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:

<table>
<thead>
<tr>
<th>Subsector</th>
<th>Subsector</th>
</tr>
</thead>
<tbody>
<tr>
<td>food,</td>
<td>chemicals,</td>
</tr>
<tr>
<td>garment</td>
<td>electronics</td>
</tr>
<tr>
<td>textile</td>
<td>non-metallic minerals</td>
</tr>
<tr>
<td>machinery and equipment</td>
<td>wood products and furniture</td>
</tr>
<tr>
<td>metal and metal products</td>
<td>other manufacturing</td>
</tr>
</tbody>
</table>
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.
The DO index calculated for a particular distance level \( d \) is given by equation 1;

\[
K(d) = \frac{1}{n(n-1)A} \sum_{i=1}^{n-1} \sum_{j=i+1}^{n-1} f \left( \frac{d_{ij}}{A} \right)
\]
Methodology

• The first step in the 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 bandwidth 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

<table>
<thead>
<tr>
<th>Variable</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>average number of labour employed per firm</td>
<td>EPZs exceed those in NEPZs</td>
</tr>
<tr>
<td>skilled labour employed by firms in EPZs</td>
<td>double those of NEPZs</td>
</tr>
<tr>
<td>Unskilled labour in EPZs</td>
<td>quadruples those in NEPZs</td>
</tr>
<tr>
<td>number of management and non-production workers in EPZs</td>
<td>thrice those in NEPZs</td>
</tr>
<tr>
<td>average monthly compensation per employee for firms in EPZs:</td>
<td>Skilled labour: EPZs exceeds NEPZs by more than 50%; 100% for unskilled labour and non-production workers and more than 100% for management staff.</td>
</tr>
</tbody>
</table>
## Results and Discussion: EPZ

<table>
<thead>
<tr>
<th>Variable (average annual overhead cost per firm)</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>electricity</td>
<td>three times higher than NEPZ</td>
</tr>
<tr>
<td>fuel</td>
<td>five times higher than NEPZ</td>
</tr>
<tr>
<td>cost of transportation</td>
<td>twice higher than non-EPZs</td>
</tr>
</tbody>
</table>
### Results and Discussion: EPZ

<table>
<thead>
<tr>
<th>Productivity variable</th>
<th>Firms in EPZ</th>
<th>Firms in NEPZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour productivity</td>
<td>6.4</td>
<td>5.9</td>
</tr>
<tr>
<td>Capital productivity</td>
<td>126.7</td>
<td>87.6</td>
</tr>
<tr>
<td>Capital intensity</td>
<td>257627</td>
<td>498834</td>
</tr>
<tr>
<td>Capacity utilization</td>
<td>63.4</td>
<td>67.8</td>
</tr>
<tr>
<td>Average technical efficiency</td>
<td>0.33</td>
<td>0.30</td>
</tr>
</tbody>
</table>
### Results and Discussion: EPZ

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-statistic</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export</td>
<td>0.0001517</td>
<td>0.0003617</td>
<td>0.42</td>
<td>0.675</td>
</tr>
<tr>
<td>Export to non LDC</td>
<td>0.0000227</td>
<td>0.000109</td>
<td>0.21</td>
<td>0.835</td>
</tr>
<tr>
<td>Export to LDCs</td>
<td>0.0000387</td>
<td>0.0001206</td>
<td>0.32</td>
<td>0.748</td>
</tr>
<tr>
<td>Domestic ownership</td>
<td>0.0077631</td>
<td>0.0118475</td>
<td>0.66</td>
<td>0.513</td>
</tr>
<tr>
<td>Foreign ownership</td>
<td>-0.0199813</td>
<td>0.016221</td>
<td>-1.23</td>
<td>0.218</td>
</tr>
<tr>
<td>Public ownership</td>
<td>(dropped)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manager education</td>
<td>-0.0000164</td>
<td>0.0000645</td>
<td>-0.25</td>
<td>0.799</td>
</tr>
<tr>
<td>Location in export processing zone</td>
<td>-0.0108845</td>
<td>0.0021918</td>
<td>-4.97</td>
<td>0.000</td>
</tr>
<tr>
<td>Firm size</td>
<td>0.034945</td>
<td>0.0013899</td>
<td>25.14</td>
<td>0.000</td>
</tr>
<tr>
<td>Constant</td>
<td>0.2854115</td>
<td>0.0085461</td>
<td>33.40</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Results and Discussion: Pattern of Clustering
Pattern of Clustering

All Enterprises
Pattern of Clustering

Large Manufacturing Firms
Pattern of Clustering
## Results and Discussion: Extent of Clustering – Results of DO Index Calculations

<table>
<thead>
<tr>
<th>Distance Level</th>
<th>DO Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>10km</td>
<td>0.0001047</td>
</tr>
<tr>
<td>20km</td>
<td>0.0001049</td>
</tr>
<tr>
<td>40km</td>
<td>0.0001051</td>
</tr>
<tr>
<td>60km</td>
<td>0.0001054</td>
</tr>
<tr>
<td>100km</td>
<td>0.0001058</td>
</tr>
<tr>
<td>140km</td>
<td>0.0001063</td>
</tr>
</tbody>
</table>
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 Industry
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.
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