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Agglomeration and Industrial Performance in Nigeria (1990-2015)

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Abstract: This study examines the relationship between industrial performance and Agglomeration economies in Nigeria. We achieve this by taking into consideration the impact of Agglomeration-level (Urbanization and Localization economies) on the industrial-level (Manufacturing and Services sector). Adopting Ordinary Least Square regression techniques, the findings of this research work reveal that agglomeration economies have more significant impacts on service sector than manufacturing sector in Nigeria. It is therefore recommended that infrastructure investments and favourable policies that will make it possible for manufacturing firms to locate near one another should be established.

Keywords: Agglomeration, Urbanization, localization, Manufacturing sector, Services sector.

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I INTRODUCTION

The significance of agglomeration in achieving industrial growth had been stressed in the new economic geography. Many economists, including Marshall (1920), have argued that geographical agglomeration is a catalyst of improved industrial performance particularly in developing economies. Agglomeration brings economic growth at an early stage of economic development. This is as a result of the fact that, scarce resources such as capital, human capital and infrastructure which are attributed to developing economies can be most efficiently utilized when industries are agglomerated (Fujita and Thisse, 2003).

Agglomeration is defined as the geographical concentration of physical and human capital in the process of development. It relates to clusters of population and business activities. In this regard, agglomeration gives room for businesses and resources to take advantage of a number of efficiency by being located close to one another (Christian, 2014). Characteristics of agglomeration economies have been classified into two major categories: Localization economies and Urbanization economies. Localization economies refer to benefits that are accrued to a group of firms that belong to the same industrial sector and are located at the same place. Such benefits are internalized and are realized as economies of scale at an industrial level. Urbanization economies, by contrast, refer to benefits that firms in a number of different industries receive from population and infrastructure clusters. Such benefits work as external economies at an industrial level (Henderson, 1986).

Agglomeration impacts, therefore, are greatly felt when the firm's product efficiency is derived from industrial clustering and interdependency, and this, most of the times serves as a platform upon which the decision making process of firms are based. In the light of the above, economic theory suggests that changes in the nature and sources of geographical agglomeration will affect the industrial development components (Rosenthal and Strange, 2004). Therefore, an understanding of the relationship between economic agglomeration and industrial growth is very important for industrial investors and policy maker.

Several empirical studies have tested the relationship between geographical agglomeration and economic growth. However, most of these past studies have been concerned majorly with empirical situations in the developed countries, while the link between the industrial growth and geographical agglomeration has not been robustly reported in developing economies particularly in Nigeria. Meanwhile, analyses of the new economic geography theory reveal that the complementarities of industrial growth and agglomeration is more evident in a country at early stages of its development. The reason being the fact that when infrastructures are scarce and the reach of capital markets is limited (which are peculiar to developing economy), efficiency can be significantly enhanced when industries are agglomerated (Fujita and Thisse, 2003). In this regard, this research work therefore studies agglomeration-growth relationship in Nigeria, so as to shed important light on cluster and concentration concepts in developing economy.

In addition, most of the past empirical evidences about the agglomeration-growth relationship are not conclusive enough. For example, a lot of research works most especially in developed economies such as Devereux (2004), Borrios (2004), Betinelli (2005) and Wen (2004), only investigated the reaction of manufacturing sector to geographical agglomeration, while the expected reaction of service sector to agglomeration has not been comprehensively reckoned with. Whereas, service industry has been adjudged as an important branch in the economy that makes up most of an economy's value added in a lot of countries worldwide (Krenz, 2010). This therefore makes the special consideration of the service industry within new economic geography modeling very necessary. This study therefore examines the reactions of both service and manufacturing industries to geographical agglomeration so as to have a robust representation in the industrial sector.

The rest of the paper is organized as follows: Section 2 discusses relevant conceptual and empirical literatures. Section 3 deals with theoretical framework and estimation model. Section 4 presents and analyzes results while section 5 concludes and makes policy recommendations.

II. LITERATURE REVIEW

i. Conceptual Issues

Agglomeration is defined as the geographical concentration of physical and human capital in the process of development. It relates to clusters of population and business activities. The agglomeration economies are conceptually classified into two major categories: Localization economies and Urbanization economies which were originated from the classic textbook of Marshall (1920).

Localization economies or specialized agglomeration refers to the benefits that are accrued to a group of firms that belong to the same industrial sector and are located at the same place. Such benefits are internalized and are realized as economies of scale at an industrial level. Following from the proposition of cost theory, localization economies occur when long run average production costs of firms in a particular industry decrease as the total output of the industry expands. This implies that external economies to individual firms in a particular industry are transformed into internal scale economies by aggregating into the industry level. According to Marshallian externalities, the sources of localization economies are identified as three sources: Labour market polling, Input sharing and Knowledge spill-over.

Considering the first factor, the cost of labour may fall as a result of agglomeration, since locating in a large local labour market attract unskilled workers which are more likely to specialize in order to find job more easily. This in turn makes firms to save time and money that they would otherwise spend on training. As regard to the second factor, input sharing as a result of agglomeration reduces transportation and coordination costs. This is possible when a firm set up an exhibition facility which is used as shared input. This makes it easy for other firms in the same agglomerated area to purchase a great variety of relatively inexpensive intermediate inputs. Finally, Marshall argues in the area of knowledge spillover that firms in the same industry may adopt different production techniques and some of these techniques may be more productive in some firms than the others (particularly in the aspect of technological advancement); these techniques may later transmit to neighboring firms, improving efficiency and lowering costs.

Urbanization economies, by contrast, refer to benefits that firms in a number of different industries receive from population and infrastructure clusters. Such benefits work as external economies at an industrial level (Henderson, 1986).

ii Theoretical Literature

Industry Life-cycle Model

Potter and Watts (2011), using ideology from biological science, evolutionary biology and biogeography, developed a theoretical model called the Agglomeration Life Cycle Model. This model illustrates how incentives to agglomerate and disperse evolve over time and how the industry life cycle changes the relationship between agglomeration economies and economic performance. According to the authors, industry life cycle is categorized into four stages: embryonic, growth, mature and decline. They described the embryonic stage as a period when firms experience increasing returns from agglomeration economies and diminishing returns from dispersion economies. During this stage, firms start to agglomerate in close geographical proximity to the entrepreneurs

The growth stage is characterized by a fast rise in the rates of firm entry, start-up, spin-off, survival and a low rate of firm exit from the industry. The growth stage is succeeded by the mature stage, characterized by constant returns to scale, as an increasing number of firms start to experience diminishing returns from agglomeration economies, the increasing agglomeration of firms within a locality causes higher labour costs, greater land rents, congestion costs, pollution and fiercer local competition. The fourth stage of the industry life cycle, decline stage, is characterized by a period of decline of agglomeration benefits that differently affects firms in the industry; the firms that continue to depend on local firms will specialize in outdated technology,

replicate established routines and will be limited to old supply chain networks of outdated and low quality products. In contrast, the other firms, with a higher capacity to adapt, will adjust their routines.

Product Life-Cycle Model

Duranton and Puga (2001) suggested that agglomeration externalities vary according to the stage of the industries' product life-cycle. The model considers that: (i) as more local firms use the same type of production process, the lower will be the cost of using it, due to specialization economies and (ii) urban crowding places a limit on city size. They start with the assumption that when a firm decides to produce a new product, it does not have enough knowledge on how to produce it. Firms will take more benefit to locate at this stage in more diversified cities as they will benefit from learning with local types of production processes. Three types of steady-state are put forward in their model: diversified cities, specialized cities and both diversified and specialized cities. When mixed configuration exists, diversified and specialized cities, it means that each firm prefers to locate in a diversified city, while searching for its ideal process; and in the future relocate to a specialized city where all firms are using the same production process, avoiding the congestion imposed by the presence of other sectors.

iii Empirical Literature

Ellison and Glaeser (1997) use an index to examine the geographic and industrial concentration of production processes in the United State. Their results reveal that industries at the region level are most agglomerated while the ones at the county level are least agglomerated. According to their findings, the 4-digit industry has the highest degree of agglomeration than at the 3-digit and 2-digit industry level. Their results also show that the textile and leather industries are most agglomerated in the US. They equally posit that some high-tech industries such as aerospace are one of the top agglomerated industries in United State.

Employing the same index, Maurel and Se'dillot (1997) examine industrial agglomeration and co-agglomeration in France at different local authority region levels and various of industrial categories. Their results reveal that the most and least agglomerated industries exhibit similar patterns to the US. Their findings show that high-tech industries, raw material extraction industries and traditional industries are most agglomerated industries in France and US.

Devereux et al (2004) develop various indices to study the distribution of productivity in the UK. On the contrary, the study show opposing results as there are some low-tech industries, excluding the textile industries, which are highly agglomerated while many high-tech industries are the least agglomerated industries in the UK. In addition, the overall degree of agglomeration in the UK is less than in the US and France.

Wen (2004) employs Gini coefficient at the 3-digit industry level to investigate the geographic concentration in 1980, 1985 and 1995 in China. He concludes that a large number of manufacturing industries have relocated from the inner provinces to the coastal regions since 1978. He posits from his findings that heavy industries, such as vehicles and machinery, are highly localized in the Northeast of China, whereas Shanghai, Wuxi, Tianjin and Qingdao, as the traditional port cities, were the centers of textile industry before 1978.

Barrios et al (2004) examine the trends of industrial agglomeration in Ireland and Portugal. Their studies were majorly on the activities of old firms and new firms, together with large number of employees movement. Their results reveal that the geographic concentration was strongly mobile due to structural changes to level up with the rest of European Union. Considering the large geographical mobility of industries and the stability in the aggregated agglomeration levels, their studies therefore conclude that agglomeration is an equilibrium phenomenon without any prominent role reserved for historical accident as often proposed by the renewed economic geography literature.

Tripathi (2013) studies urban agglomeration and urban economic growth in India. The findings show that: first, urban registered manufacturing firms in Indian industries operate under decreasing returns to scale in production. This implies the negative agglomeration effects on level of output per worker in urban organized manufacturing industries in India. Second, nature of geography matters significantly for explaining the large city population agglomeration in India. Third, large population agglomeration has a positive and significant effect on urban economic growth by considering agglomeration variables endogenously or exogenously to the estimated econometric model. Fourth, urban agglomeration boosts urban economic growth only up to a certain level of economic development at the estimated critical level of per capita city income of around Rs. 37049 at constant (1999-2000) prices.

Henderson and Kuncoro (1996) employed Java to estimate models of the choice of location for plants and establishments of small and medium-sized firms in Indonesia. They made analyses on substantial localization economies for many industries and less pronounced urbanization economies. Their results show that manufacturing plants are more likely to choose locations that already include mature establishments and plants in the same or related industries.

Meagher (2007) examines informal clusters in Nigeria by taking a look at weaver, garment and shoe producers. She equally examines the extra legal informal institutions that emerge in clusters as firms relate to each other

outside of formal legal protections. She attributes the clusters emanating from the production specialization to the materials from across West Africa and a level of international export mostly to the Nigerian Diaspora. She posits that the informal socio-cultural networks that evolve in the firms clusters have roots in pre-colonial guilds, thereby making them to suffer from significant organizational problems and have very view link to formal industry or to any function of the state. Meagher therefore concludes that when structural adjustment policies and state neglect combined to increase the economic pressures on firms, existing informal networks result into highly counterproductive practices like design stealing, undercutting and other types of unhealthy competition.

III. METHODOLOGY

i. Theoretical Framework

This study adopts a Production Function with Agglomeration Economies Model to make analysis on the implications of Agglomeration on industrial performance. The model was propounded by Ryohei Nakamura (2005). In this model, the production function for estimating geographical agglomeration effects is based on the following assumptions: (i) that the agglomeration economies are external factors in the production functions of firms. (ii) that each firm in the same industry uses identical technology. (iii) that the production functions to be estimated at the industrial level are obtained by aggregating the production functions of all the firms.

The value-added production function at the firm level is defined as follows:

$Y = g(N,V) \quad F(K,L)$

Where Y is value-added, K denotes capital input and L denotes labour input. The function g denotes Hicks neutral productivity and its component N is the city size, which is a representative variable explaining urbanization economies, while V is the total value-added of the industry in which firms belong to. The total value-added of industry (V) represents the degree of concentration of firms in the same industry in which the labour market pooling and knowledge spillover which are major features of localization economies are embedded.

ii. Model Specification

In this study, two equations are used, one that defines the performances of industry in terms of service sector and the second that defines it in terms of manufacturing sector. The reason for adopting these two measures is to have a robust representation in the industrial sector. Also, in a bid to capture the agglomeration economies of urbanization and localization, the independent variables which enter into the two equations include the following: Population in Urban Agglomeration (POPAGGLO), Population Density (POPDENS) which represent urbanization economies and Firms Offering Formal Training (FOFTRN), Labour Force with Advanced Education (LWAEDU), Information and Communication Technology (ICT), Research and Development (R&D) which represent localization economies. Therefore, following from theoretical proposition of production function with agglomeration economies which was propounded by Ryohei Nakamura (2005) the models for this study are hereby specified as follows:

$$MANUF = \alpha_0 + \alpha_1 POPAGGLO + \alpha_2 POPDENS + \alpha_3 FOFTRN + \alpha_4 LWAED + \alpha_5 ICT + \alpha_6 R\&D$$

$$SERV = \beta_0 + \beta_1 POPAGGLO + \beta_2 POPDENS + \beta_3 FOFTRN + \beta_4 LWAED + \beta_5 ICT + \beta_6 R\&D$$

Where:
MANUF = Manufacturing Value added
SERV = Services Value added
POPAGGLO = Population in Urban Agglomeration
POPDENS = Population Density
FOFTRN = Firms Offering Formal Training
LWAEDU = Labour Force With Advanced Education
ICT = Information and Communication Technology
R&D = Research and Development

Table 1. Description of Variables

VARIABLES	DESCRIPTION
Manufacturing Value-added (MANUF)	Annual growth rate for manufacturing value added
Services Value-added (SERV)	Annual growth rate for services value-added
Population in Urban Agglomeration (POPAGGLO)	Percentage of a country's population living in metropolitan areas that have a population of more than one million
Population Density (POPDENS)	A country's population divided by land area in square kilometer

Firms Offering Formal Training (FOFTRN)	Percentage of firms offering formal training for their employees
Labour Force With Advanced Education (LWAEDU)	Percentage of working age population with an advanced level of education who are in the labour force
Information and Communication Technology (ICT)	Firm's expenditures on information and communication technology
Research and Development (R&D)	Firm's expenditures on research and development

iii Sources of Data

The data set for this paper consist of annual time series spanning 1990 through 2015. All the data for variables under consideration were sourced from World Bank data base.

IV. RESULT AND DISCUSSION

i. Results

Table 2: Ordinary Least Square Regression for MANUF and Agglomeration Variables

Variables	Coefficient	Standard Error	t-statistics	Probability
POPAGGLO	9.577274	9.512456	0.481187	0.23662
POPDENS	0.307644	2.702640	0.113831	0.9106
FOFTRN	-3.892356	2.193982	-0.862521	0.03997
LWAEDU	-0.838460	0.584938	-0.065750	0.0483
ICT	-771.7679	835.4806	-2.300484	0.3360
R&D	-99.04816	41.43914	-2.390208	0.0280

Source: Author's Computation
R-Squared = 0.637939
Adjusted R^2 = 0.617137
Durbin-Watson Stat. = 1.970018

Table 2 above shows the estimated model representing the relationship between the manufacturing sector performance and agglomeration components in Nigeria. The results from the table reveal that both POPAGGLO and POPDENS which represent urbanization economies exert positive but insignificant impacts on the manufacturing sector performance. Also, FOFTRN, LWAEDU and R&D which represent localization economies have negative and significant impact on manufacturing sector performance, except ICT whose negative impact is not significant. The estimated model shows a robust R^2 value of 0.64, which simply means that the agglomeration components are able to account for 64% changes or variation in manufacturing sector performance in Nigeria. The results show a Durbin Watson value of 1.97 which means that there is no problem of autocorrelation in the model.

Table 3: Ordinary Least Square Regression for SERV and Agglomeration variables

Variables	Coefficient	Standard Error	t-statistics	Probability
POPAGGLO	2.000461	1.13540	0.197374	0.02457
POPDENS	1.678350	0.879630	0.582835	0.00346
FOFTRN	2.120937	1.337661	0.907290	0.04762
LWAEDU	0.623245	0.367330	0.589384	0.05629
ICT	357.4505	133.8244	0.374386	0.01214
R&D	-51.14301	44.15289	-1.158316	0.2619

Source: Author's Computation
R-Squared = 0.867388
Adjusted R^2 = 0.815816
Durbin-Watson Stat. = 1.905111

Table 3 above exhibits the estimated model representing the relationship between the services sector performance and agglomeration variables in Nigeria. Unlike the results from the manufacturing sector performance, results in the table 3 above shows that both POPAGGLO and POPDENS which represent urbanization economies have positive and significant impacts on services sector performance. Likewise, FOFTRN, LWAEDU and ICT which represent localization economies have positive and significant impact on services sector performance. The estimated model shows a more robust R^2 value of 0.82, which simply means that the agglomeration components are able to account for 82% changes or variation in the services sector

performance in Nigeria. The results show a Durbin Watson value of 1.90 which means that there is no problem of autocorrelation in the model.

ii Discussion of Findings

The results from the OLS regression in this study show that the impacts of urbanization economies (POPAGGLO and POPDENS) on services sector performance are significant. But the reverse is the case for manufacturing sector performance on which the impacts of urbanization economies are insignificant. The possible reason for this finding might be attributed to the nature of both manufacturing and services sector as regard to cluster in space in Nigeria. For instance, judging from one of the representatives of urbanization economies, that is, Population Density (POPDENS) which is measured by a country's population divided by land area in square kilometer; services sector seems to consume less land area than manufacturing sector does. In this regard, services sector might be able to pack together more closely in space than manufacturing sector, thereby minimizing cost and achieving more profitability than the manufacturing sector. This report is in line with the findings of Kolko (2007) who confirmed that many services occupy high-rise buildings in dense downtowns where land is costly, while manufacturing industries due to the nature of their production processes, occupy single-story buildings scattered everywhere in the same dense downtowns where land is costly.

Another very important finding in this research work is the positive and significant impacts of localization economies (i.e FOFTRN, LWAEDU and ICT) on the services sector. This finding might be connected with some factors that characterize knowledge spill-over and transmission of ideas within service industry. These factors stimulate business interactions and ease the mobility of skilled labour, which in turn bring about more innovation and productivity (Saxenian, 1994). On the contrary, localization economies (i.e FOFTRN, LWAEDU and R&D), exert negative and significant impacts on the manufacturing sector in Nigeria. This finding corroborates the assertion of Sorensen and Sorenson (2003) that the presence of highly capable knowledge manufacturing firms may bring about increased local competition thereby leading to lower performance of the weaker firms.

V. CONCLUSION AND POLICY RECOMMENDATION

Based on the results and findings of this research work, the study hereby concludes as follows: First, both manufacturing and services sectors are not homogenous in terms of how much they are affected by agglomeration components in Nigeria. Second, agglomeration economies have more significant impacts on service sector than manufacturing sector in Nigeria. Lastly, low manufacturing competitiveness and poor land use policies are responsible for negative and insignificant impacts of agglomeration economies on manufacturing sector in Nigeria.

It is therefore recommended that larger public expenditure should be channeled towards infrastructure investments to stimulate manufacturing competitiveness in Nigeria. Also, favourable land use policy, which will make it less costly and possible for manufacturing firms to locate near one another, should be established.

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