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Foreign Capital Flows and Environmental Sustainability in Nigeria

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Abstract

Foreign capital flows have major effects on various aspects of the recipient economy including its environment. While there is a vast literature on the effects of foreign capital flow components such as foreign direct investment (FDI) on the environment, the findings have been generally inconclusive leading to mixed results especially in the Nigerian context. The article adopted the non-linear autoregressive distributed lag methodology to achieve this objective. The authors found that positive and negative fluctuations in foreign capital flows affects the environmental sustainability of Nigeria through its arable landscape. In line with the findings, the article recommended that the Nigerian government should work with public and private stakeholders in the agricultural sector to ensure the utilization of said capital flows for the preservation and restoration of arable landscape in Nigeria.

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INTRODUCTION

The environment is an encompassing term used to describe a range of resources provided by nature. These include ecosystems, cropland, water resources, animal resources and mineral resources. While some of these resources are limited and not replenishable in nature, some of them such as the trees and wildlife can be replenished. Human intervention can aid the replenishment and maintenance of the range of resources covered by the term 'environment'. However, human intervention and activity can also have adverse effects on the environment as with the case of climate change and pollution.

Achike and Onoja (2014) portrayed evidence of human activity leading to environmental damage through greenhouse gas emissions and degradation arising from urbanization, indsutrialization, and overpopulation. In Europe, Pasqui and Giuseppe (2019) noted evidence of human activity on the climate leading to an increasing heat wave intensity in the Mediterranean area. European Economic Area (2021) similarly noted that human activity has affected the environment through agriculture, transport and energy production. Pollution caused by agricultural activities through the use of pesticides have negatively affected bird species and an estimated 80 percent of the 576 species of butterfly biodiversity in Europe. In line with this, Abnett (2021) avered that pollution stemming from environmental related causes led to 630,000 deaths in Europe in 2012.

Ugboma (2015) highlighted human activities damaging the Nigerian environment and climate including oil spillages, gas flares, and bio-diversity damage. The study futher averred that oil spillage is caused by numerous technological and human oversights and they occur very frequently in Nigeria. In comparison with Europe, Oshienemen, Dilanthi, and Haigh (2018) posited that European nations have experienced 10 oil spills in the last 40 years while Nigeria has witnessed 9,343 oil spill incidences within the same period. Oshienemen et. al (2018) also stated that these disasters have affected arable land, water resources and entire biodiversity of oil producing communities in Nigeria. Olagunju (2015) provided evidence of desertification in Nigeria stating that 63.83 percent of Nigeria's land mass is impinged by desertification. Akam, Owolabi, and Nathaniel (2021) further attributed the environmental damage in Nigeria to human activities such as overgrazing, industrial activities, poor financial management, institutional absence, population demographics, and the country's reliance on external financing.

Li, Dong, Huang, and Failler (2019) described the relationship between external financing (through foreign capital flows) and the environment as heterogenous in nature. The study inferred that foreign capital flows have a bi-directional impact on the sustainability of the receipient environment. This in turn implies that foreign capital flows affect the environment in two opposing ways: they lead to the depletion of the environment through the transfer of "dirty" production practices to the host countries, and they transfer cleaner technology to host countries consequently improving the quality of their environment.

Ndubuisi (2020) examined foreign capital flows in a fettered state and found that it can lead to distortions in a country's exports. The European Central Bank (2016) also identified the fluctuations and procyclicality of foreign capital flows further stating that it poses disruptive financial risks to the receipient economy. Mogensen (2011) found evidence of fluctuation in foreign capital flows to Nigeria through the sudden reversal of capital flows to emerging countries during the global financial crisis. Ignatius, Ogbonna, and Anne (2019) similarly opined that foreign capital flows to Nigeria have fluctuated over the last 3 decades owing to a plethora of global and domestic events including the global financial crises of 2008 and the 2011 general elections. More importantly, foreign capital flows was also said to impact the sustainability of the receipeint environment. This paper, therefore examined the effects of fluctuations in foreign capital flows on the environmental sustainability of Nigeria.

International Capital Flows to sub-Saharan Africa

Foreign capital inflows to Sub-Saharan Africa majorly comprises of foreign direct investment, foreign aid and foreign remittance inflows. Calderon, Chuhan-Pole, and Kubota (2019) reflected this composition between the 2000 to 2017 period when foreign direct investment represented a 3.4 percent average of the GDP of sub-saharan African countries. Capital flows in Sub-Saharan Africa follow divergent patterns in comparison with global capital flows. According to Oyekanmi (2021) four external events or shocks reshaped the structure of financing and capital inflows composition in Sub- Saharan Africa between 2008 to 2020. The events are: the global financial crisis of 2008, the 2011/2012 European debt crisis, the 2014 international oil market plunge and the 2020 covid 19 pandemic.

Although the effects of the global financial crisis on sub-sharan African countries were less severe than in advanced countries, the 2008 global financial crisis resulted in a decline in inflows to advanced economies and non-Subsaharan developing economies. The decline in foreign capital inflows became evident in the third quarter of 2008 following a substantial boom in the first half of 2008. The results emanated from the gloomy worldwide growth projections and the reduced risk appetite of investors following the crisis. Global economic growth prospects dropped to 5.5 percent in 2008 with a further forecasted reduction of 1.7 percent in 2009 (Macias & Massa, 2009). Foreign direct investments in the region however continued to grow but at a lower rate. Nonetheless, Brambila-Macias and Massa (2010) stated that the impact of the crisis of foreign direct investment was evident in the abandonment of the takeover of a South African bank by Xstrata, the indefinite deferment of the Iron-one project in Liberia by ArcelorMittal and the postponement of a USD$3.5 billion aluminium smelting investment in Tazania. Countries that were most affected include Nigeria, South Africa, Mauritius, Cote d'Ivoire, and Kenya. With regards equity inflows, the global financial crisis of 2008 also resulted to a reversal in sub-saharan countries. These reversals were consistent with sharp declines in their respective stock markets. The situation remained similar in the first half of 2009 as the Nairobi Stock Exchange All-Share Index dipped by 21.36 percent in Kenya. Similarly, the Nigerian Stock Exchange All Share Index dipped by 30.26 percent (Brambila-Macias & Massa, 2010).

A more recent event that has affected capital inflows in the region is the 2020 covid-19 pandemic. Overall, there was a 12 percent decrease in foreign direct investment inflows to the sub-Saharan African region between 2019 and 2020. Notably, within the region, the impact of the pandemic varied. For instance, in West Africa, there was a slight increase in FDI inflows to Nigeria from USD$2.3 billion to USD$2.4 billion from 2019 to 2020 while there was 52 percent decline in FDI inflows to Ghana from USD$3.9 billion to $1.9 billion within the same period. FDI inflows to Southern Africa was USD$4.3 billion also resulting in a 16 percent decrease with South Africa and Mozambique accounting for majority of the South African region's inflows. However, a few countries registered consistent FDI increase. Central Africa specifically recorded an FDI increase from USD$8.9 billion to USD$9.2 billion between 2019 and 2020. Stringent lockdown and movement restrictions primarily contributed to the fluctuation in inflows during the pandemic

(UNCTAD, 2021).

The patterns of foreign capital inflows display theme of fluctuation in reaction to external events. These surges and contraction in foreign capital inflows have real effects that may be long term on the receipient country. The reviewed literature however omitted the consequences of these fluctuations on achieveing sustainable development goals especially regarding the environment. With regards inflows to sectors that are related to the achievement of the Sustainable Development Goals, the effects of these fluctuations may be dire. For example, White (2021) stated that the covid-19 pandemic led to a considerable fall in Sub-Saharan Africa FDI inflows directed to SDG-related sectors. Greenfield investment projects in food and agriculture decreased by 78 percent while health related inflows declined by 58 percent. These have in turn exarcebated the human capital investment gaps and the natural resource value addition gap. Also, much attention was paid to external global events as a driver of capital inflow fluctuations. However, trade policies in the African region have been found as proponents of foreign capital inflows while defying globall patterns. Evidence of this can be found in the 2019 defiance of global capital flow patterns as foreign direct investment increased by 11 percent following the implementaion of the African Continental Free Trade Area agreement (UNCTAD, 2019).

Resource Footprint as a Measure of Sustainability

Other indicators of environmental sustainability as identified by Ewing, et al. (2012) in terms of the scarcity of global resources provided by the earth inlcude productive land or "land footprint". Land footprint focuses on the connection between final consumption destination and land use. There are however many calculation methods. Land use can be indicated by crop yield as employed in the ecological footprint approach through global hectare measurements. Steen-Olsen, Weinzettel, Cranston, Ercin, and Hertwich (2012) created a land footprint measurement approach for the European Union, Perminova, Sirina, Laratte, Baranovskaya, and Rikhvanov (2016) created a calculation method using material flow analysis and Yu, Feng, and Hubacek (2013) created one that addressed the entire globalized economy. These measures of land footprint calculation among others all have the consideration of the land use effect in common but there is a no existent consensus on the approach due to the fact that land type, intensity and climate characteristics differ among different geographical locations (Yu, Feng, & Hubacek, 2013).

Similarly, studies such as Giljum, Bruckner, and Martinez (2015), Schoer, Weinzettel, Kovanda, Giegrich, and Lauwigi (2012), Buhl, Liedtke, Teubler, and Bienge (2019), and Jiang, et al. (2019) employed material footprints based on the pattern of material extraction and their use in trade and consumption. Consumed resources may range for earth metals to crude oil and biodiversity and can be narrowed down specifically and accounted for. Material footprint is measured in total mass materials without reflecting the scarcity of the material. In line with this, Fang and Heijungs (2014a) proposed to develop a source depletion fooprint that measures the depletion potential of the resource.

While acknowledging that no single indicator can portray the full scenario of the pressures of human activity on the environment, this article adopted a resource indicator that depicts the replenishment capacity of the environment. As such, this article investigated the impact of human activity on the environment using arable land footprint as proxy for environmental sustainability.

METHODOLOGY

Model Specification

To achieve the objective of this study, the relationship between environmental quality (arable land) and foreign capital inflows (foreign direct investment, external debt, and official development assistance) is modelled following the empirical model of Li et al. (2021) and Udemba et al. (2020), among others. Hence, the empirical model for the study is stated as follows:

The model for the study is specified in a double log form as:

$$InALA_t = \beta_0 + \beta_1 InFDI_t + \beta_2 InEXD_t + \beta_3 InODA_t + \beta_4 InTO_t + \mu_t \qquad (4.1)$$

Equation (4.1) is the long run model that examined the relationship between ARA=arable land available, which is the proxy for environmental quality, FDI= foreign direct investment, EXD= external debt, ODA= official development assistance, TO= trade openness, In= natural logarithm, $\beta_0 - \beta_4$ represent the coefficient estimates of the model and μ= the error term, and t represents the value of the variables at different moments in time. The inclusion of trade openness in the model is deemed necessary following the argument given by Ali et al. (2021) that the attainment of trade transaction among countries also involve the depletion of natural resources which have consequential effect of the environmental quality of the trading partners.

Based on evidence of mixed order of integration arising from the results of the Augumented

Dickey Fuller and Phillips Perron unit root tests employed on the time series data of this study, the Nonlinear Autoregressive Distributed Lag (NARDL) model developed by Shin et al. (2014) which examines the nonlinear relationship among the variables in the short and long run framework was adopted. To account for the fluctuations in foreign capital inflows and how it affects environmental quality, this study decomposes the series of foreign direct investment, external debt and official development assistance into positive and negative fluctuations following the partial sum decomposition framework prescribed by Shin et al. (2014). Thus, the partial sum decomposition procedure is developed as follows:

$$FDI_t^+ = \sum_{n-1}^{t} \Delta FDI_t^+ = \sum_{n-1}^{t} max\,(\Delta FDI_t^+, 0)$$

$$FDI_t^- = \sum_{n-1}^{t} \Delta FDI_t^- = \sum_{n-1}^{t} min\,(\Delta FDI_t^-, 0)$$

$$EXD_t^+ = \sum_{n-1}^{t} \Delta EXD_t^+ = \sum_{n-1}^{t} max\,(\Delta EXD_t^+, 0)$$

$$EXD_t^- = \sum_{n-1}^{t} \Delta EXD_t^- = \sum_{n-1}^{t} min\,(\Delta EXD_t^-, 0)$$

$$ODA_t^+ = \sum_{n-1}^{t} \Delta ODA_t^+ = \sum_{n-1}^{t} max\,(\Delta ODA_t^+, 0)$$

$$ODA_t^- = \sum_{n-1}^{t} \Delta ODA_t^- = \sum_{n-1}^{t} min\,(\Delta ODA_t^-, 0) \qquad (4.2)$$

With the decomposition of the changes in the values of the variables into positive and negative fluctuation elements, the nonlinear version of equation (4.1) is restated in a nonlinear bounds test to cointegration framework as;

$$\Delta InARA_t = \beta_0 + \sum_{k=1}^{p} \gamma_k \Delta InARA_{t-k} + \sum_{j=0}^{q1} \omega_{1j} \Delta InFDI_{t-j}^{+} + \sum_{j=0}^{q2} \omega_{2j} \Delta InFDI_{t-j}^{-}$$
$$+ \sum_{j=0}^{r1} \varphi_{1j} \Delta InEXD_{t-j}^{+} + \sum_{j=0}^{r2} \varphi_{2j} \Delta InEXD_{t-j}^{-} + \sum_{j=0}^{s1} \vartheta_{1j} \Delta InODA_{t-j}^{+}$$
$$+ \sum_{j=0}^{s2} \vartheta_{2j} \Delta InODA_{t-j}^{-} + \sum_{j=0}^{t} \theta_j \Delta InTO_{t-j} + \rho InARA_{t-1} + \beta_1^{+} InFDI_{t-1}^{+}$$
$$+ \beta_1^{-} InFDI_{t-1}^{-} + \beta_2^{+} InEXD_{t-1}^{+} + \beta_2^{-} InEXR_{t-1}^{-} + \beta_3^{+} InODA_{t-1}^{+} + \beta_3^{-} InODA_{t-1}^{-}$$
$$+ \beta_4 InTO_{t-1} + \mu_t \qquad (4.3)$$

Equation (4.3) illustrates the NARDL model that combines the short run and long run estimates of the independent and dependent variables. To generate the long run estimates of FDI, EXD, ODA, TO, and GDP, $\beta_1, \beta_2, \beta_3, \beta_4$, and β_5 are normalized on ρ, respectively. The short run estimates of the independent variables are attached to the Δ operator while p, q, r, s, are the respective lag length of the variables which are chosen based on the Schwarz criteria. The long run relationship among the variables is ascertain through the bounds test to cointegration process developed by Pesaran et al. (2001). The criteria that govern the procedure of establishing cointegration follows that the F-statistic of the bound test must be greater than the upper bounds critical values (I(1)). But if the value is below the lower bound critical values (I(0)), there is presence of short run relationship, however, the test becomes inconclusive if the F-statistics is between the upper and lower bound critical values.

Equation (4.3) is the nonlinear ARDL specification that models the nonlinear impact of foreign direct investment, external debt, and official development assistance on available arable land in Nigeria. From the model, FDI_t^{+}= positive fluctuation in foreign direct investment, FDI_t^{-}=negative fluctuation in foreign direct investment, EXD_t^{+} =positive fluctuation in external debt, EXD_t^{-}= negative fluctuation in external debt, ODA_t^{+}= positive fluctuation in official development assistance while ODA_t^{-}= negative fluctuation in official development assistance while all other variables remain as earlier stated.

The nonlinear ARDL considers additional asymmetry test to validate whether the positive fluctuation and negative fluctuation are different or not. The asymmetry test is considered for the short run and the long run estimates of the decomposed variables. The null hypothesis that governs the asymmetry Wald test in the short run is stated as $\sum_{j=0}^{q1} \omega_{1j} \Delta InFDI_{t-j}^{+} = \sum_{j=0}^{q2} \omega_{2j} \Delta InFDI_{t-j}^{-}$ for foreign direct investment, $\sum_{j=0}^{r1} \varphi_{1j} \Delta InEXD_{t-j}^{+} = \sum_{j=0}^{r2} \varphi_{2j} \Delta InEXD_{t-j}^{-}$for external debt and $\sum_{j=0}^{s1} \vartheta_{1j} \Delta InODA_{t-j}^{+} = \sum_{j=0}^{s2} \vartheta_{2j} \Delta InODA_{t-j}^{-}$ for official development assistance. The rejection of the null hypothesis implies that the positive and negative fluctuations are different, but if otherwise, the linear short run model becomes the appropriate model. Meanwhile, to confirm the long run asymmetry test, the null hypothesis is stated as $\frac{\beta_1^+}{\rho} = \frac{\beta_1^-}{\rho}$, $\frac{\beta_2^+}{\rho} = \frac{\beta_2^-}{\rho}$, and $\frac{\beta_3^+}{\rho} = \frac{\beta_3^-}{\rho}$ and the significance of the Wald test validate that the positive fluctuation is different from negative fluctuations. However, if the insignificant Wald test estimates imply the non-rejection of linear relationship between the variables, the specification of a linear model within the ARDL framework would become the appropriate model.

To account for the nonlinear speed of adjustment process of equation (4.3), the nonlinear error correction model following the proposition of Shin et al. (2014) is expressed as follows;

$$\Delta InARA_t = \rho\varrho_{\,t-1} + \sum_{k=1}^{p} \gamma_k \Delta InARA_{t-k} + \sum_{j=0}^{q1} \omega_{1j} \Delta InFDI_{t-j}^{+} + \sum_{j=0}^{q2} \omega_{2j} \Delta InFDI_{t-j}^{-} + \sum_{j=0}^{r1} \varphi_{1j} \Delta InEXD_{t-j}^{+} + \sum_{j=0}^{r2} \varphi_{2j} \Delta InEXD_{t-j}^{-} + \sum_{j=0}^{s1} \vartheta_{1j} \Delta InODA_{t-j}^{+} + \sum_{j=0}^{s2} \vartheta_{2j} \Delta InODA_{t-j}^{-} + \sum_{j=0}^{t} \theta_j \Delta InTO_{t-j} + \mu_t \qquad (4.4)$$

Where $\rho\varrho_{\,t-1}$is the nonlinear error correction term generated through $\varrho_{\,t-1} = InEF_{t-1} - \widehat{\beta_0} - \widehat{\beta_1^+} InFDI_{t-1}^{+} - \widehat{\beta_1^-} InFDI_{t-1}^{-} - \widehat{\beta_2^+} InFPI_{t-1}^{+} - \widehat{\beta_2^-} InFPI_{t-1}^{-} - \widehat{\beta_3^+} InODA_{t-1}^{+} - \widehat{\beta_3^-} InODA_{t-1}^{-} - \widehat{\beta_4} InTO_{t-1}$. Meanwhile, $\widehat{\beta_0} = -\beta_0/\rho$, $\widehat{\beta_1{}^+} = -\beta_1{}^+/\rho$, $\widehat{\beta_1{}^-} = -\beta_1{}^-/\rho$, $\widehat{\beta_2{}^+} = -\beta_2{}^+/\rho$, $\widehat{\beta_2{}^-} = -\beta_2{}^-/\rho$, $\widehat{\beta_3{}^+} = -\beta_3{}^+/\rho$, $\widehat{\beta_3{}^-} = -\beta_3{}^-/\rho$ and $\widehat{\beta_4} = -\beta_4/\rho$.

RESULTS

The result for the non-linear ARDL model for foreign capital flows and arable land available in Nigeria. Specifically, there are three panels in Table 5.1 which provides details of short run, long run, and the post estimation tests.

In Panel A, the results for the short run coefficients show that positive fluctuation in foreign direct investment and positive fluctuation in official development assistance have positive impact on arable land available in Nigeria. This implies that increase in positive fluctuation in foreign direct investment and positive fluctuation in official development assistance leads to increase in arable land available in Nigeria. Conversely, negative fluctuation in foreign direct investment, positive and negative fluctuations of external debt, negative fluctuation of official development assistance and trade openness have negative impact on arable land available in Nigeria. This implies that increase in negative fluctuation in foreign direct investment, positive and negative fluctuations of external debt, negative fluctuation of official development assistance and trade openness leads to decrease in arable land available in Nigeria in the short run.

Results from the study also indicate that the long run estimates of positive fluctuation of foreign direct investment and negative fluctuation of official development assistance have positive impact on arable land available in Nigeria. Conversely, negative fluctuation of foreign direct investment, positive and negative fluctuation of external debt, positive fluctuation of official development assistance and trade openness have negative impact on arable land available in Nigeria.

In addition, there was evidence of significant effect of positive and negative fluctuation of foreign direct investment and positive fluctuation of external debt on arable land available in Nigeria (LFDI_POS = 0.0313, t-test =2.1341, $p<0.05$; LFDI_NEG = -0.0521, t-test =-3.4987, $p<0.05$; and LEXD_POS = -0.1314, t-test = -3.0989, $p<0.05$). This implies that positive and negative fluctuation of foreign direct investment and positive fluctuation of external debt are significant factors influencing changes in arable land available in Nigeria. In contrast, negative fluctuation of external debt, positive and negative fluctuation of official development assistance, and trade openness have no significant effect on arable land available in Nigeria (LEXD_NEG = -0.0486, t-test =-0.8408, $p>0.05$; LODA_POS = -0.0001, t-test =-0.0034, $p>0.05$; LODA_NEG = 0.0360, t-test =1.8740, $p>0.05$; and TO= -0.0007, t-test = -0.6544, $p>0.05$). This implies that negative fluctuation of external debt, positive and negative fluctuation of official development assistance, and trade openness are not significant factors influencing changes in arable land available in Nigeria.

Table 5.1: NARDL Model for Foreign Capital Flows and Arable Land

Panel A: Short-Run Estimates				
Variable	**Coefficient**	**Std. Error**	**t-Stat**	**Prob**
CONSTANT	2.3312***	0.5455	4.2738	0.0003
D(LFDI-POS)	0.0216*	0.0126	1.7127	0.0997
D(LFDI-NEG)	-0.0360***	0.0111	-3.2379	0.0035
D(LEXD-POS)	-0.0906**	0.0345	-2.6279	0.0147
D(LEXD-NEG)	-0.0335	0.0428	-0.7822	0.4418
D(LODA-POS)	0.0000	0.0130	-0.0034	0.9973
D(LODA_NEG)	-0.0038	0.0186	-0.2049	0.8394
D(LODA-NEG(-1))	0.0248*	0.0135	1.8371	0.0786
D(TO)	-0.0005	0.0007	-0.6333	0.5325
ECM(-1)	-0.6897***	0.1591	-4.3336	0.0002
Panel B: Long-Run Estimates				
Variable	**Coefficient**	**Std. Error**	**t-Stat**	**Prob**
LFDI_POS	0.0313**	0.0147	2.1341	0.0433
LFDI_NEG	-0.0521***	0.0149	-3.4987	0.0018
LEXD_POS	-0.1314***	0.0424	-3.0989	0.0049
LEXD_NEG	-0.0486	0.0578	-0.8408	0.4087
LODA_POS	-0.0001	0.0189	-0.0034	0.9973
LODA_NEG	0.0360*	0.0192	1.8740	0.0732
TO	-0.0007	0.0010	-0.6544	0.5191
CONSTANT	3.3802***	0.0411	82.3008	0.0000
Panel C: Diagnostic test			**Statistics**	**Prob**
Bounds Test			3.5037**	
Adjusted R-squared			0.8994	
F-Statistics			33.7848	0.0000
Normality Test			13.9074	0.0010
Serial Correlation Test			1.8991	0.1735
Heteroscedasticity Test			0.0839	0.7740
Linearity Test			0.4124	0.5271
Stability Test			CUSUM Stable	CUSUMSQ Stable

Wald Tests for Asymmetry

The result of the Wald test for asymmetry is presented in Table 5.2 for the short run and long run asymmetry. The Wald test for short run asymmetry showed that only the positive fluctuation and negative fluctuation of foreign direct investment on arable land available in Nigeria were different due to the significance of the Wald test at 1% level, whereas others were not significantly different. For the long run Wald test for asymmetry, there is evidence that the value of positive and negative estimates of foreign direct investment, external debt, and official development assistance are not significantly different due to the Wald test estimates at 5% level of significance. Hence in the short run, only positive and negative fluctuations of foreign direct investment have significant effects on the arable landscape in Nigeria. In the long run, positive and negative fluctuations of foreign direct investment, external debt, and official development assistance do not affect arable landscape in Nigeria.

The findings of this study suggest that foreign capital flows through its significant effect on arable land also impacts crop production. Similar assertions were made from the findings of Santangelo (2018) that investigated the impact of foreign capital flows on arable land in developing countries using a conditional mixed process model (CMP) and the Sobel test using the delta method. Santangelo (2018) revealed that foreign direct investment positively influence land and food security through the expanion of arable land used for crop production. However, Schrempf-Stirling and Wettstein (2015) identified multinational investment practices in host countries and existing domestic regulations as factors that affect the impact of FDI on arable land and subsequently food production. This highlights the role of various interplaying factors in the effect of FDI on arable land. These factors may include domestic regulations such as the institutional management of foreign direct investment in the examined countries. It is also noteworthy that further disparities in results can be attributed to the methodology and sample countries adopted. For instance, Doytch (2020) found that there is a significant difference between the rate at which foreign capital flows through FDI influenced bio-productive lands between developed and developing countries. Summarily, foreign capital flows affect arable land footprint in countries including Nigeria. Other factors examined above however influence the direction and duration of the effects.

Table 5.2: Wald Test for Asymmetry

Variables	Wald Test	Prob
Short run Asymmetry		
LFDI	13.5029	0.0012
LEXD	1.1934	0.2855
LODA	1.3065	0.2643
Long run Asymmetry		
LFDI	1.7376	0.1999
LEXD	0.9296	0.3446
LODA	0.0233	0.8799

CONCLUSION

The study examined the asymmetric effects of foreign capital flow components on environmental sustainability in Nigeria. From the findings of the study, there was a significant effect of fluctuations in foreign capital flows on arable land available in Nigeria further implying that foreign capital flows fluctuations significantly impacted arable land in Nigeria. However, the short and long run, implications vary as highlighted above.

In general, the results of the study revealed that fluctuations in foreign capital flows indeed affect the environmental sustainability of Nigeria significantly. As such, the results are in line with the postulations of the pollution haven hypothesis.

The following recommendations were given:

i. From the results of the study, foreign capital flow fluctuations can significantly affect arable land available in Nigeria. Hence, the Nigerian government should work with public and private stakeholders in the agricultural sector to ensure the utilization of said capital flows for the preservation and restoration of arable landscape in Nigeria.

ii. Overall, fluctuations in foreign capital flows have significant effects on the environmental sustainability of the Nigerian environment in the short and long run. Accordingly, the Nigerian government should ensure the adequate monitoring of foreign capital flows and their effects on the Nigerian environment through various sectors and industries. When this occurs, the effects of negative and positive fluctuations on the environment will be anticipated and adequate measures will be taken towards the sustenance of the Nigerian environment. Finally, it will help achieve Nigeria's pledge to the Paris climate agreement.

Conflicts of Interest

The writers have disclosed no conflicts of interest.

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