Foreign Direct Investment, Manufacturing Export and the Environment in Nigeria: A Test of Pollution Haven Hypothesis

Joshua Sunday Riti I Gede Eko Putra Sri Sentanu** Anna Cai*** and Shelim Sheikh*****

Abstract

One of the ultimate desires of every economy is to achieve sustainable economic growth and development. However, the means through which this objective can be achieved are multidimensional. Emission is closely related to manufacturing output and the performance of a sector is sometimes measured by its exports. This paper investigated the relationship between FDI inflows, manufacturing export and the environment in Nigeria, testing the existence of pollution haven hypothesis (PHH). The data spanned from 1980-2013 sourced from Central Bank of Nigeria statistical Bulletin, and World Development Indicators. Auto regression distributed lag model (ARDL) was

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used to estimate the short as well as the long run parameters. The result of the findings showed that FDI significantly influenced the variation in CO_2 while manufacturing export parameter was found to be positive though insignificant. The granger causality result indicated that a unidirectional causality runs from FDI to $C0_2$. The findings support the existence of pollution haven hypothesis while a positive relationship exists between manufacturing exports and emission. The speed of adjustment hovers around 48% in reconciling the short and long run dynamics of the model. The paper therefore recommends among other things that government in bid to pursue economic growth and bridge savings gap should also pursue cleaner technological FDIs i.e. environmental laws should be instituted to ensure that environmental friendly goods are produced. Policies towards the attraction of FDI should be diversified and not only concentrated on oil industries that emit large sum of emissions.

Keywords: *Foreign Direct Investment, Environment, Manufacturing Export, Pollution Haven Hypothesis*

การลงทุนโดยตรงจากต่างประเทศ การผลิตเพื่อการส่งออก และสิ่งแวดล้อมในประเทศไนจีเรีย: การทดสอบสมมติฐานการเปลี่ยนมลพิษไม่จำกัด

Joshua Sunday Riti I Gede Eko Putra Sri Sentanu** Anna Cai*** and Shelim Sheikh*****

บทคัดย่อ

หนึ่งในความปรารถนาสูงสุดของทุกเศรษฐกิจ คือ การบรรลุการเจริญเติบโตทางเศรษฐกิจและการพัฒนาที่ยั่งยืน อย่างไรก็ตาม วิธีในการบรรลุวัตถุประสงค์ดังกล่าวมีหลากมิติ ปริมาณการปล่อยมลพิษมีความสัมพันธ์กับปริมาณผลผลิตด้านอุตสาหกรรม และบางครั้งผลการดำเนินงานของสาขาใดสาขาหนึ่งวัดโดยการส่งออก การศึกษาความสัมพันธ์ระหว่างการไหลเข้ามาของการลงทุนโดยตรงจากต่างประเทศ การผลิตเพื่อการส่งออก และสิ่งแวดล้อมในประเทศไนจีเรีย โดยตรวจสอบสมมติฐานการปล่อยมลพิษไม่จำกัด (Pollution Haven Hypothesis (PHH) ข้อมูลได้จากรายงานสถิติของธนาคารกลางของประเทศไนจีเรียตั้งแต่ปี พ.ศ. 2523-2556 และจากดัชนีการพัฒนาโลก โดยใช้กระบวนการปรับการกระจายของการถดถอยโดยอัตโนมัติ (Auto regression distributed lag model (ARDL) เพื่อคำนวณ

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ค่าพารามิเตอร์ทั้งระยะสั้นและระยะยาว ผลการศึกษาแสดงว่า การลงทุนโดยตรงจากต่างประเทศมีอิทธิพลอย่างมากต่อการเปลี่ยนแปลงปริมาณก๊าซคาร์บอนไดออกไซด์ ในขณะที่ค่าพารามิเตอร์ของการผลิตเพื่อการส่งออก พบว่า มีผลในเชิงบวกแต่ไม่มีนัยสำคัญ ผลของการทดสอบความเป็นเหตุเป็นผล (granger causality) แสดงว่า มีความเป็นเหตุเป็นผลทิศทางเดียวจากการลงทุนโดยตรงจากต่างประเทศกับปริมาณก๊าซคาร์บอนไดออกไซด์ ผลการศึกษาสนับสนุนสมมติฐานการปล่อยมลพิษไม่จำกัด ในขณะที่มีความสัมพันธ์เชิงบวกระหว่างการผลิตเพื่อการส่งออกและการปล่อยมลพิษ อัตราการปรับเข้าสู่ด้านพลศาสตร์ระยะสั้นและระยะยาวของแบบจำลอง จะอยู่ประมาณร้อยละ 48 ดังนั้น หนึ่งในข้อเสนอแนะของการศึกษา ก็คือ ในความพยายามที่จะบรรลุการเจริญเติบโตทางเศรษฐกิจและลดช่องว่างการออม รัฐบาลควรดำเนินนโยบายส่งเสริมการลงทุนโดยตรงจากต่างประเทศที่ใช้เทคโนโลยีที่สะอาดขึ้นเช่นกัน เช่น การออกกฎหมายด้านสิ่งแวดล้อม เพื่อเป็นหลักประกันว่าจะมีการผลิตสินค้าที่เป็นมิตรต่อสิ่งแวดล้อม นโยบายชักชวนการลงทุนจากต่างประเทศควรมีความหลากหลายและไม่ควรเน้นอุตสาหกรรมน้ำมันที่ปล่อยมลพิษออกมาเป็นจำนวนมากเท่านั้น

คำสำคัญ: *การลงทุนโดยตรงจากต่างประเทศ สิ่งแวดล้อม การผลิตเพื่อการส่งออก สมมติฐานการเปลี่ยนมลพิษไม่จำกัด*

Introduction

The Pollution haven hypothesis refers to the possibility that foreign investment could be sensitive to weaker environmental standards. A possible asymmetry exists between foreign capital and local environmental standards. When firms avoid environmental regulations by relocation, it could trigger competition for lax environmental policy in order to gain comparative advantage in "dirty" goods production. The power of foreign firms, especially, and the desperate attempt to woo and tame foreign capital by poor countries might sometimes force these countries to lower the country-specific regulation. Direct and strict environmental regulation may increase production cost, for this reason and in attempt to promote investment and attract foreign capital, trade liberalization in emerging and transition economies might, by design or by default, lead to lax environmental policies (Aliyu, 2005).

The pollution haven hypothesis has three dimensions. The first is the relocation of heavy polluting industries from developed countries with stringent environmental policies to developing countries where similar policies do not exist, are lax or not enforced. Accordingly, global free trade would encourage polluting industries and processes to move to countries with weak environmental policy. The second dimension is the dumping of hazardous waste generated from developed countries (industrial and nuclear energy production), in developing countries. This issue was the subject of the Basle Convention on hazardous waste. The last dimension is the unrestrained extraction of non-renewable natural resources in developing countries by multinational corporations engaged in producing petroleum and petroleum products, timber and other forest resources, etc. All the dimensions relate to conscious decisions on environmental policy and how they impact on the environment, future production and trade. The pollution haven hypothesis therefore has two empirical consequences, namely: FDI outflow in developed countries is positively correlated with environmental policy stringency and pollution in developing countries is positively linked to FDI inflow. We intend to examine only pollution in developing countries is positively linked to FDI inflow using disaggregated data.

One of the ultimate desires of every economy is to achieve sustainable economic growth and development. However, the means through which this objective can be achieved are multidimensional. Empirical studies from both cross country and country specific experiences have pointed to Foreign Direct Investment (FDI) as being critical in promoting growth. For instance, De Mello (1997) outlines two main channels through which FDI may be growth enhancing: First, FDI can encourage the adoption of new technology in the production process through capital spillovers. Second, FDI may stimulate knowledge transfers, both in terms of labour training and skill acquisition and by introducing alternative management practices and better organizational arrangements.

Apart from the above submissions, FDI is also expected to bridge the internal resource and savings gap, increase managerial abilities, reduce foreign exchange shortage and improve balance of payments in less developed countries. The foregoing notwithstanding, there appears to be no general agreement among researchers on the association between FDI inflows and economic growth. While some studies observe a positive impact of FDI on economic growth, others detect a negative relationship between these two variables Aitken and Harrison (1999), Djankov and Hoekman (1999), Damijan *et al*. (2001), Konings (2000), Castellani and Zanfei (2002) and Zukowska-Gagelmann (2002) for evidences from both sides of the debate).

The need to develop and expectations from the beneficial impacts of FDI which constitutes one of the key outcomes of globalization process in the developing nations actually propel many of the African countries to support and promote liberalization policies in their various countries. This led to the adoption of the structural adjustment programmed in the 1980s by these developing African countries. But adopting liberalization policies and allowing for free movement of capital, particularly long term capital such as FDI could embody some adverse environmental consequences. Some view environmental quality as a normal good and hence opine that free trade and the resulting economic growth would lead to cleaner environment. This line of argument forms the root of the famous Environmental Kuznets Curve (EKC).

Despite the barrage of critique that trail the importance of FDI, it is interesting to note that Nigeria still sees FDI as an avenue through which growth-enhancing performances may be permeated to the entire economy. The adoption of the structural adjustment programmed in 1986 actually created an impetus for the inflows of FDI into the country unlike the pre 1986 era that was characterized by restrictive policy measures like Nigerian Enterprise Promotion Decree (NEPD) and other Indigenization Decrees. Thus, Nigeria is one of the few countries that have consistently benefited from the FDI inflows to Africa.

Many studies on pollution Haven Hypothesis focused on FDI and environmental standards. However, pollution emission is closely associated with manufacturing output and the performance of a sector is sometimes measured by its exports. Low and Yeats (1992) reported that, there has been a large increase in the average number of countries with revealed comparative advantage in "dirty" industries mainly because, developing countries have stronger tendency to develop comparative advantage in heavy polluting relative to non-polluting industries. The expansion has occurred in all the polluting sectors. Dirty industries account for the largest share of exports of some developing countries and there is reduction in "dirty" goods exports from industrial countries. Therefore this study seeks to measure the relationship not only between FDI and emission but also to examine export-emission led hypothesis. If such a relationship exists, then government, international agencies and stake holders alike can be armed with the key policy instruments on both environmental laws and diversification rather than focusing on only one. It is against this background that the study is interested in unraveling the causal link between FDI and environment on the one hand and environmental impacts of manufacturing export proxy for growth on the other hand, testing the existence of the pollution haven hypothesis in Nigeria. It is therefore natural then to ask whether and to what extent the upsurge in FDI inflows may have caused or contributed to increased environmental damage or whether and to what extent the upsurge of FDI inflows may have contributed to increase in manufacturing export. If we can establish a relationship between FDI and pollution emission ($C0_2$), we can as well establish a relationship between manufacturing export and pollution emission ($C0_2$). This paper is divided into five sections. Following the introduction in section I is

the review of related literature which occupies section II. Section III examines FDI inflows into Nigeria and the level of pollution emission in form of $C0_2$ emission as well as manufacturing export. Section IV takes the empirical analysis using some data on $C0_2$, FDI and trade. While the conclusion and recommendations take section five.

Theoretical and Empirical Literatures

A plethora of studies have been conducted on the economics of FDI in developing countries over the last three decades. Theoretical research in this area can be roughly categorized into two groups. The first group of studies has provided the theoretical rationale of the effect of FDI inflows on economic growth which is known as the FDI-growth nexus (Romer, 1986; Lucas, 1988; Rebelo, 1991; Grossman and Helpman, 1991). The second group of studies has attempted to relate theoretical consideration to the impact of FDI on the environment in developing countries which is referred to as the FDI-environment nexus (Pethig, 1976; Copeland and Taylor, 1994, 1995; Porter and van der Linde, 1995). On one hand, researchers from both developed and developing countries have extensively looked into the first issue while, on the other hand, the second category of studies is only sparsely researched in the context of the African continent.

According to standard trade theory, trade in goods worsens environmental quality in countries that have a comparative advantage in the production of "polluting" goods. The comparative advantage may derive either from the distribution of the world endowments of the factors of production (the factor endowments theory, FET), in which case the developed or developing countries become dirtier with free trade due to their capital or resource abundance. Or, from policy related differences in tolerance of pollution (the pollution haven hypothesis, PHH), in which case the *less* developed countries are expected to become dirtier with international trade due to pollution haven effects. Nevertheless, static trade theory abstracts from an important determinant of environmental quality that is affected by international trade, namely income.

The relationship between international capital mobility, in particular Foreign Direct Investment (FDI), and the environment has also received recently considerable

attention, but almost exclusively at the empirical front (Barbieri, 2002; Copeman and Taylor, 1995; Eskeland and Harrison, 2003; Li and Liu (2005) and Wei, 2004; Keller and Levinson, 2002; Mani and Wheeler, 1998; Millimet and List, 2004; Xing and Kolstad, 2002). The theory underlying this body of work is the pollution haven hypothesis. In a nutshell, this theory postulates that polluting firms will find it profitable to relocate to countries with "lax" environmental standards. Consequently, FDI will worsen the environment in the receiving while improving it in the originating country.

Unlike a vast amount of literature that has been conducted on FDI-growth nexus, empirical studies on FDI-Environment nexus are still relatively sparse both in the developed and developing countries. Smarzynska and Wei (2001), Xing and Kolstad (2002), Eskeland and Harrison (2002), He (2006), Baek and Koo (2008) and Acharyya (2009) are among the first set of empirical studies that have attempted to address this issue. For instance, Xing and Kolstad (2002) examine the effect of the US FDI on environmental quality in both developed and developing countries; they find that developing countries tend to utilize lax environmental regulations as a strategy to attract dirty industries from developed countries. The empirical evidence on the relationship between FDI and environmental quality has so far been rather mixed. For instance, Keller and Levinson (2002) and Xing and Kolstad (2002) report –rather weak- support for the pollution haven hypothesis. Xing and Kolstad (2002) and others report the absence of any link, or sometimes a positive association. The latter association could be accounted by findings such as that by Eskeland and Harrison (2003), that foreign owned plants are significantly more energy efficient and use cleaner types of energy than domestically owned plans. Nonetheless, it should be noted that, to the best of our knowledge, there exists no theory predicting that FDI will involve more efficient and cleaner plants than domestic investment in countries with low environmental standards. He (2006) explores the relationship between FDI and the environment in China; he unearths evidence that an increase in FDI inflows results in deterioration of environmental quality. However, these studies implicitly assume a one-way causality from measures of environmental quality (SO_2 and CO_2 emissions) and/or economic growth (GDP) to FDI and adopt a structural model (i.e., reduced form equations) to estimate the impacts of FDI based on such causality.

Baek and Koo (2008), using cointegration analysis and a Vector Error Correction (VEC) model, examine the short and long run relationships among Foreign Direct Investment (FDI) economic growth and the environment in China and India. The results show that FDI inflows play a pivotal role in determining the short and long-run movement of economic growth through capital accumulation and technical spillovers in the two countries. However, a FDI inflow in both countries was found to have a detrimental effect on environmental quality in both the short- and long-run. Also, they found that, in the short-run, there exists a unidirectional causality from FDI inflows to economic growth and the environment in China and India. A change in FDI inflows causes a change in environmental quality and economic growth but the obverse does not hold. Acharyya (2009) examines two most important benefits and costs of foreign direct investment in the Indian context GDP growth and the environment degradation. He finds a statistically significant long run positive but marginal, impact of FDI inflows on GDP growth in India during 1980-2003. On the other hand the long run growth impact of FDI inflows on CO_2 emissions is also found to be substantial. In Nigeria Ajide & Adeniyi (2010) assessed FDI, economic growth and environmental nexus in Nigeria using the ARDL bound testing approach. While the results establish a long run relationship between environment and foreign direct investment, the same cannot be said about foreign direct investment and economic growth which only depicts short run causal link between the two.

Foreign Direct Investment, Manufacturing Export and the Environment in Nigeria

Not so much FDI has been attracted into the African continent, except for a few countries for reasons such as: negative image of the region, bad governance, large scale corruption and corrupt practices, foreign exchange shortages and an unfriendly macroeconomic policy environment, among others. Of a few African countries that have benefited from FDI inflows, Nigeria was ranked as the second top FDI recipient after Angola in 2001 and 2002 (UNCTAD, 2003). Nigeria's share of FDI inflows to Africa varied from around 24.19% in 1990 to a low level of 5.88% in 2001 and almost doubled at 11.65% in 2005 (Ayanwale, 2007) and (CBN, 2012).

The UNCTAD World Investment Report shows that FDI inflow to West Africa is mainly dominated by inflow to Nigeria who received 70% of the sub-regional total and 11% of Africa's total. Out of this Nigeria's oil sector alone receive 90% of the FDI inflow.

From Table 1 and Figure 1, it is evident that Nigeria has consistently benefited from the FDI inflows into Africa as her share of FDI inflows to Africa averaged around 10% between 1980 and 2003. Table 1 also shows Nigeria's FDI both in nominal and real terms. From Table 1, it is observed that nominal FDI inflows into Nigeria which stood at N-188.2 million in 1970 rose to N253.0 in 1975 further rose precipitously to a value of N920.0 in 1980. This value later rose substantially to N75, 940.6 in 1995 before peaking at N225, 036.5 in 2002. But fell precipitously to a negative value N-341717.25 in 2005 through 2009. This period coincided with the pre and during global financial crisis of 2008.

Correspondingly, there was an increase in FDI in real terms from N1190.70 in 1970 to N1222.20 in 1975 and decline in the mid-1980s to a negative value of N-955.32. FDI forms a small percentage of the nation's Gross Domestic Product (GDP). However, its share of 2.47,-0.81, 2.39 and 3.93% in 1970, 1980, 2000 and 2002, respectively is far from trivial.

Table 1: Nigeria's Foreign Direct Investment, 1970-2012

Year	Nigeria	Africa	Percent of Africa
1970	-188.2	392	-
1975	588.0	2430	24.19
1980	920.00	5119	21.07
1985	2555.00	10667	14.43
1990	13877.40	8928	11.77
1995	75940.60	12231	8.22
2000	111952.20	8489	10.96
2005	-341717.25	NA	11.65
2010	2978258.30	NA	NA
2011	3506908.30	NA	NA
2012	3466351.10	50.01bn	27.6

Source: Central Bank of Nigeria Statistical Bulletin, 2012

The downward trend of FDI inflows can be explained by the world oil price crash in 1980s and also in 2008 as a result of global financial crisis. This later led to a massive divestment from the nation and the subsequent low level of inflow obtained until 1986. The gradual increase of FDI was occasioned by the adoption of SAP in the late 1980s during the Babangida-led administration. The then policy measures which aimed at encouraging FDI inflows include: the inauguration of the Industrial Development Coordination Committee (IDCC), the Companies and Allied Matters Decree 1990, financial liberalization and the debt-equity swap programmes. The aftermath of the global financial crisis also saw an upward rise in foreign direct investment into Nigeria at an unprecedented rate.

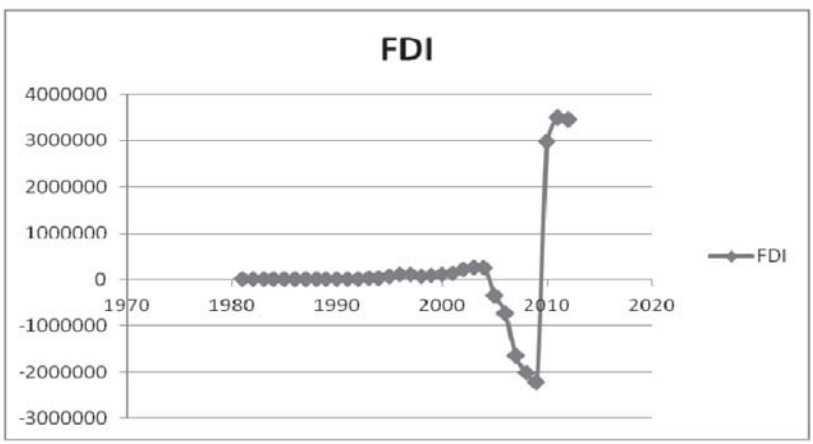

Figure 1: Trend of FDI Growth % Inflows in Nigeria (1981-2012)

Table 2 shows anecdotal evidence on the growth-environment nexus in Nigeria. It is clear that the average annual growth of per capita CO_2 fell precipitously from 0.84 tons from 1980-1989 to 0.41 tons in the period spanning 2000-2012.

This result is not surprising given the rate of decline in the share of the manufacturing sector in total GDP which took a downward turn from 8.186 from 1980-1989 to 4.104 from 2000-2008. In terms of the relationship between per capita CO_2 emissions and GDP per capita, an inverse pattern appears to emerge in the movement of these variables suggesting that as GDP per capita increases, per capita emission falls over the period 1980-2008.

Table 2: Trend of $C0_2$ per Capita, FDI GDP per Capita, and Manufacturing Export/GDP between 1980 and 2012

Years	Per Capita $C0_2$	FDI Stock(US$)	GDP/ Capita	Manufacturing Export/GDP	Energy Consumption
1980-1989	0.837	4425.887	1440.788	8.186	786.746
1990-1999	0.452	15526.920	1533.667	5.012	779.810
2000-2008	0.412	41023.390	1666.230	4.104	770.308
2009-2012	0.400	4234.250	1768.210	4.232	762.204

Source: WDI, 2013

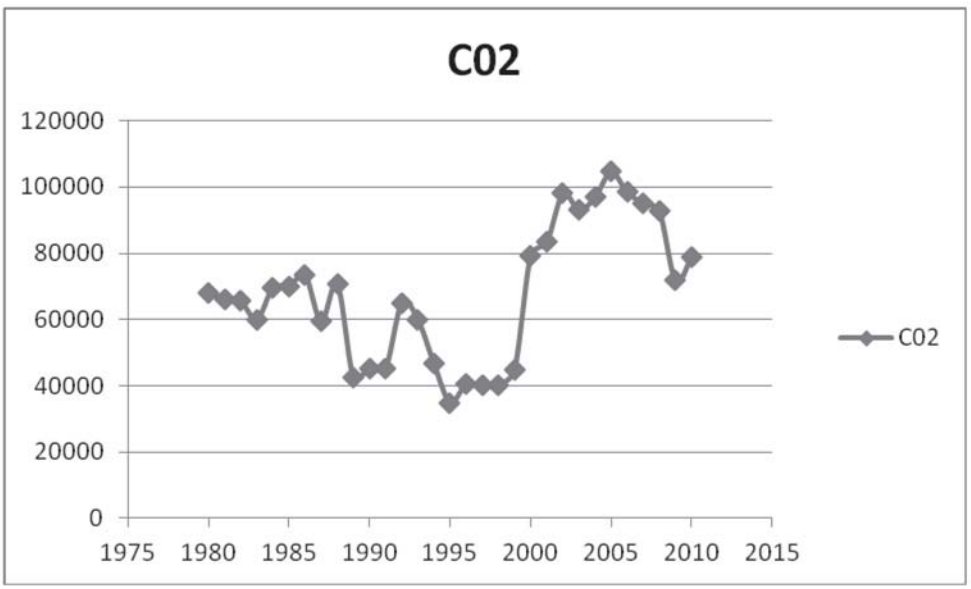

Figure 2: Trend of C02 Emission in Nigeria (1980-2012)

Figure 3 below shows the trend of manufacturing export of the country form 1981-2012. It is observed that the manufacturing export has increased substantially over the years at an average of over 24%. Except 2009-2010 that recorded a fall in manufacturing export due to the aftermath of the global financial crisis of 2008.

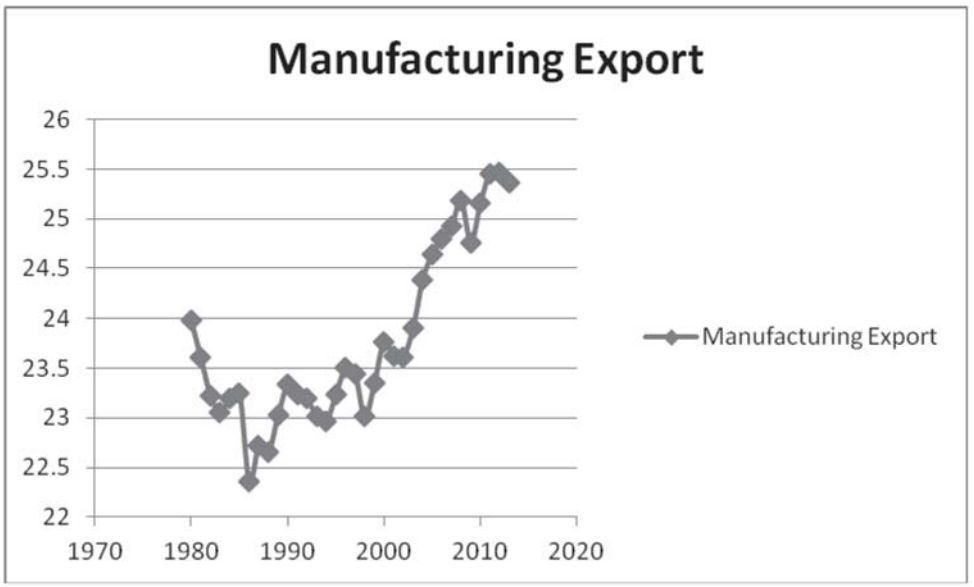

Figure 3: Trend of Manufacturing Export in Nigeria (1980-2012)

Methodology

Based on the literature review and the theoretical framework, this section is preoccupied with the methodology of the research by formulation of models to capture the relationship between FDI, manufacturing export and $C0_2$ in Nigeria. The use of Auto Regression Distributed Lag (ARDL) bound testing approach to co integration is adopted to estimate the parameters and to test the validity of the pollution haven hypothesis. The Co integration and Error Correction framework have proved to be successful tools because it captures the long-run equilibrium relationship as well as short-run variations and dynamics. Data relied upon in this research are purely secondary obtained from the central bank of Nigeria (CBN), National Bureau of Statistics (NBS), World data bank (World Development Indicators). In line with the pollution haven hypothesis, the model for the research is:

$$C0_{2t} = f(FDI_t, MANexp_t)u \quad (1)$$

Where $C0_2$ is the measure of pollutants
FDI is Foreign Direct Investment
MANexp is manufacturing export
U is the error term

In a more explicit form, the model can be written n a log-linear form to transform the variables into the same unit and base. Thus:

$$logC0_2 = \beta_0 + \beta_1 logFDI + \beta_2 logMANexp + U_t \quad (2)$$

Where β_1 and β_2 are expected to be greater than zero for PHH to exist in Nigeria The conditional VECM can be specified as:

$$\Delta \log C0_{2t} = \beta_0 + \theta_1 \log C0_{2t-1} + \theta_2 \log FDI_{t-1} + \theta_3 \log MAN\exp_{t-1} + \sum_{i=1}^{p} \beta_{1i} \Delta \log C0_{2t-i} + \sum_{j=1}^{q} \beta_{2j} \Delta \log FDI_{t-j} + \sum_{k=1}^{r} \beta_{3k} \Delta \log MAN\exp_{t-k} + \mu_t \quad (3)$$

Where:

θ_i are the long run multipliers, β_i are the short run dynamics of the model, β_0 is the drift parameter and μ_t is the error term.

ARDL Bounds Testing Procedure

The ARDL Bounds testing procedure basically involves three steps. The first step in the ARDL bounds testing approach is to estimate equation (3) by ordinary least square (OLS) in order to test for the existence or otherwise of a long-run relationship among the variables. This is done by conducting an F-test for the joint significance of the coefficients of lagged levels of the variables.

The hypothesis would be:

$H_0: \theta_1 = \theta_2 = \theta_3 = 0$
$H_1: \theta_1 \neq \theta_2 \neq \theta_3 \neq 0$

The test which normalizes *on* $C0_{2t,}$ is denoted by

F_{C02} *(*$C0_2$*/FDI, MANexp)*

Two asymptotic critical values bounds provide a test for cointegration when the independent variables are I(d) (where $0 \leq d \leq 1$): a lower value assuming the regressors are I(0) and an upper value assuming purely I(1) regressors.

Suppose the F-statistic is above the upper critical value, the null hypothesis of no long-run relationship is rejected regardless of the orders of integration for the time series. On the other hand, if the F-statistic falls below the lower critical value

the null hypothesis is accepted, implying that there is no long-run relationship among the series. Lastly, if the F-statistic falls between the lower and the upper critical values, the result is inconclusive.

In the second stage of the ARDL bounds approach, once cointegration is established the conditional ARDL (p, q_1, q_2), the long-run model for $C02_{t.}$ can be estimated.

This involves selecting the orders of the ARDL (p, q_1, q_2) model in the three variables using Akaike Information Criterion (Akaike, 1973).

The third and the last step in the ARDL bound approach are to estimate an Error Correction Model (ECM) to capture the short-run dynamics of the system. The ECM generally provides the means of reconciling the short-run behaviour of an economic variable with its long-run behaviour.

The ECM is specified as follows:

$$\Delta \log C0_{2t} = \gamma + \sum_{i=1}^{r} \beta_{1i} \Delta \log C0_{2t-i} + \sum_{j=1}^{s} \beta_{2j} \Delta \log FDI_{t-j} + \sum_{l=1}^{s} \beta_{3l} \Delta \log MAN \exp_{t-1} + \rho ECM_{t-1} + \mu_t \quad (4)$$

From equation (4), β_i represent the short-run dynamics coefficients of the model's convergence to equilibrium. ECM_{t-1} is the Error Correction Model. The coefficient of the Error Correction Model, ρ measures the speed of adjustment to obtain equilibrium in the event of shocks to the system.

Time Series Preliminary Tests (Unit Root Test)

One major problem often associated with empirical analysis is non-stationarity of time series data. When variables being used for analysis are non-stationary, it usually leads to spurious regression results. In this case, the t-statistic, DW statistic as well as the R^2 values is not accurate.

In conducting the Dickey Fuller test, it is assumed that the error term εt is uncorrelated. But in case it is correlated, Dickey and Fuller have developed a test known as Augmented Dickey-Fuller (ADF) test. This test is conducted by: augmenting" the equation by adding the lagged values of the dependent variable $\Delta C02_{t.i}$.

Suppose the equation for C02t in our model, the ADF here consists of estimating the following:

$$\Delta C0_{2t} = \beta 0 + \beta 1 + \partial \Delta C0_2 t - 1 + \sum_{i=1}^{m} \hat{\lambda}_1 \Delta C0_{2t-i} + \varepsilon t \qquad (5)$$

Where εt is a white noise error term and $\Delta C0_{2t-1} = (\Delta C0_{2t-1} - \Delta C0_{2t-2})$ etc. The number of lagged difference terms to include is often determined empirically, the idea being to include enough terms so that the error term in (5) is serially uncorrelated. In ADF we test whether $\partial = 0$ and the ADF follows the asymptotic distributions and some critical values can be used.

For this reason, the Augmented Dickey-Fuller (ADF) test was used to test the stationary status of the variables used in the growth equation. The presence of unit root in the series indicates that the variable is non-stationary, hence the degree or order of integration is one or higher. The absence of unit root however, implies that the variables are stationary and the order of integration is zero. The result is presented in Table 3.

Table 3: The Unit Root Test Result

Variable	Level		First Difference		Decision
	Constant & Trend	Prob	Constant & Trend	Prob	
$InC0_{2t}$	-2.600132	0.2829	-5.568842*	0.0006	I(1)
$InFDI_t$	-3.463398***	0.0614	-7.596740*	0.0000	(0)
$InMANexp_t$	-2.718036	0.2367	-5.386059*	0.0008	I(1)

Note: The null hypothesis is that the series is non-stationary, or contains a unit root. The rejection of the null hypothesis is based on MacKinnon (1996) critical values. The lag length is selected based on AIC and SIC criteria, this range from lag zero to lag two. *, ** and *** indicate the rejection of the null hypothesis of non-stationary at 1%, 5% and 10% significant level, respectively.

Source: Computer using E-views 7.0 Econometric Software

Estimation Technique

The research made use of auto regression distributed lag model to estimate the short as well as a long run parameters of the model. Thus, the result of the estimation is presented in Table 4:

Table 4: Estimated Model Based on Equation (3) and (4)

Dependent Variable: $logC0_{2t}$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$logFDI_{t(-1)}$	0.070901*	0.02071	4.22361	0.0120
$logMANexp_{t(-1)}$	0.089203	0.05761	1.54846	0.5943
C	-0.029742	0.01956	-1.52045	0.0728
$\Delta logC0_{2t(-1)}$	-0.297776	0.20607	-1.44501	0.8643
ΔlogFDIt	0.874102	4.98540	0.08809	0.9487
$\Delta logFDI_{t(-1)}$	0.004117	0.01487	0.27677	0.8932
$\Delta logMANexp_{t}$	0.065097	0.73900	0.08809	0.9342
$\Delta logMANexp_{t(-1)}$	0.042581	0.06885	0.61849	0.7432
$ECM_{(-1)}$	-0.482408**	0.18686	-2.58164	0.0420

Note: *, ** and *** indicate significance at 0.01, 0.05 and 0.10 level respectively. Probability values are quoted in square brackets. MA and ARCH denote LM-type Breusch-Godfrey Serial Correlation LM and ARCH test, respectively, to test for the presence of serial correlation and ARCH effect. JB and RESET stand for Jarque-Bera Normality Test and Ramsey Regression Specification Error Test, respectively.

II. Model Criteria / Goodness of Fit:

R-square = 0.612; Adjusted R-square = 0.461; F-statistic = 5.16 [0.047]*

III. Diagnostic Checking:

JB = 6.27 [0.133]; LM-1 = 6.354 [0.704]; LM-2 = 4.9597 [0.838]; LM-3 = 7.537 [0.5819]; ARCH (1) = 0.148 [0.536]; ARCH-2 = -0482. [0.841]; ARCH-3 = -0.832 [0.726]; White Heteroskedasticity = 54.441 [0.243]; Ramsey RESET = -0.900 [0.937]

Source: Computater using E-views 7.0 Econometric Software

The use of bounds cointegration test is adopted in this research. The mixture of both I(0) and I(1) variables in the unit root test would not be possible under the Johansen procedure. This gives a good justification for using the bounds test approach, or ARDL model, which was proposed by Pesaran *et al*. (2001). The result is presented in Table 5:

Table 5: Bounds Test Critical Values for Co integration Analysis

Critical Value	Lower Bound Value	Upper Bound Value
1%	3.74	5.06
5%	2.86	4.01
10%	2.45	3.52

Note: Computed F-statistic: 5.16 (Significant at 0.05 marginal values). Critical Values are cited from Pesaran et al. (2001), Table CI (iii), Case 111: Unrestricted intercept and no trend

Source: Computer using E-views 7.0 Econometric Software

In Table 5 the results of the bounds co-integration test demonstrate that the null hypothesis of against its alternative is easily rejected at the 1% significance level. The computed *F*-statistic of 5.16 is greater than the upper critical bound value of 4.01, thus indicating the existence of a steady-state long-run relationship among $InC0_{2t}$, $InFDI_t$ and $InMANexp_t$.

Granger Causality Test

Granger causality test is used to test the direction of causality between FDI and C02, FDI and MANexp, $C0_2$ and MANexp. Granger (1969) proposed a time series data based approach in order to determine causality. In the Granger sense, X is a cause of Y if it is useful in forecasting Y. This means that X is able to increase the accuracy of the prediction of y with respect to a forecast, considering only past values of Y. The direction of causality determines the direction of the relationship among variables and Granger causality test has four directions for these purposes:

(a) Unidirectional Granger-causality from X to Y and not vice-versa
(b) Unidirectional Granger-causality from Y to X and not vice-versa
(c) Bidirectional or feed-back causality from X to Y and or from Y to X
(d) Independence or lack of causality

The result of the granger causality is presented in Table 6:

Table 6: Granger Causality Test Result

Null Hypothesis	F-stat	Prob.	Decision	Direction
$logMANexp_t$ does not granger cause $logC0_{2t}$	0.54283	0.5887	Accept	Independence
$logC0_{2t}$ does not granger cause $logMANexp_t$	0.63005	0.5419	Accept	
$logFDI_t$ does not granger cause $logC0_{2t}$	7.66127	0.0030*	Reject	logFDIt→$logC0_{2t}$
$logC0_{2t}$ does not granger cause $logFDI_t$	0.37612	0.6908	Accept	
$logFDI_t$ does not granger cause $logMANexp_t$				
logMANexpt does not granger cause $logFDI_t$	0.73315	0.4904	Accept	Independence
	0.18561	0.8317	Accept	

Note: → indicates the direction of causality

Source: Computer using E-views 7.0 Econometric Software

Results and Discussions

To investigate the presence of random walk in the time-series data, a unit-root test is carried out. This is to ascertain the stationary nature of the data to avoid a spurious regression model. The results obtained are reported in Table 4. Based on the ADF test statistic, it was initiated that out of three variables, two have unit root i.e., $logC0_{2t}$, and *logMANexp* while log*FDIt* is I(0) variable. Noticeably, the mixture of both I(0) and I(1) variables would not be possible under the Johansen procedure. This gives a good justification for using the bounds test approach, or ARDL model, which was proposed by Pesaran *et al*. (2001).

The estimation of Equation (3) and (4) using the ARDL model is reported in Table 5. The goodness of fit of the specification, that is, *R*-squared and adjusted *R*-squared, is 0.612 and 0.461 respectively. The robustness of the model has been definite by several diagnostic tests such as Breusch- Godfrey serial correlation LM test, ARCH test, Jacque-Bera normality test and Ramsey RESET specification test. All the tests disclosed that the model has the aspiration of econometric properties, it has a correct functional form and the model's residuals are serially uncorrelated, normally distributed and homoskedastic. Therefore, the outcomes reported are serially uncorrelated, normally distributed and homoskedastic. Hence, the results reported are valid for reliable interpretation.

Table 5 indicates that FDI inflows have a positive impact on $C0_2$ emission. If there is one percent increase in FDI inflows, $C0_2$ increases by 0.072 percent. This analysis demonstrates that, in the long-run, pollution haven hypothesis holds in Nigeria, as coefficient of FDI variable is positive and has significant effect on $C0_2$ emission over the period. This findings is consistent with the works of Ajide & Adeniyi (2010); Jonathan & Kehinde (2013); Riti & Kamah (2015); Akbostanci, Tunci & Turuk-Asik (2004); and Baek and Koo (2008) who asserted that FDI inflows in both countries are found to have a detrimental effects on environmental quality in both the short- and long-run. Also, they found that, there exists a unidirectional causality from FDI inflows to economic growth and the environmental degradation proxied by $C0_2$ emission. The coefficient of MANexp is also positive but not statistically significant. Though the result of emission-exports led hypothesis is positive and insignificant, the findings is in line with the works of Parmeshwar (2013) and Akbonstanci, Tunci & Turuk-Asik (2004) who maintained that pollution intensity of industries seem to be a determinant of exports. The coefficient of determination (R^2) shows that 61% variation in $C0_2$ emission is caused by the joint variation in the independent variables. This is also supported by the F-statistic value of 5.16 greater than the F-tabulated value of 2.34. However, the result shows that short run dynamics are statistically insignificant.

On the cointegration test the result demonstrates that the null hypothesis against its alternative is easily rejected at the 1% significance level. The computed *F*-statistic of 5.16 is greater than the upper critical bound value of 4.01, thus indicating the existence of a steady-state long-run relationship among $InC0_{2t}$, $InFDI_t$ and $InMANexp_t$. That is, though individually, the series have short run distortions, but in the long run, there is a steady equilibrium.

The granger causality test in table 6 shows that causality runs from FDI to $C0_2$. This is an indication that as more FDI flows into the country more pollution is expected. This further consolidates on the findings of Baek and Koo (2008) who found that, in the short-run, there exists a unidirectional causality from FDI inflows to the environment. The ECM is rightly signed by having negative value. The speed of adjustment hovers around 48%.

Conclusion and Policy Implications

The main objective of multinational companies is to maximize profit; investment under such a motive will cause negative effects to the host countries. Pollution emission is closely associated with manufacturing output and the performance of a sector is sometimes measured by its exports. This paper examined the relationship between FDI, Manufacturing export proxy for growth and the environment ($C0_2$ emissions) in Nigeria between year 1981-2013. The unit root result shows that $C0_2$ and MANexp have unit root and are stationary at first difference while FDI is stationary at levels but at 10% significance level. The bounds co integration test indicates that the variables have steady and long run relationship although, individually they are not stationary. The granger causality also shows that causality runs from FDI to $C0_2$ while neither causality was detected between $C0_2$ and MANexp nor between FDI and MANexp. This means growth rate of pollution ($C0_2$) is granger caused by growth rate of FDI inflows. The results of the estimates supported the existence of Pollution Haven Hypothesis in Nigeria for the period under study. This is because only FDI coefficient possesses the appropriate sign (positive) and is statistically significant. Most studies focused on the relationship between FDI and emission. This study was able to point out the relationship between manufacturing export and emission aside the FDI-emission led hypothesis. Policy makers therefore can be armed with the policy of diversification of the FDI inflows into the economy. The ECM is rightly signed by having negative value. The speed of adjustment of the variables from short run distortions hovers around 48%. The intuition behind the results lies on the catalytic role which FDI plays in causing $C0_2$ emission (pollution) in the economy.

This empirical result is plausible given the fact that multinational companies invest mostly in oil and energy sector while little or no attention is paid to the other sectors of the economy like tourism, agriculture etc. The paper therefore recommends that government in bid to pursue economic growth and bridge savings gap should also pursue cleaner technological FDIs and also encourage FDIs in other sectors of the economy (diversification) rather than attracting FDIs that concentrate only in the oil and energy sector alone. In addition, environmental laws should be instituted to ensure that environmental friendly goods are produced. Finally, the paper suggests

that future researchers on this topic should look at the pollution haven hypothesis in two empirical consequences, namely: FDI outflow in developed countries is positively correlated with environmental policy stringency and pollution in developing countries is positively linked to FDI inflow. In addition, issues of other determinants of FDIs aside environmental policies should be considered by developing countries in bid to attract foreign direct investment.

Competing Interest

The author declares that he has no competing interest

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