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INDUSTRIAL CLUSTERS AND COMPETITIVENESS IN THE NIGERIAN MANUFACTURING SECTOR[1]

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ABSTRACT

This study investigated the benefits of industrial cluster in the Nigerian manufacturing sector, using the World Bank Investment Climate Survey of Nigeria based on 2,387 firms in sub-sectors of the manufacturing sector Applying the stochastic production function approach, an efficiency index for each firm is derived from which average technical efficiency for firms located in both export and non-export processing zones are computed. The results show that firms clustered in export- processing zones attract comparatively more general and skilled labour than firms located outside the clusters and offer better compensation to their employees, however they seem to incur more costs on average on overheads such as electricity, fuel, water, transportation and communication services. Significantly, technical efficiency was low for both categories of firms. Location of firms in export processing zones thus show significant but perverse (negative) effects on the level of technical efficiency of firms.

KEYWORDS: ***Cluster; Manufacturing; Competitiveness; Firms; Nigeria***

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1. INTRODUCTION

Cluster development has emerged as an important new direction in economic policy, and a coordinated and efficient way to promote economic growth, prioritize major investments and deliver infrastructure. Typically, an industry cluster strategy is driven by the notion that firms agglomerated in clusters potentially perform better than their counterparts located out of cluster owing to benefits from networking, knowledge sharing and human capital mobility (Madsen, Smith and Dilling-Hansen (2002). There is growing evidence that clustering helps small firms to surmount growth impediments and compete in world markets (Nadvi and Schmitz, 1999) This happens in three specific ways (Mccormick, 1999). First, clustering spurs collective efficiency which fosters firms' competitive advantage; second, it facilitates growth in little incremental steps; and third, clustering eases response to opportunities and crises.

Apparently, persuaded by the manifest benefits of the cluster approach, Nigeria's recent policy directions and plans have favoured the development of clusters and use of economic zones[3] to drive growth in several key sectors, including agriculture and industry and the overall economy. This policy direction was also influenced by the relatively successful outcomes of traditional clusters in Nigeria notably, Nnewi automotive cluster and Otigba Computer Village cluster, both characterized by significant inter-firm linkages and collaborative action. The former is especially significant reaching back to the 1980s and surviving some of the most turbulent periods of Nigeria economic and political history.

This paper provides answers to the following research questions. Do manufacturing firms cluster? Why clustering observed and what are the benefits of clustering? Does clustering yield productivity improvements for firms/sectors, and if so what are the characteristics of clusters that work best? How is knowledge transmitted within clusters? How can industrial policy be framed to promote clustering where it makes sense to do so?

2. OVERVIEW OF THE NIGERIAN MANUFACTURING SECTOR

Nigeria manufacturing accounts for less than 5 per cent of overall output growth in the economy - a distant shot from the 30-35% share required to fulfill the country's aspiration of becoming one of the twenty most developed economies in the world. The sector has been stunted by a rash of growth inhibiting factors including appalling physical infrastructure, especially meager and erratic power supply, high cost of funds, abysmal access to finance, multiple taxation and low domestic patronage.

[3] This is in sharp contrast to policies that attempt to foster more dispersion of economic activities in order to reduce regional inequalities popular in much of the 1960s and 1970s.

Table1: Nigeria: Sector Contribution to GDP

	2009			2010		
	% of GDP	Growth (%)	Contribution to GDP Growth (%)	% of GDP	Growth (%)	Contribution to GDP Growth (%)
GDP Basic Prices	**100.00**	**6.96**	**100.00**	**100.00**	**7.87**	**100.00**
Oil & Gas	16.29	0.45	1.13	15.85	4.98	10.32
Non-Oil	83.71	8.32	98.87	84.15	8.43	89.68
Agriculture	**41.70**	**5.88**	**35.59**	**40.84**	**5.64**	**29.89**
a. Crop Production	37.16	5.53	31.45	36.37	5.57	26.30
b. Other Agriculture	4.54	6.31	4.14	4.47	6.23	3.60
Industry	**26.01**	**2.85**	**11.09**	**25.52**	**5.81**	**19.23**
a. Mining & Quarrying	16.62	0.66	1.67	16.20	5.13	10.84
i. Oil & Gas	16.29	0.45	1.13	15.85	4.98	10.34
ii. Solid Minerals	0.33	12.08	0.55	0.34	12.28	0.52
b. Manufacturing	4.17	7.85	4.67	4.16	7.64	4.05
c. Building &Construction	1.92	11.97	3.16	2.00	12.08	2.95
d. Utilities	3.30	3.23	1.57	3.16	3.32	1.39
Services	**32.29**	**12.04**	**53.32**	**33.64**	**12.39**	**50.87**
a.Wholesale & Retail Trade	18.14	11.48	28.72	18.70	11.19	25.81
b.Hotels & Restaurants	0.48	11.89	0.79	0.50	12.01	0.74
c. Transport	2.78	6.83	2.66	2.68	6.72	2.31
d. Telecommunications	3.59	34.73	14.22	4.49	34.93	15.94
e. Finance & Insurance	3.70	4.01	2.19	3.57	3.95	1.86
f. Real Estate & Business service	1.81	10.62	2.67	1.85	10.36	2.83
g. Public Administration	0.68	4.41	0.44	0.66	4.23	0.37
h. Health & Education	0.25	10.01	0.34	0.25	9.82	0.31
i. Other Services	0.93	9.80	1.27	0.94	9.78	1.15
Primary Production	**58.32**	**4.34**	**37.27**	**57.04**	**5.49**	**40.73**
Secondary	**6.09**	**9.12**	**7.83**	**6.16**	**9.04**	**7.00**
Tertiary	**35.59**	**11.16**	**5491**	**36.80**	**11.55**	**52.27**

Source: Underlying Data from National Bureau of Statistics, Abuja (2011)

The Nigerian government commitment to manufacturing growth has spawned a number of recent initiatives targeted at removing constraints hindering the performance of the sector. A 200 billion naira Manufacturing Intervention Fund (MIF)[4] was launched in April 2010 to improve access to credit by manufacturers and to refinance and restructure banks' loan portfolio to favour the manufacturing sector. In December 2010, the Government announced a US$500 million loan facility to support growth of Small and Medium Enterprises. However, large power deficits persist and which continue to dampen industrial production as firms incur considerable costs to purchase diesel for powering their plants. Significantly, the government is on the verge of privatising the country's power sector through core investment sales, concessions and management contracts in the belief that this will inspire improved performance. Electricity generation in the country went down to as low as 2000MW in 2010, but later increased to 4700MW. Peak generation of 4800MW was achieved in September 2015. This capacity is expected to be stepped-up ton 6000MW by December 2015.

As part of strategies to address the challenges confronting the manufacturing sector within a cluster approach, the Nigerian authorities have pursued the establishment of Free Trade Zones (FTZ) and Export Processing Zones (EPZ). By definition, export processing or free trade zones are plainly marked industrial estates which houses

[4] The MIF was instrumental in reviving/resuscitating the textile and garment industry.

manufacturing activities targeted predominantly for the export market. In principle, FTZs offer simplified business environment with clear-cut operational guidelines free from bureaucratic bottlenecks and obstructive trade barriers. They are expected to provide excellent industrial facilities and security such as serviced plots, pre-built factory buildings, constant and regular electricity and water supply, good telecommunications system and specialised security arrangements. In principle, enterprises sited in these industrial clusters enjoy greater benefits and are exposed to lesser shocks than enterprises located elsewhere which place them in pole position to chase the country's targets of industrial transformation and export growth.

Following the setting up of the first Free Trade Zone (Calabar Free Trade Zone) in Calabar in 1989, several more of these zones have been developed. Today, Nigeria has about 24 FTZs licensed by the Federal Government. Less than 13 of them are currently operational. Some are under construction and in the early phases of development. Two types of free trade arrangement operate in Nigeria – the specialised and the general-purpose trade/export zone, which are managed by two bodies – Nigerian Export Processing Zone Authority (NEPZA) for the general-purpose zones and Oil & Gas Free Zone Authority (OGFZA) for oil & gas zone. They have the mandate to approve new zones, modify existing ones, grant permits and approvals for operators in the EPZs, and manage the zones.

Table 2: SOME EXISTING ZONES AND STATUS

Name	Location	Status	Mode	Management
Calabar Free Trade Zone	Calabar, Cross River State	Completed (over 80% occupied)	General purpose	NEPZA
Onne Oil & Gas Free Zone	Onne, Rivers State	Completed (Over 80% occupied)	Specialised	OGFZA
Kano Free Trade Zone	Kano, Kano State	Under construction	Non-oil export	NEPZA
Maigatari Free Trade Zone	Maigatari, Jigawa State	Under construction	Non-oil export	Jigawa State Govt.
Banki Free Trade Zone	Banki, Borno State	Under construction	Non-oil export	Borno State Govt.
Lekki Export Processing Zone	Lekki, Lagos State	Under construction	Non-oil export	Private initiative

Nigeria's trade zone experiment is however not without its troubles as many of the FTZs in the country are either not operating at all, or operating below their planned capacity. This reflects a lack of vision in the implementation of the EPZ scheme, absence of clear objectives or targets tied to projects, 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 and lack of physical and institutional infrastructure such as roads, customs procedures, intellectual property rights, legal systems and relevant legislations.

The Nigerian government is in the process of carrying out a comprehensive restructuring of the Free Trade Zones (FTZs) in the country to reposition them as vehicles for industrial growth and development and to open up more job opportunities and generate wealth. This review is expected to update extant legislations to provide strong legal and regulatory framework that would secure investor confidence over a long term horizon.

Box1: Examples of Industrial Clusters in Nigeria

The Nnewi Automotive Parts Industrial Cluster (Oyelaran-Oyeyinka, 2004)

- The Nnewi Automotive Parts Industrial Cluster is a huge success story in Nigeria, and It is a very good example of how an informal cluster can survive and succeed without government support in terms of provision of essential public utilities. This industrial cluster exports automotive parts to countries in the West African sub-region as well as other international destinations. Its key critical success factors include active participation of private industry associations such as Nnewi Chamber of Commerce, Industry, Mines and Agriculture and the Nigerian Association of Small Scale Industries, a social – cultural milieu characterized by competitiveness, high entrepreneurial spirit as well as investment in training and capacity to imitate and assimilate foreign technology. Above all, the Nnewi cluster made an independent effort to provide the necessary infrastructural support when the state failed to do so.

- Since the mid-1970s, local traders in Nnewi have transformed themselves into manufacturers of automobile parts through close linkages to technology suppliers in Taiwan Province of China. Seventeen firms, ranging in size from enterprises with 40 employees to those with 250, supply Nigeria and other West African markets with switch gears, roller chains for engines, auto tubes, batteries, engine seats, shock absorbers, foot rests and gaskets for motorcycles, as well as other parts. Most of these firms have the design capability to modify products and adapt the production process to the local market. Firms in Nnewi grew despite major infrastructural and credit constraints. Electricity, for example, was only supplied through private generators, water was provided through the company's boreholes, telephone service was poor and tariffs high, land was expensive and scarce, and banks were reluctant to extend the level of credit offered to companies with high inventory costs. Despite all these limitations, Nnewi firms succeeded in innovating, growing and exporting to neighbouring countries while other firms in Nigeria were failing.

- Much of this success was due to the acquisition of skills by workers mainly through learning by-doing, especially during equipment installation and test run, and through inter-firm linkages with foreign technology suppliers, notably those from Taiwan. However, as in the Suame Magazine case, vulnerabilities in the production strategy of the cluster have emerged, especially because firms were not well organized within the cluster to support a continuous process of improvement. As Oyelaran-Oyeyinka (1997) pointed out, "a weak local capital goods capability continues to slow down a full acquisition of major innovation capability… " Here is where policies and new support structures, notably credit facilities are critically needed.

The Otigba Computer Village

- The Otigba Computer Village is a more recent development, dating back to 1995. It covers an area of some 325 square kilometers in Ikeja, Lagos and provides, for the "sale, service and repair of ICT products and components, particularly to the Lagos industrial base, led by the oil and financial sectors. Increasingly the Otigba cluster is meeting regional West African market demand with some 392 SMEs employing more than 3000 workers." The cluster development has been characterized by significant inter-firm cooperation and joint action.

- Cooperation has been particularly noticeable in dealing with (municipal) government's treatment of the cluster, where the Computer and Allied Products Association of Nigeria (CAPDAN) has been very active. This has resulted in a supportive municipal government that has, for instance, facilitated property access and rental and licensing and refrained from heavy-handed inspection and licensing practices. Other areas of significant cooperation relate to technology and market support, security, and infrastructure maintenance.

- A key factor at play in this cluster appears to be the relatively very high educational level of the workforce and the fact that many of the skilled workers have ties with one another going back to their school or college. This has contributed to a high level of commercial trust among the firms, reflected, inter alia, in the appetite for the provision of supplier credits among firms in the cluster, as well as

know-how exchange and joint warehousing. Given the cluster's dependence on imported inputs (63.5 percent), the quality of trade facilitation services is an important determinant of cluster competitiveness.

- Government policy in support of the industry includes the standard package of duty rebate and tax holidays. There is also a preferential public procurement policy in place directing government ministries, departments, and agencies (a group of public agencies widely referred to in Nigeria by the acronym MDAs) to source IT products domestically.

Onitsha[5] Plastic Cluster

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Onitsha is a very dynamic city and has the highest concentration of manufacturers in Eastern Nigeria with products ranging from pharmaceuticals to paints, and from plastics to chemicals. It attracts trading partners from the rest of the country and different parts of the West African subregion. The plastic cluster in Onitsha is known as the Osakwe Industrial Cluster, it is situated at Awada layout in Onitsha and has about 75 industries employing over 1,800 workers. The industries are managed by the Industrial Economy Development Agency, a local group that provides planning, research and development, tools, infrastructure, security, and training to members of the cluster. The industries cover a wide range of products: plastic film extrusion, plastic pipe extrusion, plastic injection, plastic blow moulding, polythene bag making, and plastic waste recycling. There are three service workshops, and a machine development and building company.

3. CONCEPTUAL FRAMEWORK[6]

The collective efficiency framework for cluster analysis hinges on two dimensions of the concept: the planned and the unplanned, or the active and the passive (Schmitz and Nadvi, 1999). While passive collective efficiency is associated with external economies, active collective efficiency arises from interactions and synergies among clustered firms. External economies obtain when social benefits swamp private benefits. They are side-effects or derivatives from economic action. Krugman (1991), following Marshall (1890), identifies three main types of external economies in enterprise clusters: labour market pooling, intermediate input effects, and technological spill-over's.

Joint action represents another aspect of collective efficiency. it refers to mindful effort by clustering firms to foster inter-firm linkages and networks. Schmitz and Nadvi (1999) argue that aside external economies` consciously pursued joint action" is crucial for industrial clusters to succeed. Four categories of joint action in clusters, based on two dimensions are suggested. The first dimension is the number of co-operators, i.e., two (bilateral cooperation) or more than two (multilateral action). The second is the direction of cooperation, i.e., cooperation among firms involved in different stages of the production distribution chain (vertical cooperation); or collaboration between/among competitors (horizontal joint action)

[5]Onitsha is a very dynamic city and has the highest concentration of manufacturers in Eastern Nigeria with products ranging from pharmaceuticals to paints, and from plastics to chemicals. It attracts trading partners from the rest of the country and different parts of the West African subregion.

[6] This section draws on Mccormick, 1999

The institutional context is a crucial determinant of the potential of clustering to spur industrialization. A string of institutional factors of a social, economic and political character impinge on business operation and organization. What particular institutional issue is relevant to specific business activity is unclear. New Institutional Economics (NIE) suggests that these may include economic institutions such as contracts, firms, and property rights (Williamson, 1985; North, 1990; Langlois and Robertson, 1995).

Cortright (2006) points to foundational elements such as labour market pooling, supplier specialization, knowledge spillovers, entrepreneurship, path-dependence and lock in, culture and local demand, as drivers of industrial clustering. Drawing insights from close observation of the pattern of economic activity in the industrial districts of England, Cortright (2006) advanced three grounds to expect more productive outcomes from groups of firms in a particular trade located in close proximity, namely labour market pooling; supplier specialization, and knowledge spillovers. This is what has come to be known as the "Marshallian Trinity". In theory, the argument is that agglomeration attracts a pool of labor with common set of skills and a concentration of similar firms offering ready market for suppliers and providing the scale needed for them to refine and specialize their expertise, ultimately provoking productive effects.

Audretch and Feldman (1996) inquired into spatial distribution of activity within clusters and linked this to the existence of knowledge externalities. Their working hypothesis was that innovative activity will tend to cluster in industries where new economic knowledge mirrored by industry R & D, university research, and skilled labour are in place. In their empirical investigation, the authors found that resource dependent industries tend to be more geographically condensed and that sectors displaying the greatest spatial density include primary metal, textiles, food and beverages, leather and chemicals. Secondly, they found that the propensity for innovative activity to geographically cluster was correlated with knowledge spillovers within the cluster and that sectors exhibiting this tendency include transportation equipment, instruments and electronics.

Using French firm-level data from 1996 to 2004, Martin, Mayer and Mayneris (2008) sought answers to the following set of questions: How large are the gains from agglomeration? How much does the productivity of a firm increase when other firms from the same sector decide to locate nearby? Do firms internalise these gains when making their location decisions? The authors found that a 10% increase of employment in neighbouring firms of the same industry spurs productivity increase of about 0.4-0.5%. They argue that because gains from clustering in many countries of Europe are suboptimal, it should not invite subsidisation of firms located within clusters. They however admit that the estimation of agglomeration economies is tricky as better endowments (public infrastructure, climate etc.) associated with agglomerated areas may lead to the attraction of more productive firms, with the possibility of overestimating the gains of agglomeration.

The European Commission (2008) aligns with the difficulty in estimating the economic impact of clusters in strict statistical terms and proposes a combination of methodologies that includes case studies as a complementary approach for gaining more penetrating insights into the clustering phenomenon. Moreover, the publication found that cluster firms engage more closely with research institutions in their vicinity than other firms and have easier access to international networks and capital. They also found that dynamic clusters induce a more intensive

personal exchange between firms higher than in non-clustered locations. In their view, such "crosspollination" of ideas and innovation underpinned the success of the Silicon Valley model. Similarly, they attributed the success of the Stockholm ICT cluster to higher rates of inter-firm labour mobility compared to the rest of the labour market and higher rates of intra-firm mobility relative to comparable private-sector enterprises.

Porter's (2003) study of US clusters, confirms that economic development gauged by average wages and employment growth is higher in US regions with high proportion of their workforce located in "strong" clusters. Corroboratively, Wennberg & Lindqvist (2008) found that firm level clustered firms created more jobs, made higher tax payments, and paid higher wages to employees. The study also established that location in a cluster impinges positively on the chances of survival of new firms.

While endorsing the potential of clustering to engender greater innovativeness, employment and growth especially in the first years of existence, Brenner and Gildner (2006) surmise that the positive association between local clusters and economic performance may ebb over time, although will remain visible, on average, in local clusters lasting for more than 50 years. Importantly, the study affirms that "old" clusters have long term positive impact on employment, income and the local start-up rate only, and negative repercussions in regard to involvement of a region in new technologies; suggesting that clusters have to innovate and adapt to new contexts and challenges.

4. DATA AND MODEL SPECIFICATION

The World Bank Investment Climate Survey of Nigeria carried out in 2006 provides the data backdrop for 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 focusing 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.

The 12 modules are:

- Control information
- General information about firms
- Sales and export
- Supplies and import
- Capacity and innovation
- Investment climate constraints
- Infrastructure and services
- Conflict resolution and legal environment
- Business-Government relations
- Labour relations
- Finance and,
- Productivity

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.

We assume a transcendental logarithmic production function expressed in non linear form. The advantage of a trans-log production function over the log-linear form is that it is much more general (it has a flexible functional form permitting the partial elasticities of substitution between inputs to vary). We therefore specify the stochastic production frontier model as follows:

$$InY_{it} = \alpha_0 + \alpha_1 InK_{it} + \alpha_2 InL_{it} + \alpha_3 X_1 + \alpha_4 X_2 + \beta_1 (InK_{it})^2 + \beta_2 (InL_{it})^2 + \beta_3 (InK_{it})(InL_{it}) + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Y_{it} is value added or output of firm i at time t. The value added was estimated by subtracting the cost of intermediate raw materials and goods from the total annual sales. *K* is capital which was estimated by subtracting total annual depreciation cost from the total cost of rental of land/building, equipment and furniture. While *L* is labor inputs were representing the total number of employees or total annual cost of labor including wages, salaries and bonuses and social payments. X_1 is ratio of technical workers to total production workers; this differentiates skilled and unskilled workers. X_2 measures average annual capacity utilization of firms. The error term captures the random effects and technical inefficiency, i.e. $\varepsilon_{it} = v_{it} - u_{it}$. v_{it} is the usual random disturbance value say due to changes in investment climate and it is assumed to be independent and identically distributed; $N(0, \sigma_v^2)$, while u_{it} are random variables that represent firm-specific effects that reflect firm efficiency and management skills and according to Battese and Coelli (1992), they are assumed to be independent and identically distributed and non-negative truncations of the $N(\mu, \sigma^2)$ distribution. They are modeled as;

$$u_{it} = \eta_t u_i = u_i \exp(-\eta[t - T], \qquad t \in \gamma_i \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where η is unknown scalar parameter representing rate of change of technical efficiency, and u_{it} is the technical inefficiency effect of the ith firm in the last year of the data set. The random variable u_{it} can either increase at a decreasing rate ($\eta > 0$), decrease at an increasing rate ($\eta < 0$) or remain constant ($\eta = 0$) which is a special case for a time-invariant model. $\gamma(i)$ is the time function or periods involved from which observations for the ith firm are obtained.

The trans-log parameterization of the stochastic frontier model allows for neutral total product hence enabling estimation of returns to scale. We note that total product is neutral if β_i is equal to zero such that the production

function reduces to a Cobb-Douglas form. The technical efficiency (TE) of the i^{th} firm at time t can then be defined as the ratio of the actual output to the potential output;

$$TE = \exp(-u_{it}) \quad \ldots\ldots (3)$$

5. ESTIMATION PROCEDURES

The estimation proceeded sequentially in several stages. In the first stage, we use cross section data on manufacturing firms and separately estimate the stochastic production functions in Nigeria. Thereafter, we estimate the efficiency index for each firm (both exporters and non exporters) from which average technical efficiency for exporting and non-exporting firms are established. In the final stage, we investigated the relationship between firms' technical efficiency and their exporting behavior while controlling for other variables particularly firms' characteristics. The estimation used the following function:

$$TE_{it} = \beta_2 EXP_{i,t=1} + \beta_3 X_{it} + \varepsilon_{it} \quad \ldots\ldots (4)$$

EXP is dummy for exports; 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;

Foreign ownership: Dummy = 1 if foreign owned, the assumption is that foreign firms are more efficient than the 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 exports to non LDC countries.

Education of manager: Dummy = 1 if manager has at least a Bachelors degree.

Location: Dummy = 1 if firm located in an exporting zone.

6. RESULTS AND DISCUSSIONS

The dearth of detailed firm level data showing input-output relationships limits us to a rather more pragmatic approach to pursuing the clustering question in the Nigerian manufacturing sector. Hence, our empirical strategy is to assess agglomeration benefits within the ambit of EPZ clusters in the country. From the investment climate survey data, industrial cluster axes in Nigeria can loosely be classified into three, viz, Lagos-Ogun axis, Kano-Kaduna/Abuja axis and Enugu-Calabar/Awka axis. The Lagos-Ogun industrial zone hosts 64% of the total firms located in the EPZs in Nigeria. The Kano-Kaduna/Abuja zone embeds 20% and Enugu-Calabar/Awka zone, about 10% while 6% is located in other parts of the country as shown in Table 3.

Table 3: Distribution of Firms in EPZ by Location

EPZ Cities	Frequency	Percent
Abeokuta	14	12.28
Abuja	5	4.38
Awka	3	2.63
Calabar	5	4.38
Enugu	3	2.63
Kaduna	9	7.89
Kano	10	8.77
Lagos	60	52.63
Sokoto	4	3.50
Umuahia	1	0.87
Total	114	100

Source: Authors' Computation, Underlying Data from investment climate Survey, 2006

In theory, firms clustered in a particular location are expected to attract comparatively more labour in general and skilled labour in particular than firms located outside the clusters due to enhanced productivity and greater specialization. This supposition appears corroborated in Table 4 as average number of labour employed per firm in EPZs exceed those in non-EPZs. Specifically, skilled labour employed by firms in EPZs was double those of NEPZs. Unskilled labour in EPZs quadruples those in NEPZs, while number of management and non-production workers in EPZs was thrice those in non-EPZs.

Table 4: Average Number of Labour Employed per Firm by Location of Firms

Type of Employee	Firms in EPZ	Firms in NEPZ
Skilled	19	9
Unskilled	21	6
Management	6	2
Non-production workers	7	2

Source: Authors' Computation, Underlying Data from investment climate Survey, 2006

Similarly, firms in EPZs are expected to offer better compensation to employees than firms in NEPZs perhaps as a result of scale effects and more competitiveness. Table 5 reveals that average monthly compensation per employee for firms in EPZs topped those in NEPZs by more than 50% for skilled labour, about 100% for unskilled labour and non-production workers and more than 100% for management staff.

Table 5: Average Monthly Compensation per Employee by Location of Firms

Type of Employee	Firms in EPZ	Firms in NEPZ
Skilled	20505	14084
Unskilled	12806	6599
Management	47359	23690
Non-production workers	7128	4785

Source: Authors' Computation, Underlying Data from investment climate Survey, 2006

Surprisingly, average annual overhead cost per firm was far higher for cost items such as electricity, fuel, water and communication services for firms located in EPZs. For instance, average annual cost of electricity was about three times higher and fuel costs five times higher for firms located in EPZs compared to their counterparts in non-EPZs (Table 6). Moreover, cost of transportation which is expected to be much lower for firms in EPZs due to proximity was actually twice higher than for firms in non-EPZs.

Table 6: Average Annual Overhead Cost per Firm by Location of Firms

Cost	Firms in EPZ	Firms in NEPZ
Electricity	503517	167238
Fuel	1585859	350311
Water	198290	86694
Transportation	951891	420455
Communication services	245863	121368

Source: Authors' Computation, Underlying Data from investment climate Survey, 2006

Partial productivity analysis for both classes of firms presented in Table 7, shows higher productivity of labour and capital and lower capital intensity for firms in EPZs. Capacity utilization was slightly higher for firms in non-EPZs, although the differential in technical efficiency between both categories of firms was quite negligible. Average technical efficiency was rather low at 0.3.

Table 7: Partial Productivity Analysis by Location of Firms

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

Source: Authors' Computation, Underlying Data from investment climate Survey, 2006

In theory, clustering of industry fosters vertical and horizontal integration among firms with associated efficiency spin-offs. Thus, firms located in export processing zones are hypothesised to be more efficient than those sited outside the zones. However, Table 8 shows that location in export processing zones have significant but perverse (negative) effects on the level of technical efficiency of firms. This counter-intuitive sign is puzzling. Perhaps the most plausible explanation is that many EPZ's in Nigeria are only so in name as they are in dire conditions or barely up to scratch as much of the infrastructure required to drive production remains unavailable or chronically inefficient. Granted that establishment of export processing zones is a novelty in Nigeria, rapid development of these zones may over time enhance technical efficiency of manufacturing firms in the country.

Table 8: Result of Technical Efficiency Model

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

Number of obs = 693

F (8, 684) = 99.18

Prob > F = 0.0000

R-squared = 0.5370

Adj R-squared = 0.5316

7. CONCLUSION

Cluster development has emerged as an important new direction in economic policy, and a coordinated and efficient way to promote economic growth, prioritize major investments and deliver infrastructure. For a troubled manufacturing sector such as Nigeria's, clustering may provide a remedy to the myriad constraints to industrialization. Consequently, this study investigated potential benefits of agglomeration for the Nigerian manufacturing sector. The results of our empirical analysis were mixed. While firms clustered in EPZs attract comparatively more general and skilled labour than firms located outside the clusters and offer better compensation to their employees, they incurred more costs on average on overheads such as electricity, fuel, water, transportation and communication services. Significantly, technical efficiency was low (and differential negligible) for both categories of firms. Finally, locations of firms in export processing zones have significant but perverse (negative) effects on the level of technical efficiency of firms.

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