# REVISITING THE ENVIRONMENTAL KUZNETS CURVE HYPOTHESIS WITH THE ROLE OF THE SHADOW ECONOMY IN NIGERIA

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## ABSTRACT

Climate change and environmental degradation continue to pose a serious threat to humanity, especially in developing countries. Researchers around the globe are making efforts to analyze the factors responsible for climate change and environmental degradation in order to propose policies that mitigate the problem. These researchers conduct their analyses mostly using the environmental Kuznets curve (EKC) hypothesis that emphasize the role of economic development on the environment. However, very few of the researchers have captured the influence of the shadow economy and financial development in their analyses. Consequently, the purpose of this study is to explore the role of the shadow economy and financial development in analyzing the growth-environment nexus in Nigeria. The paper utilizes annual data from 1991 to 2020 and employs a threshold regression approach. The findings demonstrate that the EKC hypothesis holds true in Nigeria, and the size of the shadow economy has an adverse effect on environmental quality in both the lower and upper regimes. It is also found that financial development has an inverse relationship with environmental degradation, regardless of the level of economic development. This suggests that the financial sector development contribute to environmental improvement. Based on these findings, the paper recommends that policymakers should take a holistic approach to sustainable development, one that considers both economic growth and environmental protection. They should also take steps to reduce the detrimental effects of the informal economy on the environment and promote responsible and sustainable financial practice.

**Keywords:** EKC Hypothesis, Financial Development, Shadow Economy, Threshold Regression

**JEL Classification Codes:** C24, C32, G20, Q57

## 1. INTRODUCTION

The growing global concern over climate change and environmental degradation, driven by the persistent harmful impact of greenhouse gas (GHG) emissions, remains a pressing issue. While numerous researchers have extensively studied the connection between carbon dioxide ($CO_2$) emissions and economic growth, there has been a noticeable gap in comprehensive research that examines the broader macroeconomic factors influencing such emissions. $CO_2$ emissions, a significant component of greenhouse gases, play a crucial role in the escalating issue of global warming and its resulting effects on climate, including increased temperatures and rising sea levels due to thermal expansion of water (Köksal, 2020 & Weimin, 2022). According to the Intergovernmental Panel on Climate Change's sixth assessment report (IPCC, 2019), $CO_2$ is responsible for 76% of greenhouse gases (GHG) emissions in the world, and its release from macroeconomic activities like manufacturing, and energy consumption contributes to the increase in its atmospheric concentration.

International organizations across the globe consistently work towards mitigating the adverse impacts of global warming, exemplified by initiatives like the 1997 Kyoto Protocol, formally known as the United Nations Framework Convention on Climate Change (UNFCCC, 2020).This protocol aimed to address the harmful consequences of global warming by implementing mechanisms like the Green Climate Fund and fostering collaborations such as the European Environment Agency and the Partnerships in Environmental Management for the Seas of East Asia (Halliru et al., 2020). Another significant milestone was the adoption of the Paris Agreement in 2015, which involved substantial commitments to reduce greenhouse gas emissions and implement adaptation strategies, all with the goal of keeping the global average temperature increase below 2°C. To achieve this goal, earnest efforts to adhere to stringent carbon limits of 2°C or lower require robust climate policies that impose significant carbon pricing. This approach would serve as an incentive, compelling the shift towards renewable energy and the decarbonization of the global economy (Ahmed et al., 2021).

The existing body of literature has extensively employed the concept of the Environmental Kuznets Curve (EKC) to elucidate the connectivity between economic development and environmental quality. Grossman and Krueger (1995) are widely acknowledged as trailblazers in establishing a long-term connection between environmental quality and income per capita. The EKC's characteristic inverted U-shape suggests that as an economy initially develops, economic growth tends to exacerbate environmental degradation. However, as economic growth approaches a specific threshold, further increases in economic growth lead to an enhancement of environmental quality (Fang et al., 2020). This threshold could be attributed to the technology effect (Ahmed et al., 2021).

Recent studies have raised concerns regarding the potential environmental impact of the shadow economy, particularly in the context of climate change and pollutant emissions (Dada & Ajide 2021, Dada et al. 2023). In countries like Gambia, Ghana, and Nigeria, it is suggested that the growth of the shadow economy has led to economic activities that extend beyond the boundaries of the official economy, with these activities accounting for up to 70% of employment (Ali et al., 2019). Many businesses operating in the shadow economy tend to disregard environmental regulations and engage in activities that involve significant levels of pollutants, including artisanal mining, auto repairs, brick and tile production, metal fabrication, and leather tanning. These practices are progressively deteriorating the environmental quality in Africa and are having substantial impacts on environmental sustainability (Khan et al., 2021).

This study contributes to the literature as follows: first, we analyzed the EKC hypothesis while accounting for the role of shadow economy. Second, the study focused on Nigeria which is the leading economy in West Africa with large size of shadow economy amidst huge environmental challenge. Third, we employed threshold regression technique to analyze the economic growth-environment nexus. The rest of the paper is structured as follows: section two provide the literature review, section three gives the methodology, section four is the empirical results while section five concluded the paper.

## 2. LITERATURE REVIEW

Numerous researchers around the globe are making efforts to determine the factors responsible for environmental challenges in order to propose policies that can curb this menace. These researchers usually conduct their analyses under the framework of EKC hypothesis, which emphasizes the effect of economic development on the environment. For instance, Cosmas et al. (2019) employed ARDL estimation technique to assess the applicability of the EKC hypothesis in Nigeria. Their results refuted the EKC hypothesis and identified an N-shaped relationship within the Nigerian context. In a study by Koc and Bulus (2020) conducted in South Korea, they examined the validity of the EKC hypothesis, taking into account the influence of renewable energy and trade openness. Employing the ARDL estimation approach, their findings revealed that improvement in per capita GDP and renewable energy consumption led to short-term increases followed by long-term declines in $CO_2$ emissions. However, the connection between per capita GDP and $CO_2$ emissions exhibited an N-shaped pattern.

In the same vein, Bandyopadhyay (2021) and Weimin et al. (2022), assessed the applicability of EKC hypothesis for India and the top 9 globalized nations respectively. Both studies found evidence of N-shaped EKC, meaning that $CO_2$ emissions initially increase with economic growth, but then start to decline at a certain point and increase again. Furthermore, Islam et al. (2023)re-visited the EKC hypothesis within the context of Bangladesh. They focused on the nexus between economic growth and four (4) greenhouse gas emissions. Contrary to the EKC hypothesis, the findings reveal a positive nexus between economic growth and pollutants (specifically $CH_4$ and $CO_2$ emissions) over the examined period. Nonetheless, the EKC pattern holds true for $N_2O$ emissions.

Furthermore, Asogwa et al. (2018) investigated the factors that most effectively account for the differences in renewable energy use and carbon emission intensity in Sub-Saharan Africa. They identified population density as a crucial factor influencing the regeneration of renewable energy. Similarly, Ikhide (2021) explored the impact of both renewable and fossil energy consumption on Nigeria's economic growth. The findings revealed that fossil fuel energy consumption positively contributes to economic growth, whereas renewable energy consumption has a negative effect on economic growth in Nigeria. Agu and Obodoechi (2021) delved into the interplay among CO2 emissions, temperature changes, productivity, and labor supply in Nigeria. Their results indicated that both labor supply and CO2 emissions have significant and positive effects on agricultural output in the country. Additionally, Onyechi and Ejiofor (2021) and Oyedele and Oluwalaiye (2023) separately investigated the impact of energy consumption on CO2 emissions in Sub-Saharan Africa and Nigeria, respectively. Both studies found a positive correlation, demonstrating that energy consumption contributes to an increase in CO2 emissions.

On the other hand, some of the researchers assessed the nexus between informal/shadow economy and environmental challenges. In this regards, Köksal et al. (2020) and Dada and Ajide (2021),assessed the influence of the informal economic activities on environmental quality in Turkey and Nigeria respectively. Both researchers found that the informal economic activities increase environmental damage. Similarly, Baloch, et al. (2022) and Eren et al. (2022)explored the effects of the informal economy on environment in Pakistan and Turkey respectively. Both studies found that the informal economy has detrimental influence on environment. The authors argued that this is because informal businesses often operate without the necessary environmental permits and regulations, and they may also use less efficient technologies and produce more waste than formal businesses. In another similar study.

Other researchers analyzed the influence of financial sector development on environment. For instance, Ali et al. (2019) and Fang et al. (2020),investigated the nexus between financial sector development and carbon emissions in Nigeria and China respectively. Both studies found that financial sector development has incremental effects on carbon emissions. Similarly, Khan and Ozturk (2021) and Xu et al. (2022),assessed the influence of financial sector development on $CO_2$ emissions. Khan and Ozturk (2021)found that financial development has a pollution inhibiting effects in 88 developing nations, while Xu et al. (2022)finding show that the impact of financial development on $CO_2$ emissions is asymmetrical in G7 countries. Additionally, Tao et al. (2023)examined the influence of financial development on $CO_2$ emission intensity in 35 OECD nations using a dynamic panel threshold approach. The authors found that the influence of financial development on $CO_2$ emission intensity is non-linear and depends on the level of information and communication technology (ICT).

Although many studies investigate the relationship between macroeconomic variables and environmental degradation, however, very few of the researchers have captured the role of the shadow economy and financial development in their analyses. In addition, most of the researchers measured environmental degradation using $CO_2$ emission which is limited in measuring the environmental quality. This study used ecological footprint (EFP) as an indicator of environmental quality and exploring the role of the shadow economy and financial development in analyzing the EKC hypothesis in Nigeria.

## 3. METHODOLOGY

### *3.1 Data and Sources*

This study uses annual data from 1990 to 2020 on ecological footprint, GDP per capita, the size of the shadow economy, financial development and urbanization. The data was collected from the Global Footprint Network, the International Monetary Fund, the World Bank's informal economy database, and the World Bank's world development indicators.

### *3.2 Variables Description and Measurement*

The study uses the ecological footprint (EFP) as dependent variable which is a comprehensive measure of environmental quality, instead of relying on $CO_2$ emissions. The ecological footprint accounts for the impact of human activities in terms of land and water required for consumption and waste assimilation. It serves as a proxy for environmental quality, incorporating various factors like crop-land, grazing, fishing, and more. In essence, it quantifies the land and sea area necessary to support a country's consumption, with a higher ecological footprint indicating a greater environmental impact (Warsame et al., 2023).

The independent variables are economic growth measured by GDP per capita (annual growth %), which represent the average production of goods and services per person within a country during a given period. Secondly, financial development index serves as a composite measure evaluating the overall well-being and effectiveness of a country's financial system. It combines various indicators related to financial institutions, markets, and services to provide insight into the degree of financial accessibility, depth, and efficiency within an economy. Thirdly, the size of the shadow economy is quantified by approximating informal output as a percentage of the official GDP. Finally, urbanization is assessed by the percentage of urban population in relation to the total population.

### 3.3 Model Specification and Estimation Technique

Following Usman et al. (2022) and Li et al (2023) with some modification. the formulation of this study's model is articulated as follows:

$$EFP_t = \alpha_0 + \alpha_1 GDP_t + \alpha_2 SE_t + \alpha_3 FD_t + \alpha_4 URB_t + \varepsilon_t \quad (1)$$

Nevertheless, model (1) is designed as a linear model, and linear models may not adequately capture variables with asymmetric structures. Hence, given the belief that there are multiple linear models required for different regime shifts in the economy, a more realistic approach involves using a regime-switching model for predictions. Consequently, model (1) has been decomposed into two regimes, resulting in the threshold regression model (2):

$$EFP_t = \begin{cases} \alpha_0 + \alpha_1 GDP_t + \alpha_2 SE_t + \alpha_3 FD_t + \alpha_4 URB_t + \varepsilon_t \;\; if\; \gamma_t \le \theta \\ \beta_0 + \beta_1 GDP_t + \beta_2 SE_t + \beta_3 FD_t + \beta_4 URB_t + \varepsilon_t \;\; if\; \gamma_t > \theta \end{cases} \quad (2)$$

In model (2), $EFP_t$ represent ecological footprint; $GDP_t, SE_t, FD_t$, and $URB_t$ are GDP per capita, shadow economy, financial development, and urbanization respectively; $\alpha_0$ and $\beta_0$ are the intercepts of the first and second regime respectively; $\alpha_1, \alpha_2, \alpha_3,\; and\; \alpha_4$ are the coefficients of first regime variables; $\beta_1, \beta_2, \beta_3,\; and\; \beta_4$, are the coefficients of the second regime variables; $\varepsilon_t$ shows the error-term; $\gamma_t$ represent the threshold variable (GDP); lastly, $\theta$ is threshold value. Model (2) is also specified in compact form as follows:

$$EFP_t = \begin{matrix} [\alpha_0 + \alpha_1 GDP_t + \alpha_2 SE_t + \alpha_3 FD_t + \alpha_4 URB_t] \quad GDP\; (\gamma_t \le \theta) \\ +[\beta_0 + \beta_1 GDP_t + \beta_2 SE_t + \beta_3 FD_t + \beta_4 URB_t] + \varepsilon_t \;\; GDP\; (\gamma_t > \theta) \end{matrix} \quad (3)$$

To assess the validity of the EKC hypothesis, this study employed GDP as the threshold variable. The specific threshold value (θ) was determined by estimating model (3) and identifying the threshold that minimized the sum of squared errors in a re-ordered threshold variable. Furthermore, the threshold value was established using the Bai-Perron test, which compares L + 1 thresholds sequentially at a 5% level of significance.

Prior to conducting the threshold regression analysis, it is essential to investigate the features of the series, therefore, the analysis begin with some pre-estimation tests on the properties of the data which include descriptive statistics, correlation analysis and unit root test to determine the stationarity status of the series. Nevertheless, evidence from the research has shown that the conventional stationarity tests particularly the ADF test, exhibit lower power when there are structural breaks in the data. This implies that if we rely solely on the traditional unit root tests (such as ADF and PP), there is a significant likelihood of incorrectly accepting the null hypothesis that a unit root is present (Zayyana and Salisu, 2021). Consequently, the Zivot-Andrews (1992), and Perron (1997) unit root tests were carried out and the model is specified in equation (4):

$$y_t = \mu + \delta y_{t-1} + \beta_t + \gamma DU_t(\lambda) + \theta DT_t(\lambda) + \sum_{j=1}^{p} \phi_j \Delta y_{t-j} + \varepsilon_t \quad (4)$$

Similar to Zivot-Andrews unit root test, Perron (1997) also allowed only one single break point for any single series in his Innovational Outlier Model presented in equation (4):

$$y_t = \mu + \delta y_{t-1} + \beta_t + \theta DU_t + \gamma DT_t + \delta DU(T_b)_t + \textstyle\sum_{i=1}^{k} \phi_j \Delta y_{t-i} + \varepsilon_t \quad (6)$$

Here $T_b$ represents the time of break (1> $T_b$> T) which is unknown, DUt = 1 if t > $T_b$ and zero otherwise, DTt = Tt if t > $T_b$ and zero otherwise.

## 4.RESULTS AND DISCUSSION

This section starts by providing the results of descriptive statistics and pairwise correlation analysis, followed by the stationarity tests results. The subsequent part delves into the results of threshold regression, and the section concludes with a comprehensive discussion of the findings.

### *4.1 Descriptive Statistics and Pairwise Correlation matrix*

The results of descriptive statistics and pairwise correlations of the series are presented in table 1. The average (mean) values of ecological footprint (EFP), gross domestic product per capita (GDP), shadow economy (SE), financial development (FD), and urbanization (URB) during the study period are 0.644, 1.651, 51.271, 0.191, and 39.744, respectively. Similarly, the EFP, SE, and FD series exhibit negative skewness, while the GDP and URB series display positive skewness. This suggests that in the case of the EFP, SE, and FD series, there is a relatively greater concentration of data points towards the higher values, whereas in the case of GDP and URB, there is a relatively higher concentration of data points towards the lower values. Furthermore, the kurtosis values demonstrate that all the series except GDP are platykurtic, with a magnitude less than three, indicating relatively flat distributions. For a normal distribution, the Jarque-Bera value affirms that all the series are normally distributed, as the probability values are not statistically significant.

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**Table 1: Descriptive Statistics and Pairwise Correlation Analysis**

| Statistics/Variables | EFP | GDP | SE | FD | URB |
|---|---|---|---|---|---|
| Mean | 0.644 | 1.651 | 51.271 | 0.191 | 39.744 |
| Median | 0.681 | 2.024 | 51.225 | 0.192 | 39.074 |
| Maximum | 0.771 | 12.276 | 54.121 | 0.270 | 51.958 |
| Minimum | 0.466 | -4.507 | 48.167 | 0.121 | 29.680 |
| Std. Dev. | 0.096 | 3.911 | 1.691 | 0.035 | 7.050 |
| Skewness | -0.473 | 0.434 | -0.138 | -0.138 | 0.214 |
| Kurtosis | 1.811 | 3.269 | 1.998 | 2.585 | 1.719 |
| Jarque-Bera | 2.983 | 1.067 | 1.396 | 0.320 | 2.356 |
| Probability | 0.225 | 0.586 | 0.498 | 0.852 | 0.308 |
| Observations | 31 | 31 | 31 | 31 | 31 |
| EFP | 1.000 | | | | |
| GDP | -0.935 | 1.000 | | | |
| | (0.000) | | | | |
| SE | 0.570 | 0.740 | 1.000 | | |
| | (0.001) | (0.000) | | | |
| FD | -0.731 | -0.527 | -0.099 | 1.000 | |

| | | | | | |
|---|---|---|---|---|---|
| | (0.000) | (0.003) | (0.609) | | |
| URB | -0.976 | 0.951 | -0.462 | 0.818 | 1.000 |
| | (0.000) | (0.000) | (0.012) | (0.000) | |

Note: P-Values are in parenthesis ()

The correlation coefficients between the dependent variable (EFP) and all predictor variables reveal a notable negative correlation, except for the size of shadow economy (SE), which exhibits a positive coefficient. This suggests that there is a consistent inverse relationship between the ecological footprint (EFP) and the other three predictors (FD, GDP and URB), signifying that an increase in one predictor tends to coincide with a decrease in the ecological footprint. However, the positive coefficient observed with the size of shadow economy (SE) implies that as this variable increase, the ecological footprint also tends to increase.

### *4.2 Results of Stationarity Tests*

The results of Zivot-Andrews (1992) unit root test as presented in table 2, which identify the presence of structural breaks, demonstrate that all the variables exhibit stationarity at the level of integration [I(0)]. On the other hand, the findings from the Perron (1997) unit root test point out that both EFP and GDP are also stationary at level [I(0)]. As a result, it is reasonable to reject the null hypothesis of a unit root accompanied by a structural break in both intercept and trend across all the series. This leads to the conclusion that the variables maintain stationarity at the integration level, [I(0)].

**Table 2: Results of Unit Root Tests**

| | Zivot-Andrews (1992) | | | | |
|---|---|---|---|---|---|
| | Level | | First Difference | | Status |
| Variables | t-statistic | Break point date | t-statistic | Break point date | |
| EFP | -4.929* | 2004 | -11.962*** | 2007 | I(0) |
| GDP | -5.846*** | 2002 | -6.291*** | 2003 | I(0) |
| FD | -5.868*** | 2007 | -6.480*** | 2009 | I(0) |
| SE | -5.901*** | 2001 | -6.9302*** | 2004 | I(0) |
| URB | -5.006* | 1999 | -15.365*** | 2001 | I(0) |
| | Perron (1997) | | | | |
| EFP | -6.609*** | 2008 | -11.901*** | 2006 | I(0) |
| GDP | -5.647** | 2001 | -10.935*** | 2002 | I(0) |
| FD | -4.575 | 2008 | -6.302*** | 2008 | I(1) |
| SE | -3.756 | 2000 | -6.724*** | 2003 | I(1) |
| URB | -4.899 | 1998 | -15.042*** | 2000 | I(1) |

*Note: The maximum lag used is 4; both intercept and trend are used in the estimations; ***, ** and * indicate statistical significance at 1%, 5% and 10% respectively.*

Since all the variables are stationary at level [I(0)], as indicated by Zivot-Andrews (1992) unit root test that captured structural breaks, cointegration test is not necessary. In essence, long-run model estimation is not required. This is because, any shock to the system in the short run quickly adjust to the long run (Pesaran et al., 2001).Consequently, only the short--run model should be estimated using threshold regression approach and the result is presented in the next section.

### *4.3 Results of Threshold Regression*

Table 3 shows the results of a threshold regression analysis that examines how different regressors are associated with the dependent variable (EFP) in two different economic regimes, based on a threshold value of GDP per capita growth of 6.318%. The results are divided into two regimes: one where GDP growth is below the threshold value and one where GDP growth is above or equal to the threshold value. In the initial regime, when GDP per capita experiences a 1% increase, there is a corresponding 0.017% rise in the level of environmental degradation proxied by the ecological footprint (EFP).

**Table 3: Results of Threshold Regression**

| Dependent Variable: EFP | | | Threshold Variable: GDP | |
|---|---|---|---|---|
| | First regime: GDP <6.318 | | | |
| Regressors | Coefficient | Std. Error | t-Statistic | Prob. |
| GDP | 0.017 | 0.004 | 4.277 | 0.000 |
| SE | 0.075 | 0.011 | 6.884 | 0.000 |
| FD | -2.823 | 0.216 | -13.062 | 0.000 |
| URB | -0.013 | 0.001 | -6.502 | 0.000 |
| | | Second Regime: 6.318≤ GDP | | |
| GDP | -0.007 | 0.00 | -2.629 | 0.014 |
| SE | 0.027 | 0.011 | 2.551 | 0.017 |
| FD | -0.864 | 0.234 | -3.695 | 0.001 |
| URB | -0.011 | 0.001 | -12.867 | 0.000 |
| | | Non-Varying Threshold Regressor | | |
| C | 0.844 | 0.085 | 9.868 | 0.000 |
| $R^2$ | 0.667 | | | |
| Adjusted $R^2$ | 0.630 | | | |
| F-statistic | 18.040 | | | 0.000 |
| D-W. stat | 2.359 | | | |

However, the scenario shifts in the second regime, where a 1% rise in GDP will leads to 0.007% decrease in the EFP. This contrasting effect of GDP on environmental degradation (EFP) in the lower regime and upper regime respectively supports the validity of the EKC hypothesis within the context of Nigeria. The EKC hypothesis proposes that environmental degradation rises in the initial stage of economic growth and falls when a certain threshold has been reached (Grossman & Krueger, 1995). This finding demonstrates how economic growth can initially contribute to environmental degradation but eventually lead to environmental improvement as certain development threshold has been reached.

The findings also show that the coefficient of the shadow economy (SE) possesses a significant and positive effect on environmental degradation in both first and second regimes. Specifically, the influence of the size of shadow economy on environmental degradation is consistently positive and statistically significant across these regimes. An increment of 1% in the size of the shadow economy (SE) is associated with a corresponding increase in environmental degradation. In the first regime, this relationship translates to a 0.017% rise in environmental degradation. This implies that as the shadow economy expands by 1%, there is a concurrent increase of 0.017% in the ecological footprint, signifying a detrimental effect on the environment. In the second regime, characterized by higher GDP levels, a similar 1% increase in the shadow economy leads to a relatively larger 0.027% escalation in environmental degradation. This indicates that as the shadow economy grows, the associated environmental degradation intensifies, contributing to a more substantial 0.027% increase in the ecological footprint.

Conversely, financial development and urbanization exhibit negative effects on environmental degradation (EFP) in both the two regimes. To be specific, a 1% rise in financial development (FD) yields a significant reduction of 2.823% and 0.864% in environmental degradation (EFP) for the respective regimes. This substantial negative effect of FD suggests that its impact is consistent across both regimes, albeit with a stronger effect in the first regime. Likewise, urbanization (URB) sustains its negative effect across both regimes, with a 1% increase resulting in a substantial decrease of 0.013% and 0.011% in environmental degradation (EFP) for the respective regimes.

### *4.4. Discussion of Findings*

The threshold regression result supports the validity of the EKC hypothesis in Nigeria. This means that there is an inverted U-shaped relationship between economic growth and environmental degradation, such that environmental degradation initially rises with economic growth, but eventually falls as economic growth reached certain threshold. The threshold value of GDP per capita (annual growth %) for Nigeria is 6.318. This means that when the GDP per capita growth isbelow6.318 in the lower regime, the economic growth leads to environmental degradation. However, with GDP per capita growth above 6.318 in the upper regime, the economic growth leads to environmental improvement in Nigeria. This finding is consistent with the results of prior studies by Egbetokun*et al.*(2020), Bekun et al. (2020), and Usman (2022), all of whom also affirmed the existence of an inverted U-shaped relationship between economic growth and environmental degradation in Nigeria. Nevertheless, the finding is contrasted the work of Cosmas et al. (2019) who refutes the validity of the EKC and found N-shaped relationship in Nigeria.

The coefficient of the shadow economy (SE) is significantly positive in both the lower and upper regimes. This indicates the detrimental effect of the shadow economy on the environment, regardless of the level of economic development. There are a number of reasons why the shadow economy can have a detrimental influence on the environment. First, businesses in the shadow economy are less likely to comply with environmental regulations. This is because they are not subject to the same enforcement mechanisms as businesses in the formal economy. Second, businesses in the shadow economy are more likely to use environmentally harmful practices. This is because they are not concerned about the environmental effects of their activities. They may also be more likely to use illegal or hazardous materials. Third, the shadow economy can contribute to deforestation and land degradation. This is because businesses in the shadow economy may clear forests to make way for agricultural or industrial development. They may also use unsustainable farming practices that lead to soil erosion and water pollution.

Contrarily, financial development (FD) and urbanization (URB) are found to have negative connection with environmental degradation in both the lower and upper regimes. This means that these variables can help to improve environmental quality, regardless of the level of economic development. There are a number of reasons why financial development and urbanization can have a negative effect on environmental degradation. Financial development can help to channel investment into more sustainable industries. For example, financial institutions can provide loans to businesses that are developing renewable energy technologies or that are adopting more efficient production methods. On the other hands, urbanization can lead to a decrease in the use of natural resources. This is because cities are more efficient in their use of land, water, and energy. Urbanization can also lead to an increase in environmental awareness. This is because people in cities are more exposed to environmental problems and are more likely to demand action to address them.

## 5. CONCLUSION AND POLICY IMPLICATIONS

This paper examines the effect of the shadow economy, financial development, and urbanization on environmental degradation, as well as testing the validity of the EKC hypothesis in Nigeria using threshold regression technique. Based on the empirical findings, the paper concludes that the EKC hypothesis holds true in Nigeria, as the relationship between economic growth and environmental degradation is inverted U-shaped. The size of the shadow economy has an adverse effect on environmental quality in both the lower and upper regimes, suggesting that the shadow economy has a negative effect on the environment regardless of the level of economic development. In addition, both financial development and urbanization have an inverse relationship with environmental degradation, regardless of the level of economic development, indicating that financial development and urbanization contribute to environmental improvements.

Based on these findings, the paper recommends that, Nigerian policymakers should strike a harmonious balance between economic growth and environmental well-being. To achieve this, they should oversee and mitigate the adverse effects of the informal economy on environmental quality by enhancing regulatory measures, promoting the formalization of unregistered economic activities, and raising awareness about the environmental ramifications of informal economic practices. Furthermore, they should encourage responsible and sustainable financial strategies that support environmentally friendly investments, including incentivizing green finance, endorsing renewable energy initiatives, and fostering environmentally-conscious lending and investment practices. Lastly, they should prioritize comprehensive urban planning that underscores green infrastructure, efficient public transportation, effective waste management systems, and the creation of green spaces. This approach can help reduce the ecological footprint linked to urban expansion and enhance the overall state of the environment.

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