Can Industrial Cluster Strategy Improve the Competitiveness of Industry: Evidence from Nigeria?

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Introduction

- Cluster development has emerged as an important new direction of industrial/economic policy in Nigeria;
- Traditionally: clusters in Nnewi (automotive) Otigba (Computer Village), Onitsha (Plastic) and Kano (Leather)
- No conclusive evidence on whether industry clusters have yielded the desired benefits
- This aim of the study is to investigate the existence and benefits of agglomeration for the Nigerian manufacturing sector.

Introduction

- The first stage :WBICS of Nigeria (2006) – 2,387 firms in manufacturing
- The subsector include:

food,	chemicals,
garment	electronics
textile	non-metallic minerals
machinery and equipment	wood products and furniture
metal and metal products	other manufacturing

Introduction

- The WBICS captures firms located in EPZs
- Underlying theory: firms in industry cluster perform better than others
- This is due to benefits from networking, knowledge sharing and human capital mobility (Madsen, Smith and Dilling-Hansen (2002).

Introduction

- By locating close to suppliers, customers and competitors, an enterprise may be able to benefit from:
- productivity or technology spill-overs,
- better access to (skilled) labor,
- lower transaction costs and
- greater specialisation and division of labor and so on (Bigsten *et. al*., 2011).

Introduction

- This paper attempts to provide answers to the following research questions:
- Do manufacturing firms cluster?
- Why are clustering observed/what are the benefits of clustering?
- Does clustering yield productivity improvements for firms/sectors?
- How is knowledge transmitted within clusters?
- How can industrial policy be framed to promote clustering where it makes sense to do so?
- Answers to *some of these questions are still pending and will be obtained during the field-work component of the study.*

Nigeria's Free Trade/Export Processing Zones

- Nigerian authorities have pursued the establishment of Free Trade Zones (FTZs) and Export Processing Zones (EPZs).
- This is a component of policies to address challenges of the industrial sector
- Today, Nigeria has about 24 FTZs licensed but less than 13 of them are currently operational.
- Some are under construction and in the early phases of development

Nigeria's Free Trade/Export Processing Zones

- There are troubling aspects of Nigeria's FTZ experience;
- Many of the firms are either not operating at all, or operating below their planned capacity, reflecting factors such as:
  - lack of support by host governments,
  - inconsistency of government policy required to support long term investments,
  - shortage of skilled professionals,
  - poor infrastructure and astronomical cost of borrowing

Methodology

- Many empirical studies jump to assessing benefits of clustering without first establishing if significant clustering is in fact occurring;
- We therefore take a step back to first examine the overall pattern of agglomeration of firms in Nigeria.
- In doing this, we calculate the DO index as proposed by Duranton and Overman (2002).

Methodology

- The DO index has a number of advantages over alternative measures of agglomeration. Firstly, the exact location of enterprises is used in the location of the index rather than geographic areas or regions.
- The DO index makes use of continuous distance data which eliminates issues relating to spatial units for firms located at the border and also allows for comparison across countries and across industries.

Methodology

- The DO index calculated for a particular distance level *d* is given by equation 1;

$$K(d) = \frac{1}{n(n-1)h} \sum_{x=1}^{n-1} \sum_{y=x+1}^{n} f\left(\frac{d - d_{xy}}{h}\right)$$

Methodology

- The first step DO index is to calculate the bilateral Euclidean distance between all possible pairs of firms *i* and *j*.
- The distance between firms *i* and *j* is given by d_{ij} in equation 1; *n* is the number of firms; *d* is the chosen distance level; *h* is the bandwith and *f* is the kernel function.
- This index can be calculated for any industry or subset of firms at any distance level.
- For example, a distance level of 10km will determine how clustered an industry is when firms within 10km of each other are defined as being in the same cluster.
- Following Duranton and Overman (2002) we use a Gaussian kernel with the bandwidth set as per Section 3.4.2 of Silverman (1986)

Methodology

- Nigeria has a rich and unique dataset (over 6,000 firms) with addresses of all enterprises in Nigeria, number of employees and four-digit industrial classification of the enterprise.
- The precise location data allows us to calculate the DO index and therefore avoid the issues that arise when using spatial units such as administrative areas to analyse clusters.

Methodology

- We geocode the addresses to obtain longitude and latitude coordinates for each firm.
- We were able to establish the coordinates for almost 70% of the firms. Errors were returned for just over 30% of firms due to incomplete or inaccurate addresses.
- There is no reason however to believe that these errors are systematic and we assume that they reflect random errors due to input or reporting mistakes.

Methodology (EPZs)

- The World Bank Investment Climate Survey of Nigeria carried out in 2006 provides the data backdrop for the EPZ arm of this study.
- The survey was in two categories: a universal survey that covers manufacturing firms, micro-enterprises, retails and residual businesses, and a more restricted survey focussing specifically on the manufacturing sector and addressing wide ranging issues pertinent to the sector.
- The survey instrument for the latter was partitioned into twelve (12) major modules, each spotlighting a broad theme under which specific issues were examined.

Methodology

- Overall, 2,387 firms were surveyed, 43 per cent of which falls within the 10 sub-sectoral classification of the manufacturing sector viz., food, garments, textile, machinery and equipment, chemicals, electronics, non-metallic minerals, wood products and furniture, metal and metal products and other manufacturing.
- 12 per cent of the surveyed firms were located in the export processing zone.

Methodology

- Technical efficiency calculation

$$TE_{it} = \beta_2 LEXP_{i,t=1} + \beta_3 X_{it} + \varepsilon_{it}$$

Methodology

- *LEXP* is dummy for location in export processing zones at time t =1, X is a vector of exogenous variables that include the following firm characteristics;
- Firm size: Dummy, 1 if employment is less than 50 workers and 0 otherwise with the assumption that large firms are more efficient than small firms

Methodology

- Foreign ownership: Dummy, 1 if foreign owned, the assumption is that foreign firms are more efficient than local ones;
- Public company: Dummy, 1 if firm is a public enterprise with the assumption that public firms are fraught with a lot of inefficiency due to government interventions;
- Export destination: Dummy, 1 if firm exporting to non-LDC countries.
- Education of manager: Dummy, 1 if manager has at least a Bachelors degree.
- Export: dummy for export at time t=1

Results and Discussion: EPZ

Variable	Result
average number of labour employed per firm	EPZs exceed those in NEPZs
skilled labour employed by firms in EPZs	double those of NEPZs
Unskilled labour in EPZs	quadruples those in NEPZs
number of management and non-production workers in EPZs	thrice those in NEPZs
average monthly compensation per employee for firms in EPZs:	Skilled labour: EPZs exceeds NEPZs by more than 50%; 100% for unskilled labour and non-production workers and more than 100% for management staff.

Results and Discussion: EPZ

Variable (average annual overhead cost per firm)	Result
electricity	three times higher than NEPZ
fuel	five times higher than NEPZ
cost of transportation	twice higher than non-EPZs

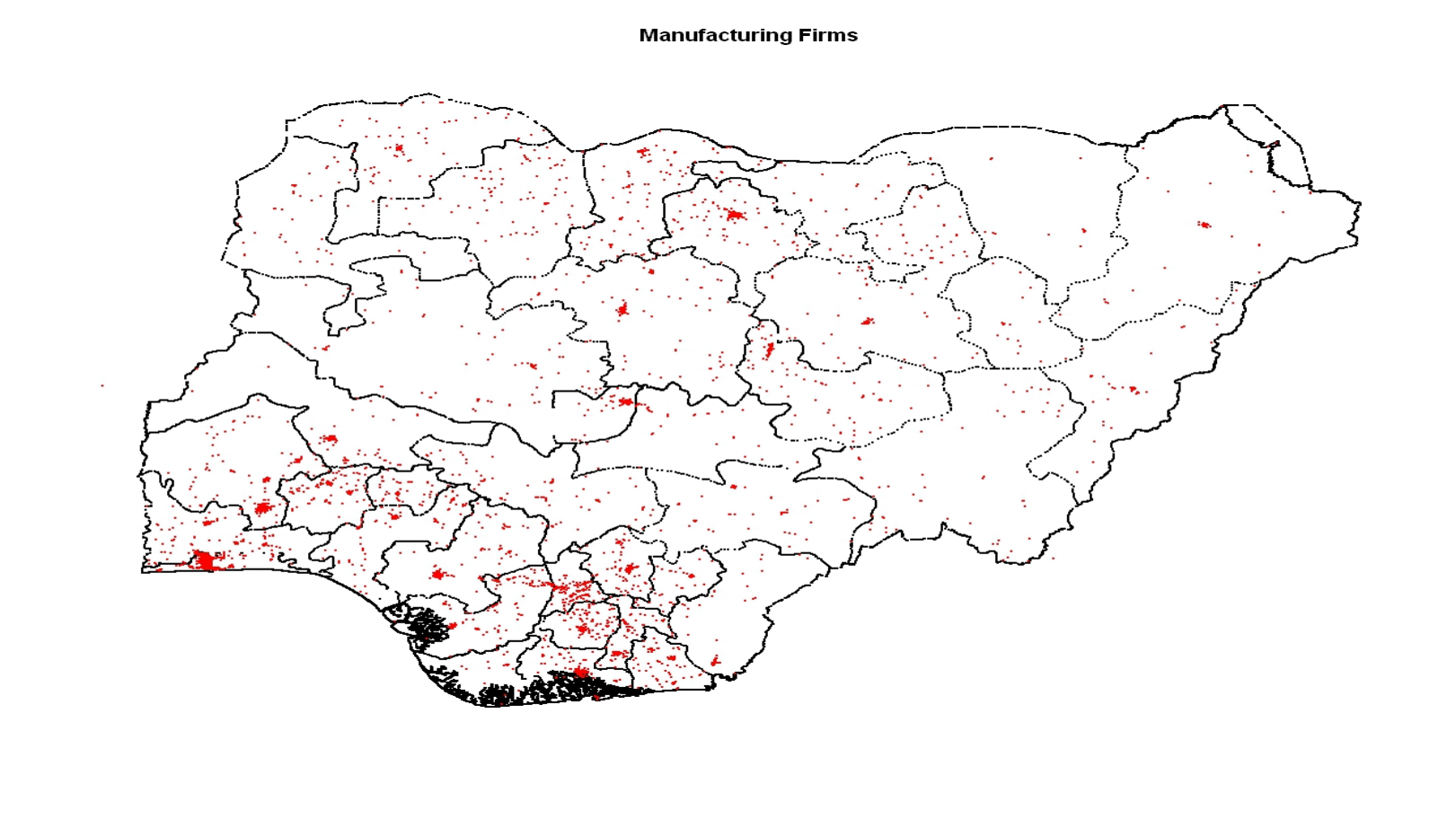
Results and Discussion: EPZ

Productivity variable	Firms in EPZ	Firms in NEPZ
Labour productivity	6.4	5.9
Capital productivity	126.7	87.6
Capital intensity	257627	498834
Capacity utilization	63.4	67.8
Average technical efficiency	0.33	0.30

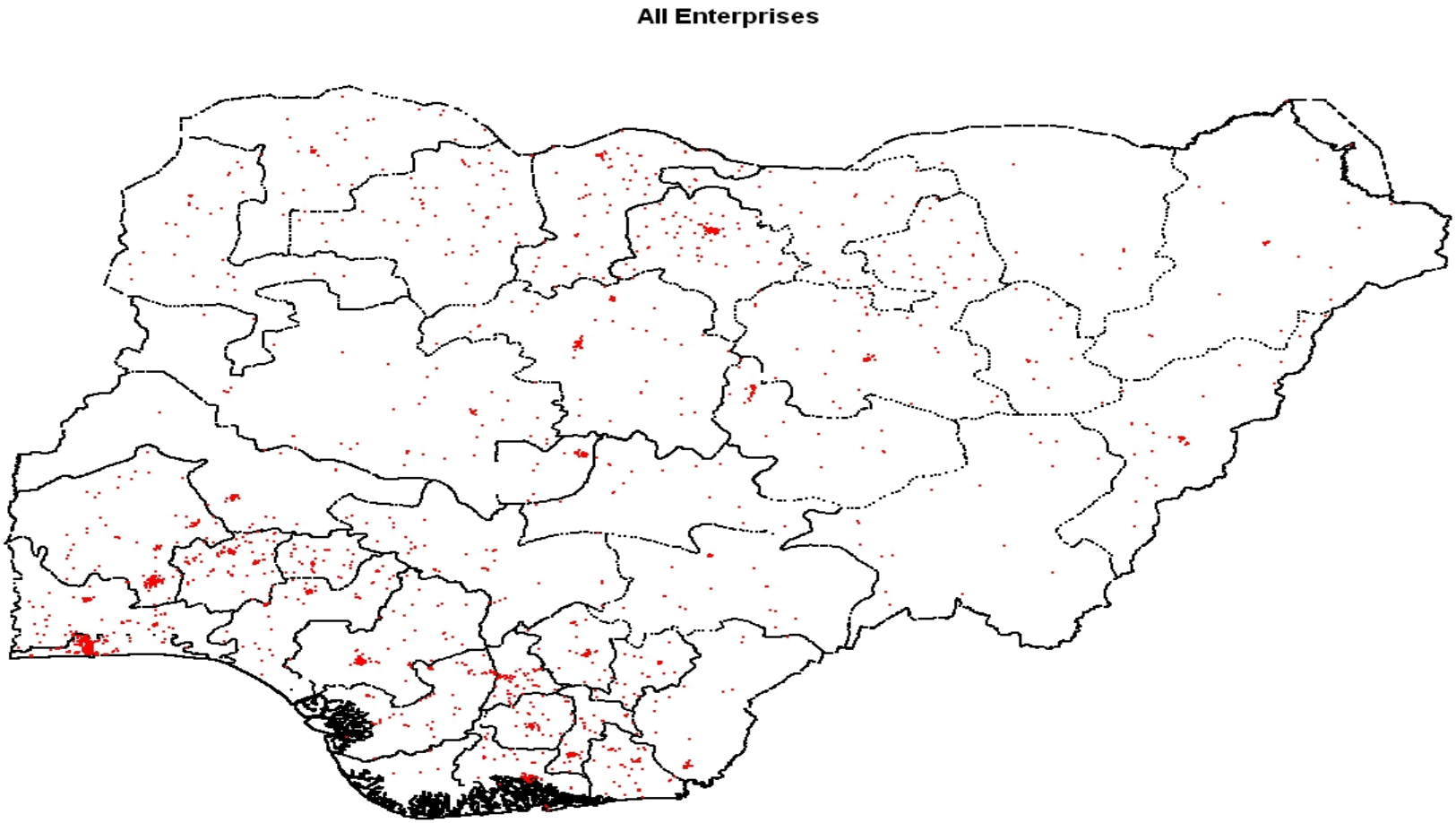
Results and Discussion: EPZ

Variables	Coefficient	Standard Error	t-statistic	Significance level
Export	.0001517	.0003617	0.42	0.675
Export to non LDC	.0000227	.000109	0.21	0.835
Export to LDCs	.0000387	.0001206	0.32	0.748
Domestic ownership	.0077631	.0118475	0.66	0.513
Foreign ownership	-.0199813	.016221	-1.23	0.218
Public ownership	(dropped)			
Manager education	-.0000164	.0000645	-0.25	0.799
Location in export processing zone	-.0108845	.0021918	-4.97	0.000
Firm size	.034945	.0013899	25.14	0.000
Constant	.2854115	.0085461	33.40	0.000

Results and Discussion: Pattern of Clustering



Pattern of Clustering



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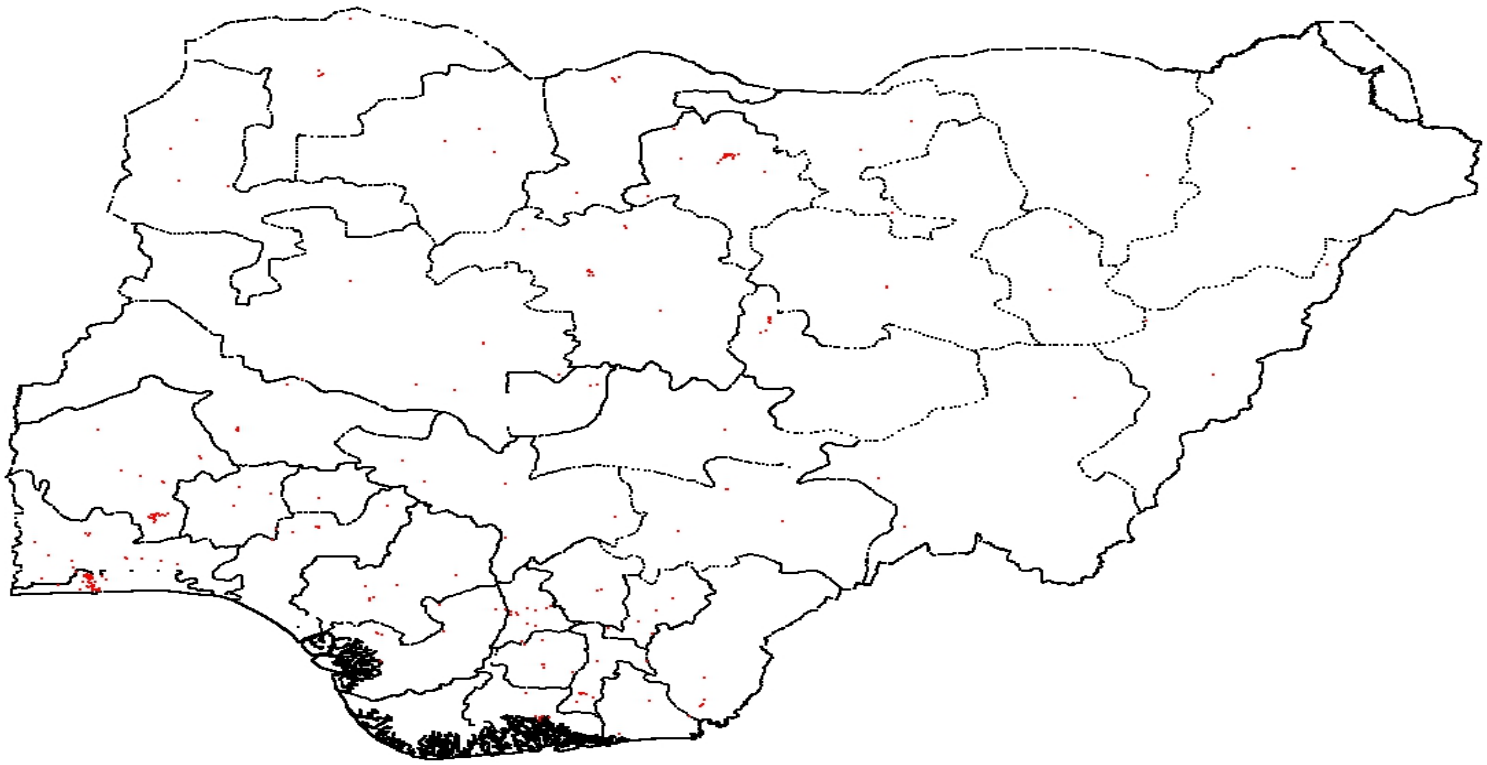

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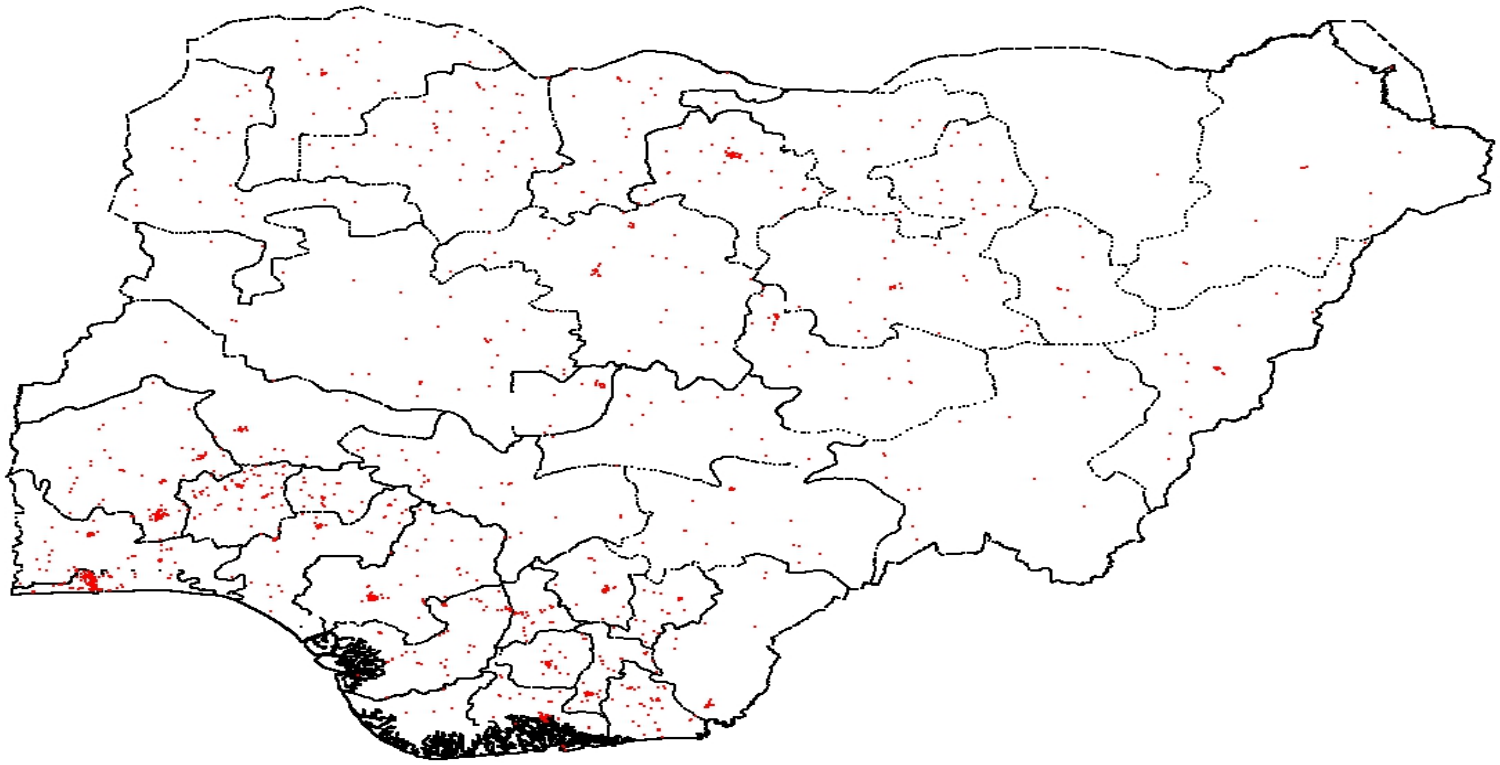


Results and Discussion: Extent of Clustering – Results of DO Index Calculations

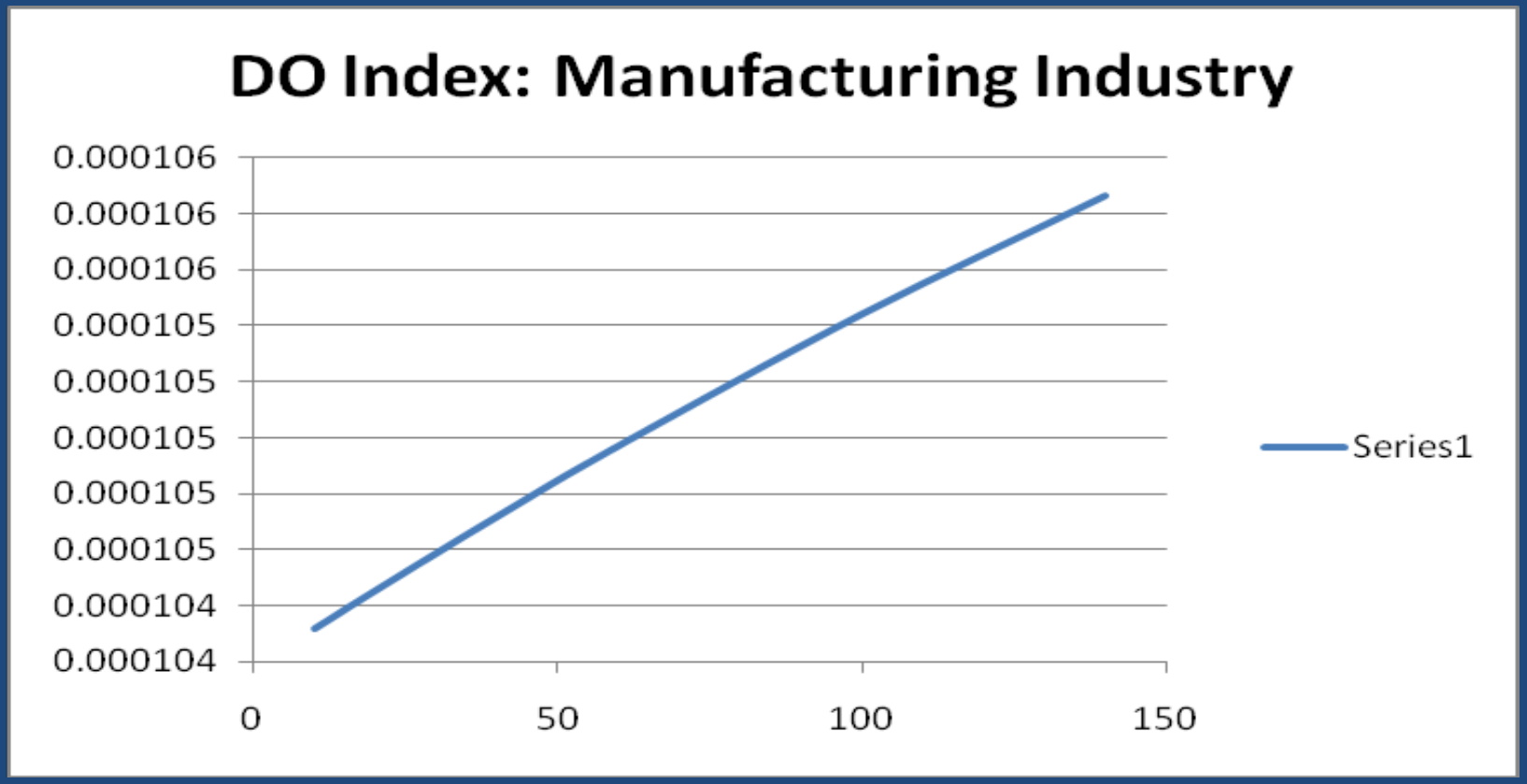
Distance Level	DO Index
10km	0.0001047
20km	0.0001049
40km	0.0001051
60km	0.0001054
100km	0.0001058
140km	0.0001063

Extent of Clustering – Results of DO Index Calculations

- The results indicate that the manufacturing industry is quite dispersed between 0 and 100km.
- For the UK, Duranton and Overman (2005), found a DO Index of over 0.004 for both Pharmaceuticals and Textiles at a distance of 10km.
- Figure 10 shows a plot of the DO Index results for the manufacturing industry.
- Peaks in the graph would indicate clusters close together, however there are no peaks indicating no manufacturing clusters located within 100km of each other.
- This result is perhaps unsurprising given the vast geographical area that Nigeria encompasses.

Extent of Clustering – Results of DO Index Calculations

- Figure 10: DO Index for the Manufacturing



Next Tasks

- The next step in our analysis is to access the statistical significance of these results.
- Comparison with the results for the UK obtained by Duranton and Overman (2006) suggest relative dispersion of manufacturing activity, however the area considered in the UK is 149,879 squared kilometers compared to 923,768 squared kilometers in Nigeria

Next Tasks

- Additionally, population patterns and the regulatory framework have an important role to play. To determine the extent to which the observed location patterns in Nigerian manufacturing exhibit significant departures from randomness we need to construct relevant counterfactuals.
- We consider the set of all existing sites for enterprises as the set of all possible locations for a manufacturing firm. This is a set of 42,778 possible sites. We then randomly allocate each of the 11,042 manufacturing firms to one of these sites

Next Tasks

- For this random allocation of firms we then calculate the DO index at each of the given distance levels and we compare this result to the DO indices calculated in Table 9.
- These counterfactuals control for the overall distribution of economic activity and also for the size of the area considered.
- We will also consider the DO indices for small and very large manufacturing firms to investigate if the pattern of clustering differs for different size firms.
- Additionally we will consider a number of illustrative industries separately to determine the extent of clustering in individual manufacturing sectors.

I thank you