The detection of industrial clusters in Algeria

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Key words

Abstract
We focus in this work on the cluster approach in Algeria. The Algerian economy is a rentier economy suffering from deindustrialization worsened since the 1980s and a lack of competitiveness of its manufacturing industry. In this context, the Algerian authorities are trying to revive the industry through a proactive approach leveraging the oil wealth they have since the 2000s. We believe that this approach will only be successful if it starts in areas favorable to the creation of clusters even in an embryonic state. We will in this work aim to statistically detect clusters after presenting the adaptation of the cluster concept in Algeria and an overview of the Algerian industry.

1. Introduction

Clustering in Algeria has been envisaged since 2007 (during the national conference on industry) in a context of deindustrialization that privatization and liberalization of FDI have not slowed. Indeed, FDI was mainly carried out in search of markets and resources at the lowest cost. Thus, an industrial strategy has been designed and clusters should help to address the decline of the industry and to enable Algerian companies to improve their international competitiveness. Sectoral redeployment of the industry was planned in 3 areas:

1. Exploitation of natural resources for the development of industries for which Algeria wants to move from primary exporter stage to producer and exporter (petrochemical products, synthetic fibers...)
2. Intensification of the industrial fabric concerns industries that must achieve an upswing in the sectors like food and electronic industries. These sectors must especially develop the upstream. For example, currently all the seeds used to produce sunflower oil are imported.
3. Promotion of new industries as ICT industries and the automobile industry which are almost non-existent in Algeria.

Detection of clusters seems an essential first step to identify areas where the important factors necessary to the development of clusters are present.

2. The concept of Clusters and Its Adaptation to the Algerian Economy

In 1890, the American economist A. Marshall in his book (Principles of Economics, 1890) found that companies operating in related fields tend to agglomerate in certain districts because this proximity helps the movement of people, knowledge, as well as enabling customers to compare more easily their products. These concentrations of firms allow external economies and synergies. In the early 1980s, the concept of district was developed in Italy around SMEs / SMI (among Italian authors, we can cite BAGNASCO, BRUSCO, BECCATINI) to explain the development of the "third Italy" (Northern Italy and center).

Indeed, SMEs that produce leather goods in Arzignano, mesh in Prato, tiles in Sassuolo, were, through close collaboration, more efficient than large enterprises in the context of recession of the 1970s and 1980s. District, according to BECATTINI (1989) "*is a socio-territorial entity characterized by the active involvement in a historically determined and circumscribed territorial area, a community of people and a population of industrial enterprises. In the district, unlike what happens in other settings, for example, the manufacturing town, community and firms tend, so to speak, to interpenetrate".* In addition, there are institutions whose purpose is to produce and reproduce these local values. Another important element of the district is the large number of SMEs operating around a product. During the 1990s, following these studies about agglomerations, several countries tried to promote them by public policies. Another model of agglomerations i.e. clusters has been defined according to M. PORTER (1998) as : « *geographic concentrations of interconnected companies and institutions in a particular field …They include, for example, suppliers of specialized inputs such as components, machinery and services, and providers of specialized infrastructure. Clusters also often extend downstream to channels and customers and laterally to manufacturers of complementary products and to companies in industry related by skills, technology and common inputs. Finally, many clusters include governmental and other institutions- such as universities; standard setting agencies …trade associations- that provide specialized training, education, information, research and technical support* ». A cluster as defined by M. PORTER differs from Marshallian district because it also includes R&D, it can also include large companies. The term "cluster" (or "grappes industrielles" in French) comes from the English verb "to cluster» or to agglomerate.

M. PORTER believes that the competitiveness of the industry based on factor endowments inherited is a passive view, he advocates building competitiveness on the benefits created by the cluster development. This latter, with other elements of the Porter Diamond, should ensure the competitiveness of enterprises. In an article dated 1990 entitled «The competitive advantage of nations[1] » M.PORTER believes that the nation's wealth depends on the following elements:
« *Factor conditions: The national's position in factors of production, such as skilled labor or infrastructure, necessary to compete in a given industry Demand conditions: The nature of home-market demands for the industry's product or service Related and supporting industries. The presence or absence in the nation of supplier industries and other related industries that are internationally competitive Firm Strategy, Structure and Rivalry: The conditions in the nation governing how companies are created, organized and managed, as well as the nature of domestic rivalry*".

Concerning the element «nature of home-market demand", it means in other words: if the clients in an economy are very demanding, pressure on businesses could be especially high. For the last two elements, they emphasize the importance of the spatial proximity of industries upstream and downstream and finally the intensity of the competition between enterprises, the process of their creation and their management.

Clustering is an interesting strategy when a group of companies is more effective than consolidated into a single business activity. The organization of enterprises on clusters allows for achieving economies of agglomeration that is to say, external economies related to proximity. The latter requires for its success a lot of coordination and strong institutional structures. Clusters group generally companies in traditional industries but some show the same type of specialized local system in high-tech sector.

In Algeria, public policies to promote clusters have been implemented since the Industrial Policy in 2007. Thus, a «National Conference of Industry" held from 26 to 28/02/2007 include the creation of clusters. The document entitled "Industrial Strategy" from the «National Conference of Industry" defines the cluster by the following elements:

- Synergy
- Sharing external economies
- Supply of training centers and R & D structures that promote innovation in enterprises
- Contribution to the development of a new class of entrepreneurs based on the mobilization of new technologies
- Contribution to the attractiveness of FDI (Foreign Direct Investment)
- A place where economic reforms find their actual translation.

Similarly, the Ministry of Industry, SMEs and Investment Promotion supports the development of clusters in Algeria by accompanying the creation of business nurseries and incubators and implements measures to support the upgrading of enterprises. This action is fundamental because in the Algerian economy SMEs made up, in 2013, 94 % of the whole number of the Algerian companies, 56% of the workforce and contribute to 48 % of non-hydrocarbon GDP.

For the current program 2010/2014, the Ministry plans to upgrade 20,000 SMEs with technical and financial assistance of the European Union. Initiatives have been taken to create pilot clusters in mechanical industry, production of dates, transport and industrial tomato in cooperation with GTZ (German Technical Cooperation for Development) under the DEVED program (Sustainable Development - launched in 2007). Initiatives have also been taken under the auspices of the former Ministry of Crafts and SMEs in 2008 under the program EdPME upgrade funded by the EU to create localized productive systems in craft industries. According to Courlet (1994) "*a localized productive system can be defined as a business in a clustered configuration space close around a job or several industrial or commercial business ... These relationships are not only commercial but also informal ... dominant business does not exclude the existence in the SPL of several industrial branches* ".

We also report marginal private initiatives that encourage the promotion of social capital that is to say, the norms and values that govern the collective activity which are essential to the success of clusters. We present the example of CHOK (Cooperative of Olive oil in "Kabylie"). The provinces of Bouira, Bejaia, Tizi Ouzou Bordj Bou Arreridj concentrate 51% of olive-growing areas of Algeria and 65 % of the production of olive oil over a radius of about 100 kilometers.

In 2004, a grower launched the idea of creating a group of entrepreneurs and farmers resulting in the creation of the CHOK to solve the problems of the profession and develop cooperation between producers. This initiative is supported by the Chamber of Agriculture. This initiative resulted in the creation of NUCLEI companies namely a group of companies who meet periodically around a host counselor within a chamber of crafts and trades or a chamber of commerce and industry to identify common problems and find solutions. We can also mention the creation of associations of private producers such as APAB: Association of Algerian Producers of Beverages. We can see from the above the diversity of agglomerations experienced in Algeria, we will focus on clusters.

3. Statistical Detection of Clusters in Algeria

The aim of this work is to test the presence of a tendency to clustering of companies by global Moran test and then locate potential clusters may exist by the method of clusters in two stages.

a) **Data and Methodology**

   Data

The data include 959,718 companies spread by region (Geographical origin) and sectors (industry, construction, trade, and services), the number of industrial areas (IND. AREA) in the

table below), areas of activity, vocational training centers called CFPA (T.C in the table below) and the working population by region. These variables promote the creation of clusters that is the reason why we have selected them in our statistical inference.

Methodology
The Moran test

Several statistical methods have been developed (BESAG & NEWELL (1991) for the identification of clusters. The overall test for detection of MORAN (GAUDART et al 2007) is used to verify the existence or non-existence of spatial clusters. This test is characterized by the search for a general tendency to aggregate; it is based on the following assumptions:

H_0: there is no tendency to clustering

H_1: there is a tendency to clustering

To measure the spatial autocorrelation, we must define the neighborhood that we consider. This neighborhood is described through a matrix, called "proximity matrix", which is generally a matrix of contiguity.

Moran index

The test is based on the so-called statistical Moran index (WALLER & GOTWAY (2004) noted and defined as:

$$I = \frac{1}{w_+} \cdot \frac{\sum_{i=1}^{i=K} \sum_{j=1}^{j=K} w_{ij}(y_i - \bar{y})(y_j - \bar{y})}{\sum_{i=1}^{i=K}(y_i - \bar{y})^2 / K}$$

where K= the number of spatial units

w_{ij} = elements of the proximity matrix for the spatial units i and j

$$w_+ = \sum_{i,j=1}^{K} w_{ij}$$

$y_i = n_i$ number of observed cases in the spatial unit i

$$\bar{y} = \frac{\sum_{i=1}^{i=K} y_i}{K} = \text{Average of observed cases on the whole K spatial units}$$

I statistic is a random variable. Under the hypothesis H_0, I follow the same asymptotic normal distribution regardless of the spatial unit i($I \to N(m, \sigma^2)$) with:

$$\hat{m} = \frac{-1}{K-1},$$

$$\bar{\sigma}^2 = \frac{(K^2 \cdot \frac{1}{2} \cdot \sum_{i \neq j}^{K}(w_{ij} + w_{ji})^2 - K \cdot \sum_{i=1}^{i=K}(w_{i+} + w_{+i})^2 + 3w_+^2)}{(K-1)(K+1)w_+^2} - \hat{m}^2$$

$$w_{i+} = \sum_{j=1}^{K} w_{ij} \quad , w_{+j} = \sum_{i=1}^{K} w_{ij}$$

The Moran measure the similarity between neighboring spatial units

I < 0 negative spatial autocorrelation, so the neighboring spatial units are different.

I $\simeq 0$ there's no correlation between neighboring, spatial units and spatial model is perfectly random.

I> 0 neighboring spatial units are similar (there is a pattern in the form of a Cluster of spatial units)

- **Two-step clustering**

The method of clusters in two steps (Two-step clustering) introduced by Chiu et al . (2001) aims to identify clusters for mixed data. So the data will be organized in groups (clusters) , the

members of each cluster are very similar to each other and very dissimilar to members of other clusters this on the basis of one or more discriminant variables. The name of the method means that the algorithm is applied in two steps:

Step 1: individuals are assigned to pre- clusters

Step 2: Pre- clusters are clustered a second time using the hierarchical algorithm (Abu Abbas (2008) .

This method implemented in the SPSS package assumes that all variables are independent. We used Excel to calculate the statistic and Moran index. The proximity matrix used is the matrix of contiguity (matrice de contiguité in french) because the only information available is the geographical origin, it is defined by:

$w_{ij=}$ 1 if the region i has a border with the region j

$w_{ij=0}$ if the region I has no border with the region j

By convention the region i has no borders with itself which implies $w_{ii=}$ 0

SPSS 17 Software was used to identify the same groups using the method described previously called clusters in two stages.

b) **Analysis and Findings**

SECTORS	INDUSTRY	SERVICES	TRADE	CONSTRUCTION	WORKING POPULATION	ROADS	TRAINING CENTER	INDUSTRY AREA	ACTIVITY AREA
MORAN'S INDEX	$2,894.10^{-7}$	$3,035.10^{-6}$	$1,075.10^{-6}$	$2,474.10^{-5}$	$1,358.10^{-11}$	0,0081237	0,002	0,613	0,008
Z(SCORE)	0,238217	0,2382141	0,2382138	0,2384907	0,23	0,3291666	0,266	7,11	0,32
P-VALUE	> 0,10	> 0,10	> 0,10	> 0,10	>0,10	>0,10	>0,10	0,00	>0,10

Based on the results below, Moran is significantly zero for all variables used , except the variable Industrial Zone . So it turns out that the variables industry, services, trade , construction, employed population , roads, CFPA are distributed randomly and there is not concentration of businesses. By against Moran on the variable Industrial Zone is significantly different from zero suggesting a tendency to clustering of firms with respect to this variable. Using the method of clusters in two steps by adopting automatic clustering reveals two homogeneous groups with respect to all variables taken together:

Cluster Size
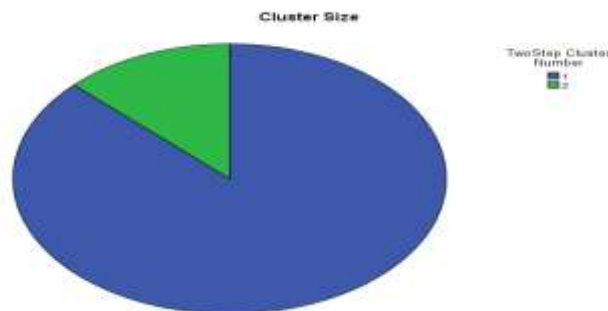
Cluster 2: 5, 6, 15, 16, 19, 31 (includes 12.5% of the regions)

Cluster 1: This cluster includes the rest of the regions (85.4 %).

Cluster 2 contains about 32 % of companies in all sectors of which 35 % from industry, 39% from the building sector, 31% from commerce and 32% from services sector.

The dominant variables in this group are in order of importance, industry variables and then construction and services. Variables industry, construction, trade, services and CFPA also dominate the cluster 1, but in reverse.

The cluster analysis shows that both the six regions composing namely: Algiers, Batna, Bejaia, Oran, Setif and Tizi-Ouzou are characterized by a high concentration of industrial enterprises mainly in agri-food (Bejaia , Tizi -Ouzou and Sétif) or related to the construction (Batna) . The majority of these companies is recently created (between 2000 and 2011) and is small (number of workers between 0 and 9). Concerning the legal status, they are more than 70 % private and concentrated in urban areas.

On other components of a cluster: infrastructure (roads, ports, airports etc.) , population , natural resources ... , the combination of which promotes the revitalization of the region , we note that all of these are equipped with infrastructure , roads (many are under construction) , ports (Algiers, Tizi -Ouzou , Bejaia and Oran), Airports (Algiers, Bejaia , Batna , Oran and Setif), academic centers or graduate schools and centers training .

However, these agglomerations of industrial enterprises have very few measurements of the tax exemption system, since only 20% of companies are concerned by the exemption, whereas entities in the trade and services account for almost 80 % of exempt entities.

Way of imposition / Sectors	Real	Lump-sum tax	Exempt from tax	Other
construction	4,6	0,4	1,2	0,5
trade	37,4	58,7	42,8	55,3
industry	12,5	9	20,2	11,1
services	45,4	32	35,8	33
TOTAL	100	100	100	100

Table 1: Distribution of economic entities by way of taxation and%

Thus, although the industry has since the crisis of the mid -1980s, seen deindustrialization resulting in a sharp decline in its participation in the creation of added value (excluding hydrocarbons, it represented less than 6% in 2013 according to NSO) and a negative total productivity of factors, it continues to be marginalized by the government in discouraging investment in this sector. With regard to the food industry specifically, the source of its problems is its dependence towards the outside world in terms of inputs. Dependence could be reduced largely by creating channels and developing existing ones to the example of olive oil sector , the milk industry etc.

The development of the upstream of the channels requires the development of agriculture in general and the promotion of agro-industrial products (tomatoes...) and involves investment in both physical capital and human capital. Indeed, universities and training centers existing in these regions, although more or less important, do not provide good quality training in relation to the specificity of the region and its needs. It would be interesting in this effect of creating BLUE (structures which create a liaison between enterprises and universities) like those in Canada and in Algeria in the region of Tlemcen.

Moreover, the food industry knows many mutations internationally through investments in R & D. In recent decades new agricultural techniques have emerged bringing great changes in the pattern of consumption (industrialization of food). Thus, Algeria in most areas, the consumption of olive oil which was dominant twenty tends to be replaced, currently, and by the margarine of

soybean oil, inducing a decrease of the production of olive oil and an increase in its price. In addition, the majority of substitute products are imported. Thus, alone, food products account for about 20% of total imports in 2013.

Reducing the food bill necessarily involves the creation of small and medium enterprises more connected to agriculture and inclusive upstream and downstream. The existence of agglomerations of industries in these regions is certainly linked to the existence of natural resources such as agricultural land, mineral water, minerals and forests. Thus, due to the proximity to reliable water sources (Bejaia , Batna , Tizi -Ouzou, Oran and Batna) many companies producing juice and lemonade were born . However, natural resources should not be the only attraction for business location. Transfer of knowledge and technology through a partnership with foreign firms or foreign direct investment (FDI) could be a factor of attractiveness for other companies and other IDE in the same branch or different branches of activity, thereby promoting the formation of agglomerations.

Conclusion

The formation of clusters in Algeria should help remedy the deindustrialization and building a productive and competitive economy. Deindustrialization is a fundamental characteristic of what in economics if often referred to as the Dutch disease which is the result of bad investment of oil revenues. We therefore believe that the creation of clusters should be prioritized for the regions where we have detected a statistically significant presence of industrial enterprises (Cluster 2), these are Wilaya: Batna, Bejaia, Tizi -Ouzou, Algiers, Setif, Oran. Discrimination of the two clusters is determined by all the variables simultaneously. These regions have strengths in the field of agribusiness and industry related to construction. These industries generally have to develop their upstream and downstream and are strongly challenged by imports and benefit less than the trade sector and the services sector from tax exemptions.

References

Messner S., Anselin L. (2003), Spatial Analyses of Homicide with Areal Data, in M. Goodchildand D. Janelles (Eds), *Spatially Integrated Social Science,* New York University Press

Anselin L. (1988), *Spatial Econometrics: Methods and Models*, Kluwer Academic Publishers,Dordrecht-Boston-London

Bacha P. Brunck T., Delany, J. Clustering methods and their uses daylight CIS, INC, 2007.

Abu Abbas O. "*Comparison between data clustering algorithms*". The international Arab Journal of Information Technology , 5 (2008) N°3, 320-325

Bagnasco Arnaldo (1977), *Tre Italia. La problematica territoriale dello sviluppo italiano,* cité dans

Daumas Jean-Claude (2006), *District industriels: le concept et l'histoire,* Papier présenté lors du XIV international Economic History Congress, Helsinki.

Barbesol Y. et Briant A. : Economies d'agglomération et productivité des entreprises : estimation sur données individuelles françaises. , economie et statistique, n° 419-420, année 2008

Becattini G. (1992). « Le district marshallien : une notion socioéconomique » *in* Benko G., Lipietz A., *Les régions qui gagnent*, Paris, PUF- 35 à 55 .

Becattini. G : Riflessioni sul distretto industriale marshalliano come conceto socio-economico Stato e Mercato- Avril 1989.

Besag, J & Newell, J. T*he detection of clusters in rare diseases*. J. R. Statist. Soc. A (1991) 154, Part 1, 143-155.

Brusco S. (1990). The idea of the industrial district: its genesis ; in Becattini G., Pike F. et

Sengenberger G., 1990, Eds. : *Industrial districts and inter-firm cooperation in Italy*, Geneva, International Institute for Labour Studies

Champagne de Labriolle C. : Une analyse marshallienne des districts industriels italiens , Université de Lyon,

Chiu T., Fang D., Chen J., Wang Y., Jeris C. A robust and scalabale clustering algorithm for mixed type attributes in large database environment. In proceeding for the 7th ACM SIGKDD international conference in knowledge discovery and data mining association for computing machinery. SanFrancisco CA (2001), PP 263-268.

Courlet.C et Bernard Soulage : Les systèmes productifs localisés de quoi parle- t'on ?- Industrie, territoire et politiques publiques- L'Harmattan- Paris- 1994.

Daumas.J.C : Districts industriels : le concept et l'histoire. XIV International History Congress, Helsinky 2006, session 28

Gaudart, J. et al. Détection de clusters spatiaux sans point source prédéfini : utilisation de cinq méthodes et comparaison de leurs résultats". Revue d'épidémiologie et de Santé Publique 55(2007) 297-306.Waller L.A., & Gotway, C.A. Applied Spatial Statistics for Public Health " .

John Willey & Sons, Inc. (2004).

Gaffard J.L et Romani P. M : A propos de la localisation des activités industrielles : le district Marshalien », revue françaised'économie, vol. 5 n° 3, 1990

Giovanna.C et Maurizio.C : « La diffusion de la démarche cluster dans trois pays du Maghreb : Algérie, Maroc, Tunisie »- éd. ONUDI et AFD- 2013

Marshall A. : « Principes d'économie politique » - 1890, Paris Giard et Brière- 1906.

Maruani M., E Raynaud, C Romani : « La flexibilité en Italie » - Paris- Syros- 1989

Porter M : The competitive advantage of nations »- The Free Press- New York- 1990.

Porter.M.E: Clusters and the New Economics of Competition. Harvard Business Review- Novembre 1998

Rasmussen J et H. Shmitz Abu Abbas O. "Comparison between data clustering algorithms". The international Arab Journal of Information Technology, 5 (2008) No3, 320-325

Annexes

Auto-Clustering

Number of Clusters	Akaike's Information Criterion (AIC)	AIC Change[a]	Ratio of AIC Changes[b]	Ratio of Distance Measures[c]
1	778,591			
2	768,706	-9,885	1,000	1,460
3	802,281	33,575	-3,397	2,139
4	886,133	83,852	-8,483	1,141
5	975,431	89,298	-9,034	1,309

a. The changes are from the previous number of clusters in the table.

b. The ratios of changes are relative to the change for the two cluster solution.

c. The ratios of distance measures are based on the current number of clusters against the previous number of clusters.

			INDUSTRY		CONSTRUCTION		COMMERCE	
			Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Cluster	1		1497,68	825,270	127,83	70,544	8536,05	4093,268
	2		5623,83	2113,066	562,33	294,081	27554,50	15260,821
	Combined		2024,43	1736,302	183,30	187,642	10963,94	9002,195

			SERVICES		CFPA		ROADS	
			Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Cluster	1		5230	2534	13,,78_	4,54	1976	1078
	2		17097	8023	32,5	22 ,32	2800	1264
	Combined							

			ZONE INDUSTRIELLE		Industrial areas		POP OCCUPEE	
			Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Cluster	1		1,22	0,96	9,49	5	179339	96459
	2		2,8	1,6	12	9,2	418738	204521
	Combined							

INDUSTRIE

CONSTRUCTION

COMMERCE

SERVICES

CFPA