, economic progress, and FDI on environmental pollution in Nigeria from 1981 – 2014 using the ARDL technique. The outcome of the bond test reveals the presence of a long-run association on the variables of the model. The short-run estimate shows that all the variables positively influence CO₂. The result of the long-run analysis further indicates that financial progress, fossil fuel, and GDP accelerates the level of CO₂ discharge. However, FDI does not explain environmental pollution in Nigeria. Hence, the study suggests that government and policymakers should formulate policies to improve financial development designed to mitigate CO₂ discharge by giving directives to financial institutions that all credits allocation should be toward the purchase of low emission technologies and domestic appliances. In addition, environmentalists should enlighten citizens on the danger of environmental pollution and ways to reduce it through public lectures and seminars.

Keywords: Financial development; CO₂ discharge; GDP; ARDL; Nigeria.

JEL codes: Q52; Q54

1. Introduction

The deteriorating condition of the global climate and high-temperature levels due to the excessive discharge of CO₂ has become an issue of concern. It is documented that the level of CO₂ has reached 36.7 billion metric tonnes and is increasing by almost 2 percent annually (IEA, 2016). This has translated to the increased temperature to a tune of more than 3^o C within a decade that affects the world ecosystem (IPCC, 2018; Tiwari, 2011). Accordingly, other problems such as rising sea level, drought, diseases outbreak have certainly decelerated the level of economic development and growth performance (Asongu, 2018). Various scholars, stakeholders, and international organizations have argued that the increasing trend in CO₂ has been attributed to the increase in the factors like financial resources, economic performance, population growth, urbanization, energy use, and production (Islam, Shahbaz, Ahmed, & Mahmudul Alam, 2013; Salahuddin & Gow, 2016; Sehwat & Giri, 2015). Theoretically, it is revealed that financial development increases the level of CO₂ discharge. Sehwat, Giri, and Mohapatra (2015) Sehwat and Giri (2015) stressed that an increase in credit allocation subject people to domestic appliances and technologies that discharge high CO₂ and thereby deteriorate environmental quality. Similarly, the influence of the availability of finance may facilitate access to a fund that led to the purchase of industrial machines that produce huge emissions (Tamazian & Rao 2010).

In Nigeria, the trend of CO₂ emission is becoming worrisome as the level of the emission discharge increasing almost by 0.2 percent annually. For instance, in 2000, the nation recorded 25,000 kt of CO₂ discharge, and in 2014, 30,000 kt was estimated. Hence, this indicates an increase in the level of CO₂ discharge (WDI, 2017). In another dimension, the banking sector has dominated almost all economic activities in Nigeria, with an increasing number of banks and other financial institutions. It is estimated

that about 500 additional banks branches were opened in both rural and urban areas (Mlachila et al., 2016). Thus, credit allocation to the citizens has been on an increasing trend. For example, the amount of credit allocated to the public was estimated to reach 186 billion dollars in 2000, while in 2014, the amount was increased to 197 billion dollars in Nigeria, indicating a nearly 40 percent rise in a decade (Mlachila et al., 2016). In line with the above situation, credit allocation may be linked with the increased level of CO₂ discharge in Nigeria. It is essential to emphasize that financial progress deteriorates environmental quality through the domestic purchase of high emission technologies and appliances. Based on this view, it is important to note that most studies on environmental pollution are concentrated in an industrial and developed nation; very few are done in Africa, particularly Nigeria. The study also measures the effect of domestic credit provided by both public and private financial institutions which have not been taken care of by earlier studies. Therefore, this study examines the effect of financial progress on the level of CO₂ discharge in Nigeria.

2. Literature Review

In recent times, several studies from the economic literature have been conducted concerning financial sector performance, energy utilization, FDI, output growth, and CO₂ discharge; however, contradicting outcomes were observed. For instance, Salahuddin et al. (2015) use data for the GCC economies to explore the link between financial progress and CO₂ using the FMOLS approach. They reveal that financial sector performance mitigates CO₂ explosions. Abid (2016) utilizes the GMM approach from 1996 to 2010 to investigate the association of financial progress on CO₂ discharge for 25 SSA economies. The outcome shows that the financial sector condenses CO₂. Dogan and Seker (2016) reveal that financial performance in industrializing and emerging nations reduces the capacity of CO₂ explosion. However, Abbasi and Riaz (2016) used the VECM approach to analyze the performance of financial and economic progress on CO₂ explosion in developing nations from 1971 to 2011. The outcome illustrates that financial and economic performance greatly influence CO₂ discharge positively. Asumadu-Sarkodie and Owusu (2016) applied the ARDL method to estimate the linkage among financial performance, energy, industrial value, and population on CO₂ in Sri Lanka from 1971 to 2012. The estimate reveals that financial performance upsurges CO₂ discharge. Similarly, Charfeddine and Khediri (2016) stressed that financial progress has a positive link to the CO₂ explosion in UAE. Saidi and Mbarek (2017) documented that in 19 emerging nations, financial development decreases the level of CO₂ explosion. Paramati et al. (2017) used the FMOLS approach to find the influence of financial progress and energy utilization on CO₂ discharge for G-20 economies. They reveal that financial performance and energy negatively influence CO₂.

Nevertheless, Bekhet et al. (2017) utilize the approach of ARDL to investigate the influence of financial performance, GDP and energy utilization on CO₂ in GCC economies. They find that financial performance accelerates CO₂ discharge. Pata (2018) analyze the performance of financial resources, industrial value, and energy use on CO₂ in Turkey from 1974 to 2014. The outcome reveals that financial resources increased the capacity of CO₂ explosion. Similarly, Ahmad et al. (2018) employ the nonlinear ARDL method to estimate the influence of financial progress and industrial performance in China from 1980 to 2014. They illustrate that financial progress and industrial performance have a positive connection with CO₂. Khoshnevis Yazdi and Ghorchi Beygi (2018), in their outcome by PMG estimates, reveal that financial development accelerates the capacity of CO₂ discharge in 25 African economies from 1985 to 2015. Wang et al. (2018) conclude that utilization of energy in 170 nations upsurges the capacity of CO₂ release. In addition, Yahaya, Adamu, and Mustapha (2020) stressed that financial progress declines the capacity of CO₂ discharge in Nigeria. However, Sehwat et al. (2015) in their analysis for India, emphasized that the growth of CO₂ discharge was connected to financial performance. Charfeddine and Kahia (2019) argued that in the event of financial sector enhancement discharge of CO₂ tends to increase. Abokyi et al. (2019) estimate the influence of financial performance and energy on CO₂ in Ghana. The outcome shows that financial performance and the utilization of energy upsurge CO₂. Ehigiamusoe and Lean (2019) used 122 nations to analyze the performance of

financial progress, energy resources, and GDP on CO₂ release. They find that all these indicators have a positive linkage with the release of CO₂.

Nonetheless, Al-mulali and Ozturk (2015) used multiple-country estimation to explore the effectiveness of energy utilization on CO₂ for MENA economies. It is revealed that energy use accelerates CO₂ explosion. Rafindadi (2016) reveals that energy utilization in Nigeria upsurges the level of CO₂ explosion. He estimates the analysis with the ARDL technique from 1971 to 2011. Magazzino (2016) explore the VAR technique to estimate the link among energy use, industrial performance, and CO₂ in Middle East nations from 1971 to 2006. The estimate illustrates that energy utilization upsurge the capacity of CO₂. Similarly, Gökmenoğlu and Taspınar (2016) analyze the performance of energy resources, industrial value, and FDI on CO₂ discharge in Turkey from 1974 to 2016. The outcome reveals that energy resources positively influence CO₂ discharge. Chen et al. (2016) apply the VECM technique to investigate the influence of energy performance and economic progress on CO₂ for 188 nations. They reveal that energy performance increases the explosion of CO₂ in developing economies. The study by Bekhet et al. (2017) stressed that energy utilization strongly influences CO₂ explosion in GCC nations from 1980 to 2011. Shahzad et al. (2017) examine the linkage among energy use, trade, financial performance, and CO₂ in Pakistan by applying the ARDL method from 1971 to 2011. The estimate shows that the use of energy accelerates the explosion of CO₂. Mirzaei and Bekri (2017) emphasize that energy utilization influences CO₂ discharge positively in Iran. Hence, they predict about 4.3 percent annual acceleration of the CO₂ explosion.

Meanwhile, Salahuddin et al. (2018) studied the influence of electricity use, FDI, and financial progress on CO₂ in Kuwait from 1980 to 2013. The analysis reveals that electricity utilization upsurges CO₂ discharge. Pata (2018b) investigates coal energy utilization on CO₂ discharge in Turkey from 1971 to 2014. The outcome indicates that the growth of coal consumption accelerates the release of CO₂. Cetin et al. (2018) analyze the influence of energy use, industrial performance, trade, and financial resources on the CO₂ explosion in Turkey from 1960 to 2013. The estimates illustrate that energy use promotes the explosion of CO₂. In a similar vein, Charfeddine and Kahia (2019) utilize the PVAR technique to estimate the effect of energy use, industrial growth, and financial progress on CO₂ discharge in 24 nations from 1980 to 2015. They find that energy utilization and financial performance positively influence CO₂ discharge. Khan et al. (2019) examine the energy use performance on CO₂ explosion in Pakistan from 1971 to 2016 using the ARDL approach. The estimated outcome indicates that energy resources upsurge the capacity of CO₂ discharge. Yahaya, Razani, and Raji (2019) explain that energy use aggravates the explosion of CO₂ in Nigeria. In another dimension, Nguyen and Kakinaka (2019) used an estimate of 107 nations to investigate the influence of energy utilization on the release of CO₂. The outcome reveals energy utilization decreases the explosion of CO₂.

Moreover, Heidari et al. (2015) analyze the influence of output growth performance on CO₂ discharge for five ASEAN nations; they reveal that growth performance increases the level of CO₂ explosion. Wang et al. (2016) investigate the influence of GDP growth and utilization of energy on CO₂ in China from 1990 to 2012. The result reveals that economic performance increases the volume of CO₂ explosion. Abdouli and Hammami (2017) used the GMM method to examine the performance of GDP on CO₂ from 1990 to 2010 for MENA countries. The finding shows output growth accelerates CO₂ explosion. Mirza and Kanwal (2017) studied the association between economic progress and energy on CO₂ in Pakistan. The estimated outcome illustrates that economic progress influences CO₂ discharge positively. Similarly, Riti et al. (2017) used the DOLS approach to estimate the link between economic performance and CO₂ explosion in China from 1970 to 2015. The estimate confirms that economic performance accelerates the capacity of CO₂ discharge. Thus, other studies do not found a similar outcome; rather, they find the negative link between output growth and CO₂ explosion (Acheampong, 2018; Dogan & Seker, 2016). Nevertheless, Zakarya et al. (2015) documented that FDI accelerates the capacity of CO₂ explosion in BRICS economies. Similarly, Shao (2018) emphasized that in 188 nations, FDI increases CO₂ discharge.

The literature reviewed indicates that connections among financial performance, energy utilization, GDP, and FDI have been established in the economic literature. However, very few studies

are done on financial sector performance and CO₂ discharge in the African nations, particularly in Nigeria (Abid 2016). In addition, the use of credit allocation to citizens from both public and private financial institutions on environmental quality has been neglected by the earlier studies. Hence, this study investigates the effect of credit allocation on CO₂ discharge in Nigeria.

3. Data and Methods

3.1 Data

Data for CO₂ discharge (kt), financial development (credit percentage of growth performance), energy utilization (kg of oil equivalent), GDP (per capita current USD), and FDI (percentage of growth net inflow) was retrieved annually from world development indicators (WDI) for the period 1981 to 2014. The variables were translated to their log term for uniformity in the interpretation. The nature of the data descriptions is illustrated in table 1. It reveals that energy utilization obtained a higher mean variation of 19.6 and a 1.65 value of standard deviation than other variables. However, a lower mean variation value of 0.95 is linked to FDI and 0.37 value of SD for CO₂ discharge and growth performance.

Table 1. Nature of the data description

Variables	Min	Max	Mean	SD
LCO2	10.4	11.5	11.0	0.37
LFD	2.16	3.64	2.65	0.32
LEC	15.8	22.8	19.6	1.65
LGDP	2.18	2.38	2.73	0.37
LFDI	0.02	3.50	0.95	0.60

Source: WDI, 2017

3.1.1 Stationarity tests

To detect the stationarity of data on variables and order of integration in an econometric model is essential for efficient estimation. In this regard, the Augmented Dickey-Fuller (ADF) test is utilized for this purpose. ADF test is presented in equation 1.

$$\Delta T_t = \alpha + \theta_{yt-1} + \lambda L + \sum_{j=1}^k \sigma_j \Delta T_{t-j-1} + \varepsilon_t \quad (1)$$

From equation (1), T indicates the trend of period t , the coefficient is represented by α , k signifies the lags, and the error term is denoted by ε_t . In the same vein, Philips Peron (PP) test was further used to reconfirm the outcome of the ADF test, as is illustrated in equation 2.

$$\sigma^2 = L^{-1} \sum_1^T \bar{e}_r^2 + 2L^{-1} \sum_{t=1}^l S(t, l) \sum_{r=t+1}^l \bar{e}_t \bar{e}_{t-1} \quad (2)$$

In equation 2 $S(t, l) = 1[t/(1+l)]$ and l denotes the lags

3.2 Specification of the analytical model

Farhani and Shahbaz (2014) used a transformed model to investigate the influence of financial progress on CO₂ discharge, and it is illustrated in the following equation.

$$\text{CO}_2 = f(\text{FD}, \text{EC}, \text{GDP}, \text{FDI}) \quad (3)$$

From Equation 3, CO₂, FD, EC, GDP, and FDI represent CO₂ discharge, financial progress, energy use, growth performance, and foreign direct investment. Hence, based on the stationarity level of the variables and the order of integration obtained, the ARDL technique is the best to use for this estimation (Pesaran et al. 2001). Equation 3 illustrates the ARDL model

$$\begin{aligned} \Delta LCO_{2t} = & \beta_0 + \sum_{j=1}^n \beta_1 \Delta LCO_{2t-j} + \sum_{j=0}^n \beta_2 \Delta LFD_{t-j} + \sum_{j=0}^n \beta_3 \Delta LEC_{t-j} + \sum_{j=0}^n \beta_4 \Delta LGDP_{t-j} \\ & + \sum_{j=0}^n \beta_5 \Delta LFDI_{t-j} + \alpha_1 LCO_{2t-1} + \alpha_2 LFD_{t-1} + \alpha_3 LEC_{t-1} + \alpha_4 LGDP_{t-1} \\ & + \alpha_5 LFDI_{t-1} + \varepsilon_t \end{aligned} \quad (4)$$

In Equation 4 the first difference operator is denoted by Δ , the time is indicated by t , and ε is the error term. It is stressed that from the short-run perspective obtaining the significant negative value of ECT means that the speed of adjustment for the variables moves towards the long run. In addition, the confirmation of the presence of cointegration among the variables in the model is done when the F-statistics value is greater than the bound test critical value.

4. Results and Discussion

For a meaningful econometric estimation, there need to check the stationarity level. Table 2 shows that all variables in the model obtained the first difference stationarity level from both ADF and PP tests. Thus, the outcome of the stationarity tests and the model estimation are presented in this part.

Table 2. Stationarity tests

Variable	ADF		PP		ADF		PP	
	LEVEL		LEVEL		First Diff		First Diff	
LCO ₂	-1.13531	(0.6898)	-1.16326	(0.6782)	-5.55675*	(0.0001)	-5.55675*	(0.0001)
LFD	-2.50746	(0.1229)	-2.28378	(0.1829)	-5.01692*	(0.0003)	-7.88251*	(0.0000)
LEC	-2.59713	(0.1037)	-2.64240	(0.0950)	-6.253656*	(0.0000)	-6.68993*	(0.0000)
LGDP	0.42907	(0.9813)	0.41068	(0.9804)	-5.30242*	(0.0001)	-5.29666*	(0.0001)
LFDI	-3.08158	(0.0378)	-3.08158	(0.0378)	-9.23807*	(0.0000)	-9.75089*	(0.0000)

Notes: * denotes statistical significance at one percent level.

The outcome of the cointegration test and is illustrated in table 3. It confirms cointegration among the variables as the value of F-statistics is higher than a bound critical value.

Table 3. Bound test outcome

	1%		5%	
F-statistics	I(0)	I(1)	I(0)	I(1)
11.0	3.41	5.06	2.86	4.01

Table 4 illustrates the outcome of the estimated model. It reveals a positive link among financial sector performance, energy utilization, output growth, FDI, and CO₂ discharge in the short run. It implies that these factors positively accelerate the explosion of CO₂ in Nigeria. It is revealed from the estimate that a one percent upsurge in financial performance results in a 0.97 percent rise in CO₂. The estimates also illustrate that a percent increase in energy utilization, growth performance, and FDI lead to a 0.09, 3.13, and 0.22 upsurge in CO₂ discharge.

Nevertheless, the significant negative value of the ECT shows the variables are adjusted to long-run form. Moreover, the outcome from the long-run analysis reveals that financial progress has a positive association with CO₂ discharge. This further elaborates that a percent increase in credit allocation leads to a 0.79 percent rise in CO₂ explosion. This situation may not be a surprise incident like the recent financial restructuring by the government in Nigeria has mandate financial institutions to give out more credit to the public in both urban and rural areas that cause more use of electrical appliances and industrial machines that emit a high level of emission (WDI, 2017).

Hence, the implication of the finding indicates that a 0.79 percent increase in CO₂ discharge is due to the allocation of more credit to the public that might be severe and leads to high temperature,

diseases outbreak and consequently deteriorate environmental quality. Therefore, the government should design appropriate and strict policies on credit allocation. For instance, the government should mandate the financial institutions give credits toward low emission discharge technologies. The outcome is in line with the finding of earlier studies (Sehrawat, Giri, & Mohapatra 2015). The table also reveals that a one percent upsurge in energy use causes CO₂ explosion to increase by 0.13 percent. This means that energy utilization in the nation has accelerated the capacity of pollution to 0.13 percent, which dents to environmental quality.

Similarly, a one percent increase in output growth leads to a 0.43 percent rise in CO₂ explosion. This outcome further justifies the theoretical affiliation on output growth performance and deteriorating environmental quality. However, in the long run, FDI does not influence CO₂ discharge in Nigeria. The justification of these outcomes in a similar vein is obtained in the earlier studies (Abdouli & Hammami 2017; Al-mulali & Ozturk 2015).

Table 4. Estimated Short and Long Run outcomes

ARDL estimation	Coefficients	SD Errors	t-Statistics	Prob
Short run estimates				
ΔLFD	0.976915***	0.148448	6.580869	0.0001
ΔLEC	0.092390**	0.030468	3.032334	0.0126
ΔLGDP	3.133195***	0.473563	6.616221	0.0001
ΔLFDI	0.229524**	0.077198	2.973185	0.0140
ECT(-1)	-0.892748*	0.412553	-2.163960	0.0557
Long-run estimates				
LFD	0.798660***	0.186425	4.284076	0.0016
LEC	0.131444***	0.039431	3.333548	0.0076
LGDP	0.432193**	0.137900	3.134103	0.0106
LFDI	-0.105146	0.217579	-0.483254	0.6393
C	5.316160***	1.634249	3.252968	0.0087

Notes: ***, ** and * represents statistically significant at 1, 5, and 10 percent levels

Table 5 indicates the outcome of the post-estimation tests. It indicates that the model was efficient and can be reliable for policymaking as there are no econometric problems such as heteroscedasticity, serial correlation, and the non-normality in the error term distribution.

Table 5. Post Estimation Outcomes

Test Type	F-statistics	Probability	Result
Breusch-Pagan Test.	0.369897	0.9702	NoHeteroskedasticity
Breusch-Godfrey Test	6.001145	0.1025	No Serial Correlation
Jarque-Bera	1.180607	0.5541	Normally Distributed

5. Conclusions

The study investigates the influence of credit allocation on the CO₂ explosion in Nigeria from 1981 to 2014 using the ARDL estimation technique. The outcome from the cointegration test reveals that the presence of long-run among the variables is established. The findings from the short-run estimates reveal that financial progress, energy utilization, output growth, and FDI positively affect the CO₂ discharge in Nigeria. In addition, the result of the long-run analysis shows that financial development, energy use, and GDP accelerate the level of CO₂ discharge. Meanwhile, FDI does not influence the CO₂ explosion in Nigeria. In this regard, several studies have been conducted on the issue of financial progress and quality of the environment; however, very few studies are done in Africa, especially Nigeria. In addition, the effect of credit allocation in this context has been left uninvestigated. Hence, this study contributes to the existing literature by investigating the influence of credit allocation on CO₂ discharge in Nigeria. Therefore, policymakers should make policies to improve the performance

of credit allocation and mitigate the level of CO₂ discharge. This could be through mandating financial institutions to give out credits for low emission technologies that help to achieve environmental quality. The inability of the present study to incorporate other determinants of CO₂ discharge such as disaggregate energy use, energy price, and stock market price due to unavailability of data as well as the study focus only on Nigeria, serves as its limitation. Thus, future research should consider other factors that can influence the level of CO₂ and incorporate other nations for concrete policy analysis.

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