SPATIAL ECONOMETRIC ANALYSIS OF INBOUND FOREIGN DIRECT INVESTMENTS IN NIGERIA:

A Geographically Weighted Regression Approach

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ABSTRACT

This paper empirically analysed the spatial distribution and identified key determinants of foreign direct investments (FDIs) in Nigeria using data on the 36 states and the Federal Capital Territory. Unlike extant studies on FDI, the approach pursued here is not only disaggregated but also spatial to better reflect observed state-level disparities often masked by conventional aggregate-level analyses. Data from the Nigerian Capital Importation Report (2014) and other official sources were used. The spatial econometric analysis of the data was conducted using ordinary least squares (OLS) and the geographically weighted regression (GWR). Several interesting results ensued, chief among which are: marked variations in the geographical distribution of FDI in Nigeria with the largest volume in Lagos; access to transport infrastructure (in terms of access to airports and seaports) and their corresponding distances also significantly influenced FDI flows to states; and Lagos State appeared to be the only FDI cluster albeit surrounded surprisingly by relatively FDI poor states. In policy terms, therefore, concerted efforts have to be made by government to provide the necessary infrastructure in a more spatially balanced manner. This will make other states, apart from Lagos, more attractive for foreign investment and ultimately result in ameliorating the tensions that typically arise from marked regional discrepancies in access to economic opportunities.

JEL classification: F23, L13, O16, P20

1. Introduction

Mainstream development perspectives, for the most part, argue for the crucial role of foreign direct investment (FDI) in steering the economy on a sustainable path to prosperity. In particular, its influence in terms of economic growth, employment generation, transfer of technology, among others has been widely documented (Asiedu, 2002; Raheem and Ogebe, 2014). Despite the well-known existence of diverse categories of capital – portfolio investment, remittances, FDI, and official development assistance (ODA) among others – there is widespread recognition of the prominence of foreign direct investment as a key predictor of economic growth (Adeniyi et al., 2015). In 2004, for example, FDI accounted for half of total capital flows to developing countries, while remittances, ODA and portfolio investment split the remaining half (World Bank, 2011).

It therefore explains why the attraction of substantial volumes of FDI has ranked high in the policy priorities of most developing economies, especially African countries. While available statistics show an increase in global FDI flows from $13.3 billion in 1970 to $2.1 trillion in 2007, Africa's share of these FDI flows fell precipitously from 9.5 per cent in 1970 to 5.3 per cent in 2009 in stark contrast with the 27 per cent share for developing economies in Asia in the latter year (Ajide and Raheem, 2016). This implies not only low FDI inflows to Africa but also a declining share of global flows. Hence, success with FDI attraction will not only offer a means of putting downward pressure on poverty rates but also position Africa to record considerable improvements in wellbeing as laid out in the sustainable development goals (SDGs).

Why is FDI such an important source of capital for development finance? The answer to this question is far from straightforward. Nonetheless, several factors have been touted as important pull factors for FDI. Although the list of such factors remains endless, human capital development, physical capital accumulation, market size, natural resource endowment, financial sector development and institutional quality are some of the most prominent (see for instance Alfaro et al., 2006; Demirhan and Masca, 2008; Abdul-Mottaleb and Kalirajan, 2010; Anyanwu, 2011).

It is imperative to stress at this point, that these causal factors do not only influence the volume of FDIs but also its spatial distribution. This is in recognition of the fact that the occurrence and degree of intensity of outcomes

result from the uneven distribution of associated determinants. In other words, a given outcome and its related factors are spatially heterogeneous. This implies that the existence and the strength of a given relationship varies in geographic space simply because outcomes and causal factors are not uniformly distributed in space. This phenomenon is best known as spatial non-stationarity, which describes a situation in which relationships between variables are not continuous over space. Brunsdon et al. (1996: 281) also describe it as "a condition in which a simple "global" model cannot explain the relationship between some sets of variables".

In light of these facts, it is likely that FDI and its drivers would vary geographically. However, uncovering their spatial patterns and detecting spatial non-stationarity in relationships, as several authors have stressed, are not easy tasks to accomplish with the aid of traditional statistical methods such as the classical ordinary least squares regression because of their incapacity to " . . . satisfy contemporary policy needs" (Nkeki and Osirike, 2013: 532). This can be traced to the widely established but fundamentally defective assumption of spatial stationarity or simply spatial homogeneity. The corollary of this is that though the dependent variable may be unevenly distributed, the distribution of independent variable(s) is spatially homogenous.

In the quest for a better understanding of spatial non-stationarity, the geographically weighted regression (GWR) technique was devised by Brunsdon et al. (1996). The technique is a local spatial tool simply designed to ascertain whether conditions are constant over space or vary from one location to another (Meade and Emch, 2010). Owing to its unique ability, it has found wide appeal in many areas of research: crime and terrorism (Breetze, 2012; Yildirim and Ocal, 2013), health care provision (Zhang et al. 2011), electoral studies (Taiwo and Ahmed, 2015), spatial epidemiology (Tu et al., 2012; Nkeki and Osirike, 2013, Chalkias et al., 2013; Wabiri et al., 2016), air quality (Lin et al., 2013), soil studies (Wang et al., 2013) and natural hazards (Martinez-Fernandez et al., 2013).

With the service of the above-mentioned tools and other techniques such as Global Moran's I and Local Moran's I, the key questions of interest to pursue in this paper therefore include: how is inward FDI in Nigeria distributed across geographic space? Is there clustering of FDIs and/or are there agglomeration effects? Which factors are the most important determinants of the observed state

level variations in FDI in Nigeria? Does spatial non-stationarity exist in the relationship between FDI and its determinants? Finally, are there policy lessons to be learnt from the foregoing? The present paper contributes to the existing stock of evidence on the determinants of FDI in Nigeria in a number of ways. First, the focus on FDI destination on a state-by-state basis makes this a pioneer attempt. It is reckoned that this finer grained analysis offers more insights than earlier empirical works that used aggregate data. This is especially the case where the interest rightly is the germane purpose of policy articulation. Second, the regional dimension of our within-country approach will also help identify FDI clusters that can serve as the source points for spillovers which can drive regional development. Third, this is, to the best of the authors', the first application of spatial statistical techniques to the study of FDI in Nigeria. Lastly, applicable national as well as regional policy implications to be drawn from this scholarly effort are very alluring owing to their specificity. Of course, such appropriate policy mix will foster the achievement of the twin objectives of increasing FDI flows into Nigeria and ensuring that regional inequalities are squarely addressed.

The structure of the paper is as follows. Following this introductory narrative, section 2 provides background information particularly on trends in FDI flows at the global, continental and national levels. Section 3 offers a concise review of the literature, while the details with respect to methodology and data issues are espoused in section 4. Sections 5 presents the results while the discussion and conclusion are in section 6.

2. Background/Trends in Foreign Investment

Developed countries have continued to receive the largest chunk of the global flow of FDI, which accounts for over 70 per cent on the average. The balance of less that 30 per cent is left for the developing countries (see table 1). This implies that FDI is driven by infrastructural facilities. Developed countries were able to attract that huge volume based on their high level of infrastructural development. A reclassification of the FDI flow on a continental basis shows that Europe and America are the major destinations of FDI flows. The existence of the "Asian Tigers" helped the region to record about 15 per cent. Its share was not stable prior to 1990 after which it had been recording an increasing trend. The reason for this can be linked to the diversification of American multinational enterprises

(MNEs) to the region due to its low labour cost, thus leading to industrialization in the region (Raheem and Oyinlola, 2013). Despite the exploration of natural resources and presence of foreign companies in the extractive industries of African countries, the distribution of FDI flows has been biased against Africa. The region was only able to attract about 3 per cent of the global flow. It could be hypothesized that foreign investment in the area of services and manufacturing is still quite low. This below par performance is in part due to the constraints imposed by factors such as inconsistent policies, political instability and poor infrastructure, among others.

Table 1. Global FDI Flow (inward) as a Percentage of GDP (1970-2013)

	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-10	**Average**
World	100	100	100	100	100	100	100	100	**100**
Developing Economies	22.5	27.59	31.95	18.74	29.87	31.74	27.24	36.53	**28.27**
Developed Economies	77.49	72.41	68.03	81.24	69.45	66.91	69.01	64.51	**71.13**
Africa	6.55	3.94	2.61	2.48	2.15	1.61	2.47	3.99	**3.22**
America	24.64	26.47	36.68	42.25	20.74	24.78	18.83	17.71	**26.51**
Asia	4.51	10.59	18.34	9.95	19.62	18.61	16.87	22.47	**15.16**
Europe	44.99	40.75	26.88	33.68	44.31	39.11	46.15	37.93	**39.23**
LDCs*	0.92	1.5	0.86	0.48	0.69	0.64	1.31	1.75	**1**

Source: Excerpt from Raheem and Oyinlola (2013).

* = Less developed countries

Table 2 depicts FDI flows into developing countries only. An interesting point to note is the significant share (over 50%) which Asia was able to attract. The dominating strides of the Asian Tigers attest to this outcome. The Caribbean and Latin America are the second highest beneficiaries of FDI flows. Despite polices put in place to serve as incentive for FDI inflows, the Africa region was only able to attract a meagre 10 per cent of the total flow to the developing region. The share of LDCs has been fairly stable and increasing, at an average of about 4 per cent. Oceania performed poorly as it was only able to attract 0.23 per cent of the total FDI flow.

Table 2. Regional Distribution of FDI to Developing Countries

	1975-84	1985-94	1995-99	2000-2004	2005-2010
Developing Economies	100	100	100	100	100
Africa	9.35	8.22	4.81	7.25	9.56
Carribean and Latin America	38.01	28.23	41.13	36.18	32.51
Asia	48.93	60.75	51.77	52.68	53.49
Oceania	0.71	0.57	0.19	0.11	0.23
LDCs*	2.99	2.19	2.07	3.77	4.21

Source: Excerpt from Raheem and Oyinlola (2013).

FDI inflow into Nigeria from 1970 to 2013 and its value as a percentage of GDP is presented in table 3. It depicts that during 1970-1974, inflow of FDI stood at an annual average value of US$ 285.2 million and it increased slightly to US$354 million between 1975 and 1979. Nigeria implemented the indigenization policy in 1972 as well as the Nigerian Enterprises Promotion Decree (NEPD). This government action restricted FDI entry into Nigeria. Later in 1977, government further tightened this policy stance which plausibly explains why FDI initially increased slightly during 1975-1979 and declined to as low as US$157.5 million between 1980 and 1984.

FDI inflow into Nigeria bounced back during 1985–1989 to an average annual value of US$710.5 million. The impressive foreign investment inflow during this period could be attributed to the introduction of the privatization policy in 1986 and government efforts in 1989 to relax restrictions placed on FDI entering the economy. Apart from privatization, the Nigerian Investment Promotion Commission Act was passed in 1995. This Act enabled foreign investors to invest in all sectors of the Nigerian economy and also allowed them to hold up to 100 per cent ownership share in an organization, except in the petroleum sector where FDI was limited to joint ventures.

The democratic transition experienced in the country in 1999 as well as further privatization of sectors such as telecommunications supported FDI inflow, pushing it up to an estimated annual amount of US$1,616 million for 2000 to 2004. The value rose sharply during 2005-2009, to an annual average

of US$6524.8 million. Since 2010 however, FDI inflow into Nigeria has been on the decline, except in 2011 when the inflow rose. The decline has been attributed to the global financial crisis of 2008-2009 and the weak global economy that is currently being experienced. Despite the high inflow of FDI into the Nigerian economy, FDI as a percentage of GDP in Nigeria is very low. It was less than 10 per cent between 1970 and 2013 with the peak value of 5.4 per cent in 1990-1994, a few years after the relaxation of FDI restricting policy in the country.

Table 3. Trend of Nigeria Foreign Direct Investment from 1970 to 2013

Year	Foreign direct investment, net inflows (BoP, current US$) in million	Foreign direct investment, net inflows (% of GDP)
1970-1974	285.2	2.14
1975-1979	354.03	1.01
1980-1984	157.53	0.45
1985-1989	710.45	2.91
1990-1994	1100.29	5.38
1995-1999	1253.68	3.74
2000-2004	1616.84	2.68
2005-2009	6524.67	4.07
2010	6048.56	1.63
2011	8841.95	2.14
2012	7101.03	1.53
2013	5609	1.07

Source: World Development Indicators.

3. Literature Review

3.1 Growth Pole Theory

The core premise of this theory is the notion that the pace of economic growth will typically differ across regions within a given country. This pattern is predicated on the spatial clustering of economic activities in line with regional peculiarities. Therefore, development is likely to be uneven on a cross regional basis and polarization is an evident concomitant effect.

The initial objective of the theory was not to consider the spatial implication of development in geographical terms, but to draw an abstract in terms of economic space. Hence, concepts such as growth pole, growth centres, core areas, among others, gained ascendancy in the lexicon of both researchers and policymakers engaged in dealing with the problems of regional development disparities.

The key selling point of this theory is the possibility of the coincident satisfaction of multiple goals, particularly sustained economic growth, stable interregional equilibrium, enhanced regional integration as well as an assortment of other desirable macroeconomic outcomes, all within a decentralized framework for development planning. Despite the initial wide acceptance of the theory, the concept has, however, been criticized for its weak "political" explanation of using the concept to solve regional development problems. Paelinck (1965) was of the view that the critique of the theory is based on the misconception of the theory assuming that the growth pole theory is all about industrialization, which will guarantee aggregate economic growth. Also, Higgins (1988) was of the view that the initial presentation by Perroux was too abstract, too complex and too nonoperational to be used for planning. Hence, he argued for a simpler, detailed and explicit illustration of the theory.

3.2 Core-Periphery Model

This model is attributed to Krugman (1991). The model describes how the movement of labour leads to economic growth through concentration in a region (agglomeration) on the condition that the taste for product variety and the share of manufacturing expenditure are large enough, and transportation costs low. Specifically, the model describes the nonlinear distribution of economic activities in spatial economy caused by the interplay of scale economies and transport costs. The Core-Periphery Model (CPM) has led to the emergence of the so-called "New Economic Geography" theoretical literature (e.g. Fujita et al., 1999). This model assumes two regions, namely the North (Core) and South (Periphery) with fixed labour endowments. The labour is assumed to be deployed only in two activity sectors (manufacturing and agriculture). While agricultural labour is immobile, manufacturing labour is responsive to wage differentials between the North and South in real terms. CPM further lays

emphasis on the importance of the share of manufacturing in national output as against that of the agricultural sector.

3.3 Agglomeration Externalities Hypothesis

The Agglomeration and Externalities hypothesis expounds the argument that innovative activities at the local level result, over the course of time, in specialization and eventual diversification (following saturation) of the production base of the aggregate economy. The advantages arising from diversification in terms of increasing returns to scale, economies of scale and their attendant reductions in the average cost of production are well documented in the literature (Marshall, 1890; Pellenbarg and Kok, 1985; and Atzema, 2001 are few examples).

Beyond the foregoing purely market-based externalities, knowledge externalities may also arise, which substantially improve the capacity of firms to innovate as a result of positive spillovers. For instance, knowledge sharing may reduce the cost of acquisition for individual firms while also raising the stock of knowledge available in the industry (Griliches, 1979).

However, over and above the implicit assumption of similarity in the activities of firms in the foregoing discourse, Jacobs (1969) avers that knowledge spillovers transcend intra-industry dynamics as the stock of knowledge accumulated in one industry may be appropriated by other industries that are involved, especially in complementary activities. Such knowledge exchanges deepen the search and experimentation efforts into more research and development which in turn, facilitates diversification externalities.

4. Data Sources and Methods

State level data on FDI flows were obtained from the *Nigerian Capital Importation Summary Report* of 2014 published by the National Bureau of Statistics. Values or some states were missing; therefore they were interpolated by averaging the values of neighbouring states. Population size per state was extracted from the 2006 population census published by the National Population Commission. Distance from every state to Lagos (the economic capital), Abuja (the country's capital) and the sea were culled from the country's distance chart. State GDP per capita and human development index (HDI) were assembled from

the *Human Development Report 2009* published by the United Nations Development Programme (UNDP). The figures for percentage population engaged in the manufacturing sector per state were retrieved from the *2009/2010 Harmonized National Living Standard Survey Report* published by the National Bureau of Statistics. The number of crop farmers was culled from the *Annual Abstract of Statistics 2009*, also published by the National Bureau of Statistics. Market potential was calculated for each state using the Potential Model. Political instability was measured by a dummy variable. In this regard, states under siege of insurgency of the Boko Haram group were coded one (1) while unaffected states were assigned zero (0).

Global Moran's I measured the degree to which FDIs clustered in space. The index value is in between -1 and +1. There are three possible outcomes of this analysis. First, positive spatial autocorrelation (+1) means states are bordered by states with similar FDI flows. Second, negative spatial autocorrelation (-1) means that states with high FDI flows are surrounded by those with low flows or vice versa. Third, random spatial autocorrelation means there is an absence of spatial autocorrelation. The local Moran's I was employed to show the agglomeration of FDIs in space. The technique specifically detected the concentrations of FDIs.

Five local spatial patterns are likely to emerge from the analysis:

a. High-High (HH) – states with high FDI inflows surrounded by states with similarly high FDI inflows,
b. High-Low (HL) – states with high FDI flows surrounded by states with low FDI flows,
c. Low-High (LH) – states that have low FDI volume surrounded by those with high volume,
d. Low-Low (LL) – states with low FDI flows surrounded by states with similarly low FDI flows.
e. Not significant – No cluster.

The ordinary least squares (OLS) regression analysis was used to determine the joint and individual contributions of independent variable(s) to the dependent variable. The model is expressed as:

$$y = \beta + \beta_1 x_1 + \beta_2 x_2 + \ldots + \varepsilon \quad (1)$$

where:

y = dependent variable or predicted variable

x = vector of independent or explanatory variable

ε = error term or stochastic disturbance

In addition to these parameters, the model offers a variety of diagnostic tests. Koeneker statistic detects spatial non-stationarity. Jarque Bera checks if residuals are not normally distributed. Studentised Breusch Pagan (BP) tested for homoscedasticity. Variance Inflation Factor (VIF) tests for multicollinearity (variable redundancy); if the VIF for a given independent variable is about or greater than 7.5, it means the given variable is redundant. A basic assumption of the model is that the relationship between the dependent and explanatory variable is constant across space. This is in fact its major shortcoming. Therefore, the OLS is most often deemed unsuitable for the analysis of geographically-variable phenomena. In order to overcome the limitation, the trio of Fotheringham, Brundson and Chartlon developed the Geographically Weighted Regression (GWR) (Brundson et al., 1996). GWR, as earlier emphasized, is a local spatial regression technique which investigates spatially varying relationships over space. It is particularly concerned with how associations change from location to location. GWR has extended the traditional regression framework by allowing local rather than global parameters to be estimated so that the model is rewritten as:

$$yi = a_0(u_i, v_i) + \Sigma_k \, a_k(u_i, v_i) \, x_{ik} + \varepsilon_i \quad (2)$$

where:

yi is the FDI for each state; (u_i, v_i) are the co-ordinates of the centroid of state i, a_o and a_k represent the local estimated intercept and effect of variable k for state i, respectively. Interestingly, these parameters are mappable as would be illustrated subsequently.

After both models were estimated, the results were compared to see the differences in the association between FDIs and the explanatory variables.

Akaike Information Criterion (AIC) was used to compare the explanatory powers of the OLS and GWR models. The comparison indicates whether accounting for geographic disparities significantly improves the model fit. Models with smaller AIC values have better fit. Unlike R^2, AIC is an absolute measure used to compare different models with the same dependent variable. OLS and GWR analyses and cartographic designs were done with the help of ArcGIS 10.0 version.

Eight domains, comprising seventeen variables, were selected for this study. Each is presented, together with the theoretical basis for the choice:

1. *Distance:* Distance was measured in terms of road distance to Lagos, the economic capital; distance to major seaport and distance to Abuja, the nation's capital. Distance, in our view, is inversely related to FDI. It is assumed that FDI would be more concentrated in or close to the country's capital, seaport and economic hub. In other words, the volume of FDI would decrease with increasing distance from these locations. Proximity to the coast is a key determinant in the outflow of Indian FDIs to South Africa, Mauritius, Nigeria, Kenya and Tanzania (Paul, 2014). The significance of distance is further confirmed by Abumere (1976), Chidlow et al. (2009), Nsiah and Wu (2014). However, it has also been corroborated that geographical distance may be overlooked if natural resources are at stake (Gonchar and Marck, 2013).
2. *Market size:* Market size is a major determinant of FDI inflow. It confers some advantages on investors, such as high revenue generation, economies of scale and availability of skilled labour. Comparatively speaking, states with large markets present greater opportunities for profit making than states with smaller market sizes. Therefore, areas with relatively large markets would be more attractive (O'Hagan, 2000). No doubt, the size of the market to the investor is a strong indicator of investment opportunity because of the consumer demand for goods and services on which FDI depends. In the words of Castellani et al. (2016: 673), "FDIs are located in the region where they can exploit economies of scale to a greater extent . . . " The role of market size is confirmed by Coughlin and Segev (2000) Charkrabarti (2001), Castro et al. (2007), Naudie and Krugell (2007), Hoa (2002), Jiang et al. (2013), Petrakou (2013), Villaverde and Maza (2015) and Castellani et al. (2016). It was

measured by population size and market potential. Market potential for each state was computed using the market potential model:

$$M_i = \sum P_i / D_{ij}$$

where:

P is the population of state *i*

D is the road distance separating states *i* and *j*

3. *Economic prosperity:* Economic growth can increase a region's share of FDI (Coughlin and Segev, 2000). Empirical evidence shows that economic growth has a positive effect on FDI flows. Larger economies are said to draw more investment because of the potentially large demand for the goods and services of foreign-owned companies (Coughlin and Segev, 2000). This is in consonance with Chidlow et al. (2009), Petrakou (2013), Anyanwu and Yameogo (2015a). Human development index (HDI), internally-generated revenue (IGR) and state GDP per capita were adopted as surrogate measures for economic prosperity.
4. *Political instability:* FDIs are influenced by degree of political instability (Lucas, 1990). Areas with politically unstable climate, under normal circumstances, are not host destinations for FDIs. Conflicts and civil violence impede FDI flows (Chidlow et al. 2009). For instance, some Indian firms, in recent times, shut down following political instability in some parts of Africa (Paul, 2014). Meanwhile, politically stable environments attract investments because of the favourable atmosphere for doing business. The role of political (in)stability in the location of FDIs has been strongly emphasized in studies such as Bolen and Jones (1982), Nguyen and Nguyen (2007), Petrovic-Randelovic et al. (2013), Anyanwu and Yameogo (2015b), and Ezeoha and Ugwu (2015). However, a somewhat different perspective says that some investors are more concerned about economic freedom than the political freedom in more democratic states because even the best of democratic states may not be able to give these firms the economic liberty they desire (Mathur and Singh, 2013). In this paper, states troubled by Boko Haram

insurgency (BH affected states), as earlier presented, were labelled one (1) while the value was zero (0) for other states.

5. *Industrial establishments:* States with manufacturing activity attract more FDIs because these investments could possibly 'feed' the existing manufacturers (Coughlin et al. 1991, Antonescu, 2015). A proportion of FDIs is often directed at the manufacturing sector of the economy. In fact, FDIs attract industries and in turn lead to regional industry specialization (Saha et al. 2014). According to Gonchar and Marek (2013: 6), "If existing agglomerations generate cost savings and productivity gains for local and foreign-owned firms, they may attract new foreign entrants that decide to establish themselves with existing agglomerations". This variable was represented by the percentage of the population with jobs in the manufacturing sector.
6. *Level of urbanization:* Urbanization is often considered to be an important factor in the spatial distribution of FDIs. Proximity to urban centres guarantees higher availability of qualified labour force, access to social amenities such as water and electricity, which in most cases is a primary consideration in FDI location. The farther away from an urban complex, the fewer the investments would be. This agrees with prior studies such as Castro, Regis and Salsausky (2007), Chidlow et al. (2009), Petrakou (2013), Bartoluzzo et al. (2013), Korez-Vide and Voller (2014), Saha et al (2014), and Jones and Wren (2016). In this study, level of urbanization is measured by a proxy – population density (computed as state population size divided by area of the state). Following this, any state whose population density exceeded the national average of 151 persons per square kilometre was classified as urban.
7. *Transport infrastructure:* The existence of highly developed transport infrastructure is an important investment criterion for FDIs. The availability of transport infrastructure in a state makes it attractive to investors because of the guaranty of high returns on investment (Hoa, 2002; Castro et al. 2007, Selhausen, 2009; Banno and Redondi, 2014, Kiel et al. 2014; Wekesa, 2015; Dwakakish and Salim, 2015). This was quantified by road density per state, as well as number of seaports and airports in each state.

8. *Natural resource endowment:* Regions or territories with abundant natural resources would draw more resource-seeking FDIs than states with little or none. Previous research has shown that natural resource endowment is basic to FDI (Naude and Krugell, 2007; Gondchar and Marek, 2013; Chiang, 2014; Anyanwu and Yameogo, 2015a; Anyanwu and Yameogo, 2015b). Here, natural resource endowment was quantified in terms of volume of crude oil production, and agricultural production (number of crop farmers per state).

5. Results

There is a marked variation in the geographical distribution of FDI flows in the country (figure 1A). High amounts of FDI were concentrated in the Federal Capital Territory ($106,121,234), Lagos ($18,479,700,300) and Enugu ($75,592,063), while Bauchi ($38,978), Osun ($62,500) and Yobe ($32,000) had the lowest amounts. It is interesting to note a region of moderate FDI flows, excluding FCT along the middle belt of the country: Niger ($18,455,437), Benue ($18,920,625) and Nassarawa ($21,712,023).

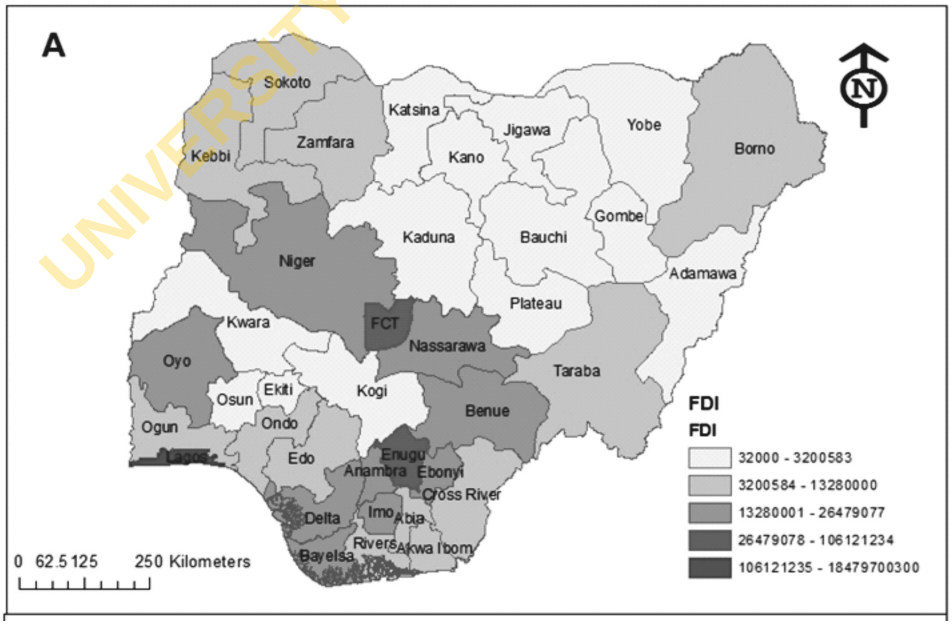

Figure 1A. Geographical Distribution of FDIs in Nigeria.

Following these observations, the next step is to find out if these investments cluster in space and if so, the nature of the clustering. The global Moran's I analysis yielded a value of 0.015744 (z= 2.050760, p<0.05). The FDIs exhibited a positive spatial autocorrelation, which means that states with high or low FDI flows are adjacent to those with similar values. The local Moran's I indicated that a High-Low (HL) cluster was found in Lagos State (I = -0.0984916, z= -3.3756; p<0.05) (see figure 1B).

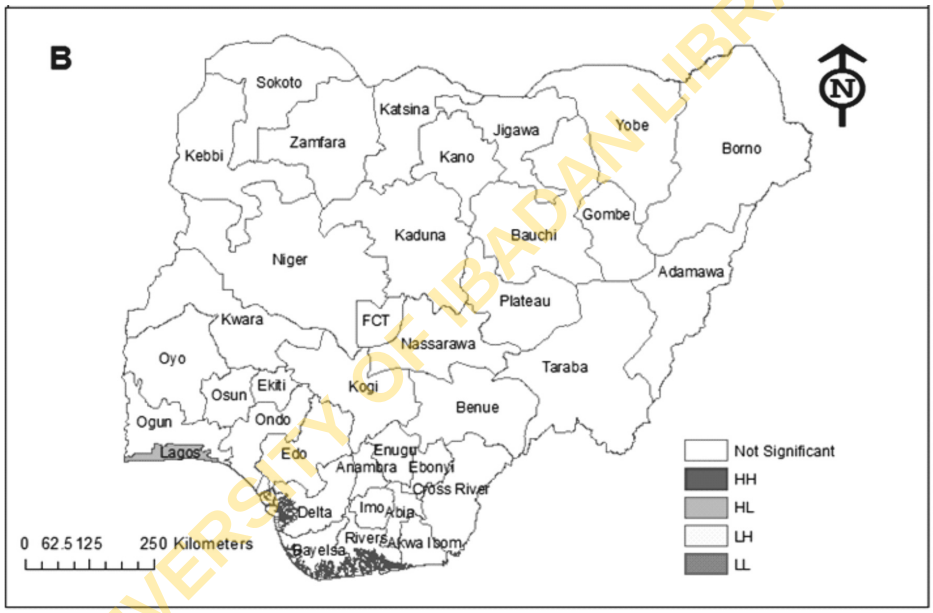

Figure 1B. FDI Cluster in Nigeria.

With respect to the determinants of FDI, table 4 contains a summary of OLS regression results. The results indicate that the number of airports, road density, distance to sea are positively related to FDI, while distance to Lagos, the economic capital is inversely associated with FDIs. The VIF column shows that these variables are necessary in the explanation of the spatial distribution of FDIs. In addition, the OLS regression reveals that these four explanatory variables account for seventy-five per cent of the variance in FDI flows, with a F-value of 24.490 (p<0.05) and AIC of 1677.833. However, the Koeneker

statistic of 18.353 ($p < 0.05$) indicates the presence of spatial non-stationarity in the relationship. The Jarque Bera statistic was significant (JB=6.919; $p<0.05$), which means the residuals are not normally distributed.

Table 4. OLS Regression Results

Variable	Coefficient	T value	P value	VIF
Intercept	-3850518848.74	-3.824042	0.000572	-
Airport	2923235217.14	-2.946550	0.000023	1.78216
Road density	41783969102.40	5.722728	0.000150	1.914647
Distance to economic capital	-2762479.898	4.946453	0.005953	1.234817
Distance to sea	5396043.086	5.083517	0.000002	1.673061
Diagnostics				
R^2= 0.753774	Adj R^2=0.722995	F= 24.5 (P=0.00)	Joint Wald= 15.96 (p=0.003)	
Jarque Bera=6.92 (p=0.03)	Koneker= 18.4 (P=0.0011)	AIC= 1677.833		

The GWR results are presented in table 5. In the GWR model, the regression coefficients of the three variables significantly vary across the country. Besides, there was a random spatial pattern in the GWR residuals (-0.077971, z= -0.588463; $p>0.05$). Based on the AIC values, the GWR model (1667.5542401) is stronger than the OLS model (1677.833003).

Table 5. GWR Results

Diagnostics	
R^2	0.87824
Adj R^2	0.837154
AIC	1667.554201

Thus, the local regression model better explains the spatial distribution of FDIs in Nigeria. In addition, the model explains about 10 per cent to 88 per cent of the variance in FDIs (see figure 2). As depicted in figure 2, there is a west-east gradient in the relationship between FDIs and the explanatory variables. Based on the map classification, the highest local R^2 values were found in the western side particularly in Oyo (0.88), Lagos (0.88), Osun (0.85), Ogun (0.88), Kwara (0.86) and Kebbi (0.84), while the lowest R^2 values obtained in the northeast especially in Adamawa (0.09), Borno (0.18), Yobe (0.11) and Gombe (0.16). The strongest part of the significant positive relationship between FDI and the number of airports was found in the northwestern tip of the country (figure 3). With respect to road density, significant positive relationships were strongest in the lower southwestern part (figure 4). A statistically significant positive relationship with distance to the sea was found across the country particularly along the southern coastal border, except for Borno State which had a negative regression coefficient (figure 5). Finally, the significant negative relationship between FDI and distance to economic capital was exhibited strongly in the northeastern part of Nigeria as expected (figure 6).

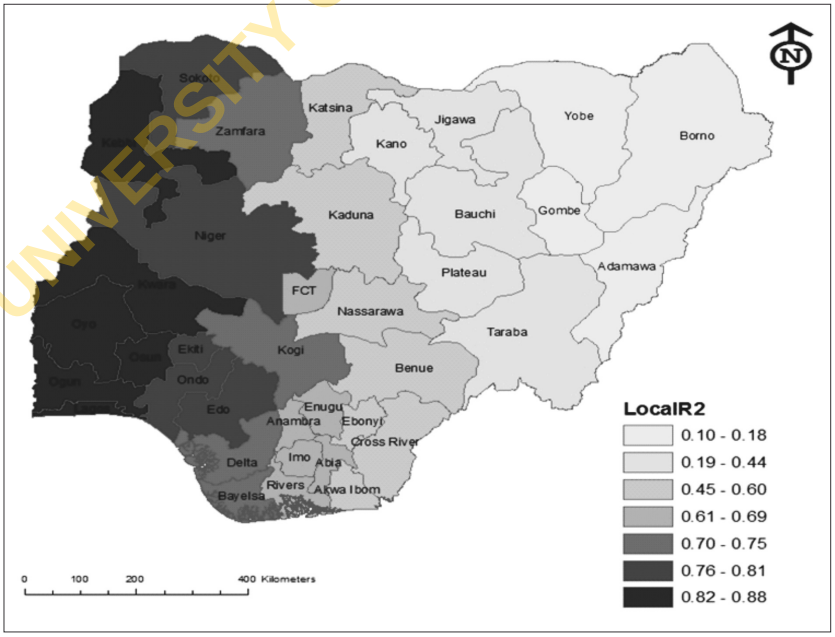

Figure 2. Local R^2 Values.

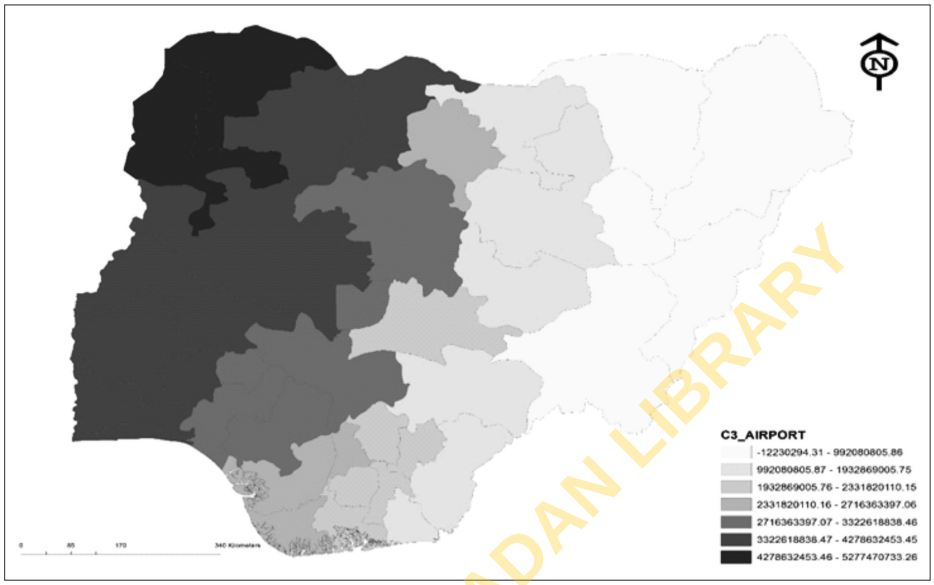

Figure 3. Airports.

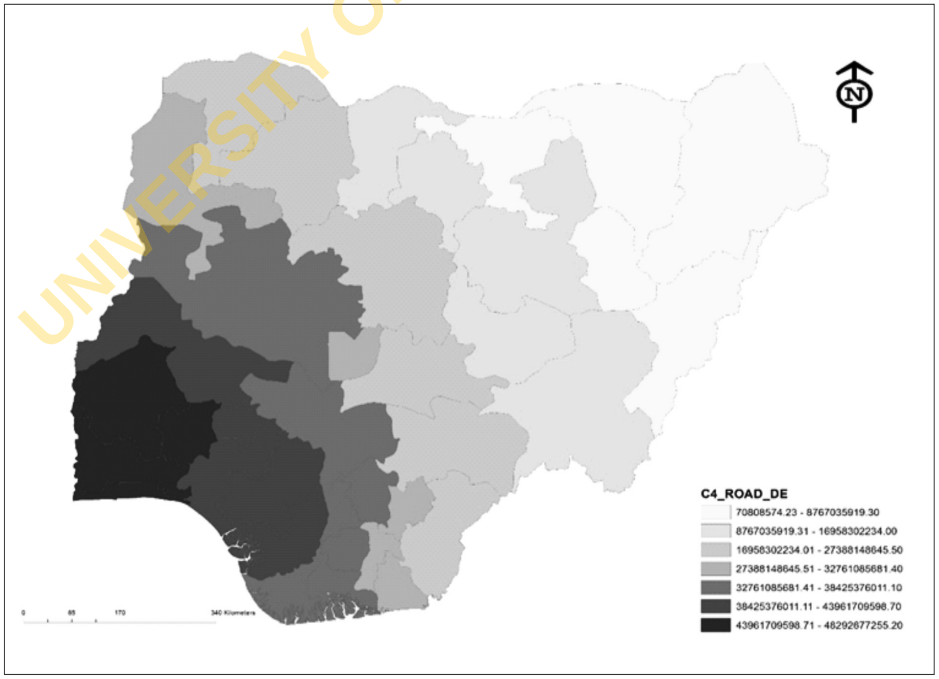

Figure 4. Road Density.

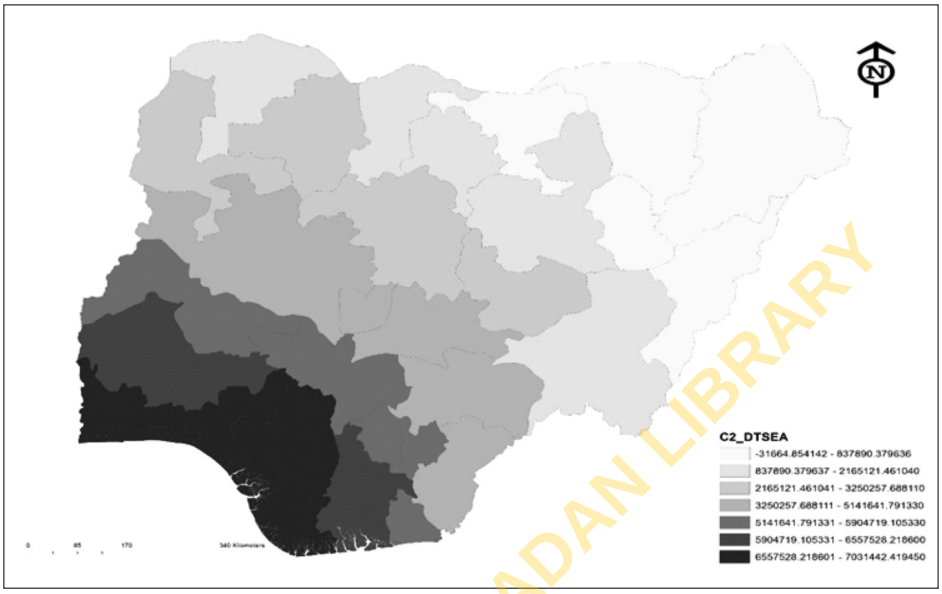

Figure 5. Distance to Sea.

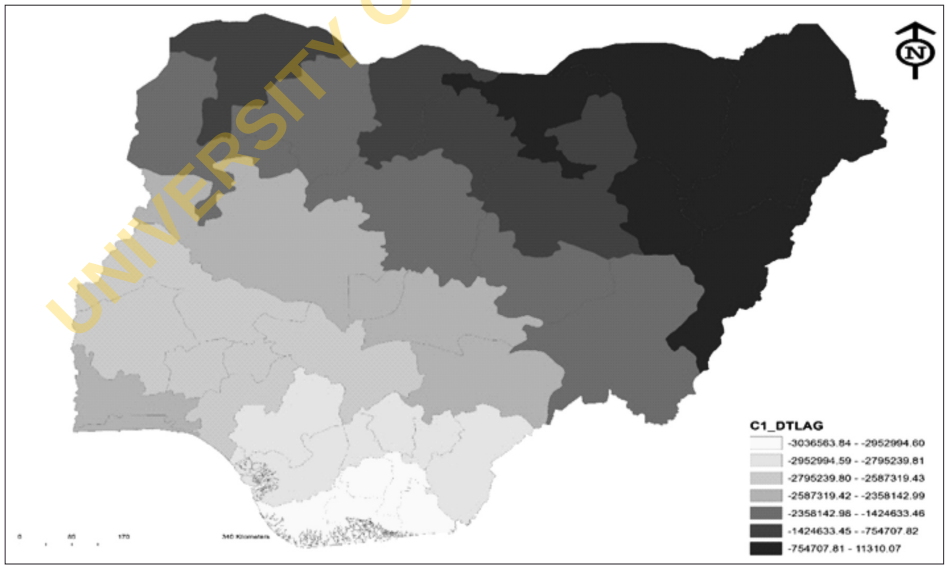

Figure 6. Distance to Economic Capital.

6. Discussion and Conclusion

The results of the study indicate that there are wide disparities in the spatial distribution of FDI in the country. The results also show evidence of positive spatial autocorrelation in FDIs. These findings are similar to the results reported for Russia (Kayam et al., 2013), South Korea (Kim and Han, 2014), China (Coughlin and Segev, 2000; Sharma et al., 2013; Blanc-Brude et al. 2014), Vietnam (Hoang and Goujon, 2014), Brazil (Bortoluzzo et al., 2013) and Mexico (Gamboa, 2013). Lagos had the largest concentrations, while Yobe State had the lowest. The reason for this observation is that Lagos is the economic heartland of Nigeria. It is endowed with vast investment and employment opportunities. It is also the home to numerous local and multinational business organizations. Although the smallest in terms of land area and largest in terms of population size, Lagos is a financial power to reckon with in Africa. In a recent commentary, the Lagos State Government (2013: 42) said:

> "If Lagos were a country in its own right, its GDP of 80 billion (2010) would make it the eleventh biggest economy in Africa and the largest among all ECOWAS countries"

No doubt, Lagos is the most attractive state for FDI, however it is mostly surrounded by relatively FDI poor states. This conforms with the following studies. In Korez-Vide and Voller (2014), most of the FDIs of German and Austrian origin were largely concentrated in the Brazilian capital and large urban areas. Similarly, Buenos Aires city and province holds more than 50 per cent of the total inflows to Argentina (Castro et al., 2007). In the United States of America, 75 per cent of the FDIs are resident in the largest metropolitan areas (Saha et al., 2014). In Greece, Athens and Thessaloniki account for 30 and 48 per cent of the country's total (Petrakou, 2013). Over 60 per cent of FDIs reside in the Bucharest–Ilfov region of Romania (Sirbu, 2014; Dornean and Oanea, 2015).

Yobe State has one of the smallest economies in the country, largely driven by small-scale subsistence agriculture. The main crops are millet, benniseed, cotton, maize, beans and sorghum. The state is endowed with commercial quantities of limestone, kaolin, gypsum, clay, trona, sandstone, silica, granite,

and diatomite, much of which is largely unexplored (Eze and Olabimtan, 2010; Yobe State Government, 2013). In addition, "the economy of Yobe State is … dependent on statutory constitutionally guaranteed transfers from the federal government. Federal allocations accounted for more than 84 per cent of the state's revenue from 2006 to 2008" (Eze and Olabimtan, 2010: 42). This case is strikingly similar to the Northeast region of Romania which is considered to be at disadvantage in terms of FDIs because of its relative location, poor transport infrastructure and its primitive agrarian economy (Sirbu, 2014).

The local Moran's I revealed that Lagos is the only FDI cluster in Nigeria surrounded by relatively low FDI states. It appears that Lagos is the preferred destination for foreign direct investment. The reasons for this are evident. In the words of Filani (2013: 13):

> Lagos makes the greatest contribution to Nigeria's leading economic indicators, with industries including manufacturing and service delivery, banking and telecommunications services as well as, to a lesser extent, fishing, mining and quarrying, agriculture and forestry. The state is rich in resources such as crude oil, bitumen, silica, clay and wood. In 2006, Lagos contributed 30 percent of Nigeria's GDP, consumed more than 60 percent of its energy, collected 65 percent of its value added tax (VAT) and accounted for 90 percent of its foreign trade and 70 percent of its industrial investments.

In addition, the state has industrial estates at Isolo, Ikeja, Apapa, Yaba, Ogba, Ilupeju, Matori, Amuwo Odofin and Oregun. It enjoys over 50 per cent of both local and foreign passenger traffic for Nigeria, and houses West Africa's largest stock exchange market (Lagos State Government, 2013). This finding contradicts the thesis of the growth pole theory and, at the same time, confirms the existence of a core-periphery pattern of FDIs. In the light of this fact, Lagos does not appear to be a growth pole. As the result indicates, there seems to be a spatial polarization of FDIs in Nigeria. In the same way, FDIs have created a schism between the richest and the poorest regions of Romania (Sirbu, 2014).

Initially, the OLS model identified three crucial factors to the explanation of spatial pattern of FDI. All, except proximity to seaport, conformed to theoretical expectations. The positive relationship between proximity to sea and FDI is

counterintuitive. At this point, it is difficult to decipher the precise reasons for this unusual pattern. Hence, more emphasis will be placed on the local spatial variability of these three factors as revealed by the GWR model. Based on the results of the GWR model, one can conclude that spatial non-stationarity exists in the relationship between FDIs and other factors. Coastal provinces, as observed, have clear relative advantage (Coughlin and Segev, 2000). As already mentioned, the influence of distance to Lagos was expectedly strongest in the northeast and decreased southwards. The reason for this is clear. States farther away would have lower investments than those closer to Lagos. Lagos is the economic heartland of the country, and it is expected that proximate states would enjoy spillover effects from the concentration of FDI in Lagos.

Road density exhibited a strong positive influence in the southwest. The area has one of the highest road density values in the country. A major highway here is the Lagos-Ibadan expressway, arguably the busiest road in the country. Like in any other economy, road transport has been instrumental to the growth of the Nigerian economy. Castro et al. (2007) showed that paved roads matter for FDI location; 10 per cent increase in per capita paved road boosts FDI in the average host province by between 17 and 33 per cent. What is more is that the number kilometres of modernized roads is directly associated with FDIs in Romania. Airports had the strongest influence in the northwestern tip, particularly in Sokoto and Kebbi states. It points to the fact that most of the investments in these states may likely come through air transport. Transport infrastructure, no doubt, is vital to investment location. In addition, a study conducted by Banno and Redondi (2014) showed how the global air network structure facilitated the inflow of FDIs into Italy. FDI dramatically increased by nearly 34 per cent two years after the opening of a new route. Similarly, air transport in the European Union has brought in 500,000 jobs and 70 billion Euros as annual income (Tlocynski, 2016).

Seaport location had great influence along the southern coast. A probable explanation for this counterintuitive observation could be that most of the FDIs did not come through the seaport of Port Harcourt city but through alternative transport routes. This is understandable for the single fact that the two leading seaports (Apapa and Tin Can Island) in Nigeria are in Lagos. Furthermore, these two ports apparently generate 50 per cent of the national port revenue (Lagos State Government, 2013). Given this background, it stands to reason that Lagos'

seaports are a major gateway of the country's FDIs. Similarities are found in Latvia's largest seaport, Riga, which is well known for being the closest seaport to the sea in the Baltic states; for its high quality services, competitive port charges and well-developed infrastructure (Bulis and Skapars, 2014), and the ports of Constanta, Galati and Tulcea through which a significant amount of FDIs pass into Romania (Sirbu, 2014).

The study's focus lies in the following areas. First, the study, as indicated *ab initio*, is a pioneer attempt on the state level variations in FDIs in Nigeria. Second, the study, from a methodological perspective, is the first to apply spatial statistics to the study of FDIs in Nigeria. Third and most importantly, the study successfully determined spatial non-stationarity in the relationship between FDIs and their determinants.

The study however had certain limitations. First, the lack of state level data on sector specific FDIs did not inspire research on their spatial heterogeneity. This might have given a clearer picture of the pattern of international investment.

Second, the literature on FDIs has indicated the key influence of inflation, tax rates, exchange rate, cultural diversity, language, fiscal incentives, and privatization on FDIs. However, the relative contributions of these important factors could not be ascertained due to the general lack of information or more specifically the dearth of state level data on these variables. Without them, it was impossible to have a very strong understanding of the underlying forces driving the investment landscape. As Petrovic-Randelovic et al. (2013: 183) put it, "... not all locational determinants have absolute importance in determining the dynamics of the inward flows. Their importance is relative, variable . . . ".

Third, the contribution of natural disaster in FDI research, which has recently emerged as an avenue of inquiry, was sidelined. In White and Fan's analysis, reported by Anuchitworawong and Thampanishvong (2015), there are three sides to the subject matter. First, some investors do not consider natural disasters as a factor in investment location because of the low odds of occurrence. Second, some may go ahead with investment despite the dangers it may pose, depending on the condition that the disaster is infrequent. Lastly, the investors, after considering the long-term effects, may reduce investment options, move investment to a more secure location or adopt disaster risk reduction measures. Unfortunately, the effect of natural disasters on FDIs at the state level could not be explored because of the paucity of data as at the time of research.

A firm grasp of the knowledge of the locational factors of FDI is vital in explaining regional variations in FDI and the formulation of the FDI policy frameworks of the host countries (Petrovic-Randelovic et al., 2013). The study's findings certainly have policy implications for regional planning and economic policy. These two policy areas are not, in the strict sense, mutually exclusive, therefore, their discussion will be taken together. As pointed out earlier, a core-periphery pattern surfaced in the analysis of the spatial distribution of FDIs. The observed spatial pattern of FDIs is most likely to exacerbate the existing spatial inequalities in the development surface in Nigeria. This certainly implies that rich states become richer and poor become poorer, which in this case, means Lagos would be overbloated with FDIs while the rest of the country will become slimmer. As a result, uneven development becomes harder to deal with than it is currently.

Just like in many countries of the world, it is in the interest of the federal government to attract FDIs into the country, particularly to lagging regions. However, the implications it would have for regional development need to be carefully considered. To avoid further disparities, it may take some area-based policies of positive discrimination which may involve, " . . . changing the spatial distribution of physical infrastructure, population and economic activity" (Okafor, 2001: 306) so as to bring FDI to disadvantaged states. The policies of positive discrimination, within the context of the study, may build on our findings and take the form of building a strong transport infrastructure, particularly road infrastructure. This is a good policy alternative in states with deficiency in this regard, especially those outside southwest Nigeria. Road transport is central to the Nigerian economy, given the federal government's huge investment and the large passenger traffic in the transport subsector. Despite its significance, Akinyemi (2012: 16) stated that "most of the roads are in a terrible state of disrepair, . . . suffered from continued lack of maintenance, poor design and construction, excessive use and inadequate financing of road projects". Therefore, building a strong transport infrastructure does not only mean building new infrastructure, but also strengthening the existing stock. The use of tax holidays or other forms of tax incentives could drive FDIs to potentially rich but investment poor states such as Yobe.

Clearly, the availability of the requisite quantum and quality of infrastructural facilities is necessary for the attraction of FDI as the findings

eloquently suggest. Therefore, government at both the national and sub-national levels need to intensify programmes aimed at tackling infrastructure gaps within their domains. If this precondition is sufficiently met, the economic environment becomes more business friendly and thereby a credible receptor of FDI flows. Also, the Lagos success story in terms of FDI mobilization needs to be replicated in other regions of the country. Doing this will foster improvements in the geography of economic opportunities and plausibly result in greater overall national welfare.

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