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ABSTRACT OF THE PhD THESIS ENTITLED:

**IDENTIFYING LOCAL INDUSTRIAL CLUSTERS IN
ROMANIA,
VECTORS OF REGIONAL DEVELOPMENT**

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CLUJ-NAPOCA

2016

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Keywords

local industrial clusters, competitiveness poles, cluster categories, emerging industries, correlation, territorial autocorrelation, agglomeration, areas with intense research activities, financing

Introduction

During the last years clusters – as a phenomenon – have begun to play an increasingly important role not only from an economic, but also from a political point of view, the concept being used quite often in development policies, being considered a simple solution to many of the complex problems of the economy.

In recent years in Romania, following widespread EU and global trends, a series of cluster initiatives have started to appear, these being either the result of bottom-up initiatives of the economic environment or sectorial associations initiated by catalyst organizations which have claimed the role of managing these structures, the main goal being to generate common benefits for the member organizations.

A series of studies have pointed out the role played by clusters in the process of economic development by ensuring a tight link between the economic and the academic environment, this type of knowledge transfer being considered more and more the key element in generating competitive advantages in the context of an ever sharpening global competition. Despite all these, even though in Romania a series of studies have been elaborated on the subject in the last years, most of them offer us nothing more than a static picture of the existing situation, usually expressing a single point of view and without an emphasis on identifying factors which have formed the base of these agglomerations and which could contribute to further strengthening the clustering processes. Moreover, the lack of an adequate methodology can often lead to incorrect or irrelevant results which can negatively affect the measures included in different programming documents. In conclusion, the main aim of the PhD thesis is to offer a clear and comprehensive image of the clustering processes in Romania by making use of innovative quantitative methods, to analyse their impact on economic development and by identifying specific spatial structures, to increase the impact of future innovation and development policies.

Summary overview of the thesis chapters

In addition to the conceptual framework and the hypotheses, the thesis is divided into 12 chapters: the first five are mainly theoretical while the rest have a more practical approach.

Chapter four deals with spatial clusters of economic activities, reviewing previous research results and making an inventory of concepts and definitions developed and used in recent decades.

Since the literature on clusters in Romania can often be associated with the need for substantiation of public policies or presentation of results of various EU-funded projects, the *fifth chapter* reviews the role attributed to clusters in the process of regional development within policy- and planning documents.

Before developing a theoretical model to analyse the emergence and evolution of clusters in Romania (clusters understood as concentration of certain industries and not necessarily local systems formalised by collaboration agreements), the *sixth chapter* defines the phenomenon called Local Industrial Clusters (LIC). For the purpose of this thesis and for practical reasons, local industrial clusters are defined as “a concentration of companies belonging to one or more cluster categories or emerging industries that came into being as a result of self-augmenting processes, in a well-defined geographical area close to public research institutes or state universities, where spillover effects can be considered significant.”

Given the need for self-augmenting processes within clusters which do not occur among all types of companies of any industry, the *seventh chapter* deals with the delimitation of groups of related industries, also referred to as cluster categories. According to the methodology developed in the US and adapted for analysing the EU economy in 2014, 51 cluster categories have been proposed, the rest of the economy being considered as local, having an almost similar density in all regions. The cluster categories encompass the so called “traded” industries, serving markets beyond their own location, being directly exposed to competition from other regions. These industries have a much higher tendency to concentrate in certain regions, in this sense high salaries and highly innovative activities are considered to be key elements of regional economies.

Although the new definitions of cluster categories from 2014 propose to include the industries based on the exploitation of natural resources, given not only that they were excluded from the 2012 analysis but also that the studied clusters are required to be the result of self-supporting processes, these industries (mining of ferrous metals, mining of non-ferrous metals, coal

mining, oil and gas extraction, and forestry) are omitted from the quantitative analyses. Thus we have a total of 46 cluster categories, covering a total of 384 traded industries at NACE 4 level. These industries represent about 41% of all companies nationwide, employ 51% of employees nationally and generate 54% of Romania's total turnover.

Chapter eight concerns the delimitation of the geographical area where the agglomerations in the cluster categories are to be analysed. Given the requirement to ensure accessibility of individual companies within maximum 60 minutes (to ensure effectiveness of spillover effects among companies) and the criterion of proximity to research institutes or universities, the analysis is conducted on territories made up of Territorial Administrative Units (TAUs) located within 30 minutes from such institutions. These territories are called Areas with Intense Research Activity (or ZAIC from the Romanian abbreviation). These ZAICs comprise a total of 370 administrative-territorial units, representing just under 12% of the total number of TAUs in Romania. In 2014, these areas were inhabited by 40.4% of the Romanian population and 70.2% of the private sector employees worked there. If we look at the number of companies, their percentage in ZAICs is slightly lower, around 65%. Only the total turnover of the companies in Romania has a much higher concentration in these areas, i.e. a little over 76.5%.

Chapters nine and ten analyse the dynamics of traded industries which make up cluster categories both across the whole of Romania and in ZAICs. As regards the share of traded industries in the Romanian economy, we can see an almost constant growth over the 2008-2014 period, which shows a significant increase in the importance of those sectors and their role in supporting the economy in general.

The percentage of companies in these industries rose from 39% to 41.2%, the percentage of employees from 49.6% to 50.6%, but the sharpest increase can be noticed in the turnover, where - even after adjusting the data to the inflation index - the growth was almost 7 points, from 46.8 to 53.6%. Therefore, Romania's economy is heading towards a new structure similar to that of western regions, entering ever deeper into the global economic competition.

Looking at the various sectors throughout the country, we would consider that the cluster categories which are the most significant at national level should be those situated in the top 20% in terms of growth. Thus the analysis focuses on the first 9 cluster categories out of the total of 46, not just in terms of company and employee number growth, but also growing turnover. While the positive evolution of the number of companies in a particular area is a good indicator of the entrepreneurial spirit, the employment rate shows the role that a particular industry already plays in the economy. Moreover, the growth rate of the turnover in a particular

sector may indicate a change in its importance in the economy or the emergence of new technologies that lead to a better use of resources in that area.

If we look at the dynamics of the industries in the cluster categories nationwide, we can see that their evolution is not much different from the dynamics at ZAIC level. But if we analyse their dynamics over two distinct periods of time (2008-2014 and 2010-2014), we can see a number of differences depending on the effects the economic crisis has had on them, being able to delimit the categories which have successfully survived the harsh years following the 2008 events.

In *chapter eleven*, we try to identify local industrial clusters using the four star approach. In our analysis, we use a cluster mapping methodology applied mainly in the US and the European Union, adapted by the authors Ketels and Protsiv, and described in detail in the 2014 Cluster Panorama. The methodology has been modified here and there to suit the purpose of this analysis and the available data sets.

Given the concentration of research activities in just a few urban centres (national research institutes and state universities being present in only 26 urban areas of the total 41 counties), our intention is to identify the territorial distribution patterns and trends of cluster categories in these areas, finding hotspots and characteristics which contributed to their better positioning compared to the other areas of the country. Regarding the identified local industrial clusters, we will consider as relevant those which have scored at least three stars out of four, in other words the top 10 LIC according to at least three of the four indicators.

The country's capital is the only area with 2 four-star clusters and 10 three-star clusters. In the rest of the 26 ZAICs, there are 9 four-star clusters and 24 three-star clusters in total. However, if we leave aside the capital area and recalculate the respective indicators for the other ZAICs, we end up with 15 four-star clusters and 29 three-star clusters.

To avoid cases where we identify three- or four-star clusters with strong dynamics but with a very small number of employees, we take into account only those clusters that have at least 1% of the total number of employees working in the global industries of that ZAIC. By applying this criterion, the number of 4-star LICs is down to 11 in 9 fields. The application of the additional criterion brings the number of 3-star LICs down to 32.

In the last 8 years, the European Commission has launched a series of initiatives both to support innovation and economic growth, as well as to strengthen the competitiveness of the European economy in general. One of the areas of interest is the delimitation of emerging industries and

the analysis of their role in supporting the EU economy. *Chapter twelve* analyses the evolution of these industries in ZAICs, as they are defined in the 2014 Cluster Panorama analysis.

In Romania, the ten emerging industries are well represented in terms of number of employees. As at EU level, all ten emerging industries have a lower rate of decline than the average of traded industries (although at EU level we can speak of an average annual growth of 0.27% between 2007 and 2012). In terms of productivity, five of the ten emerging industries (biopharmaceuticals, digital industries, environmental industries, medical devices and mobility technologies) have a higher labour productivity than the average of traded industries at ZAIC level (334,000 RON/employee), while in the EU, in 2013, only four fell into this category, namely the digital industries, the creative industries, the experience industries and the manufacture of medical devices.

Chapter thirteen analyses the relationship between the presence and performance of emerging industries and the economic and social welfare of the Romanian population. Usually, the cornerstone of cluster support policies is the presumption that the concentration of economic activities in certain industries facilitates increased performance of companies and contributes to faster economic and social development of the area. Although locally the agglomerations of companies in fields with high growth potential are usually associated with a positive impact on the economy, productivity or unemployment, lately many researchers have shown no positive effects on welfare interpreted in a broader framework that includes social elements or environmental aspects.

As a general conclusion, after calculating the correlation coefficient for a set of selected indicators, we can see that while the existence of a large number of employees in emerging industries is usually related to the distribution of indicators such as the percentage of people with higher education - both in TAUs across the country and in ZAICs, other indicators such as entrepreneurship rate are related especially to features such as the productivity of certain industries, in which case the values calculated at the country level are different from the ones at ZAIC level. In contrast, although the illiteracy rate is closely linked to education, it does not show any relation with the elements belonging to emerging industries. We may also think that the presence or performance of emerging industries should have a negative correlation with indicators such as unemployment, but its values do not fall below -0.119 in neither case; sometimes there are even positive values of 0.209 (productivity of digital industries). Surprisingly, we have not been able to find a correlation between the presence or performance of companies in emerging industries and TAUs' income per capita (either nationwide or in

ZAICs) or TAUs' spending on social services, an indicator which could very well express social welfare.

Regarding the correlation of elements relating to emerging industries, although the presence of certain domains was expected to have a major influence on the development and productivity of others (e.g. a large number of employees in the digital industries should be correlated with high productivity of industries such as the manufacture of biopharmaceuticals, medical equipment or mobility technologies), such relationships could not be found. The lack of such relationships even in ZAICs suggests that the interconnection and collaboration among emerging industries is relatively low in Romania, generally with no tight connections and without the tendency to participate in interdisciplinary research projects to increase productivity or develop new and innovative products/services.

Chapter fourteen analyses the relevance of ZAICs in studying the emerging industries in Romania by identifying specific spatial relationships resulting from the calculation of the spatial autocorrelation index. Spatial autocorrelation as a phenomenon exists because all the processes take place in a particular area, usually representing systematic concentrations and not necessarily a random distribution. The calculations and the resulting scatter plots on the number of employees in emerging industries show that almost all HH-type clusters - with a positive correlation of values above the national average - are located within ZAICs. Moreover, except for a few communes in the Bucharest, Reșița, Iași, Bacău and Călărași ZAICs, all LL-type clusters (with a positive correlation, but with values below the national average) are located outside the areas of interest. As regards the degree of specialisation, the relationships with ZAICs are not quite so obvious. We can see that in the case of HH-type clusters, the ZAICs that stand out are Timișoara, Pitești, Constanța and the southern halves of Brașov and Reșița, which means that these territories consist of large and connected areas, with a high degree of specialisation in single sectors that make up emerging industries. In terms of increase in the number of employees in emerging industries, we can see a phenomenon that is almost diametrically opposed to the previous one, namely most hotspots are outside the 30-minute accessibility limit even though they are located near ZAICs. Finally, in terms of emerging industries' productivity, we don't seem to have HH-type clusters, except for the Timișoara ZAIC and the northern part of the Arad ZAIC.

Although generally the territorial autocorrelation method may not be suitable for delimiting the concentration of emerging industries, it can be extremely useful in mapping areas that excel at one or more of the four studied indicators. In most cases, ZAICs include almost all compact

HH-type areas, with a large number of employees working in emerging industries, while most of the LL-type clusters are located outside ZAICs. However, in terms of specialisation, there are several HH-type clusters outside ZAICs, especially in the Apuseni Mountains area and in central-northern part of the Southern Carpathians and the Danube Delta; the more developed areas are known to have a much more diversified economy, hence the lower degree of specialisation. Nevertheless, we can see extended HH-type clusters in the Timișoara, Pitești și Constanța ZAICs: in the first two, the specialisation is in mobility industries, whereas in Constanța the specialisation is in fields belonging to the Blue Growth and experience industries.

Finally, *chapter fifteen* analyses financing possibilities between 2007 and 2013 for financing activities of clusters and competitiveness poles, in particular by correlating the theme of the projects submitted under Operations 1.3.1 and 1.3.3 of the Sectoral Operational Programme for Increase of Economic Competitiveness with the areas of interest identified in the previous cluster mapping analyses.

The purpose of this section is to outline those cluster categories which, in the previous analyses, were identified as having high growth potential in some regions but no project ideas covering them were submitted under SOP IEC Operations 1.3.1. and 1.3.3. The same method is used to highlight the sectors which were not necessarily identified as being of interest, but several project proposals were submitted under these two Operations, targeting the use of local resources and competitive advantages that previous analyses have failed to identify. The importance of these observations is all the more important as several studies and analyses show that most initiatives are carried forward by their initiators even if they are not funded. As a result, these initiatives can be a good starting point in the development of funding programmes for future periods and they are also indicative of the sectors which are likely to have the highest growth in those areas in the coming years.

Conclusions

The new methodology used to map local industrial clusters in Romania and identify their role in regional development has brought new results that confirm or refute the conclusions of the previous studies on this topic and at the same time draw attention to many issues which have not been pointed out until now due to the lack of data and a proper methodology.

First, as regards the mapping of cluster categories, we can see that although they often give us the opportunity to compare results at European level, the aggregation of individual industries does not allow us to adapt the methodology so as to find niche sectors, such as the manufacture

of traditional ceramics, etc. As seen, the results are not very encouraging, as the concentration of sectors with a higher added value is much below the European level. After correlating the results on the existence of local industrial clusters with the locations and sectors identified in the past as having a high potential of forming local networks for collaboration, we have managed to find not only a large number of differences, but also some areas with great development opportunities in the future: the manufacture of biopharmaceuticals in Târgu Mureș, the leather products industry in Alba Iulia, the aerospace and defence industry in the Bacău and Brașov areas, or the furniture sector in Pitești are just a few of them. Moreover, we have been able to determine accurately those economic activities which, although a few years ago seemed to be of major importance, in time they have lost significance especially as a result of the global economic crisis.

By including in our analysis elements such as the growth rate or labour productivity, we have been able to determine more accurately the areas with significant performance over the last six years. However, for more accuracy of future analyses, we recommend that an inventory of the research fields related to state universities or national research institutes in those areas be made in order to see whether their activity is really relevant to the identified fields or their simultaneous presence in the same locations is pure coincidence.

Although ZAICs concentrate a large part of the economic activities of the Romanian economy, only the number of companies in global industries tends to concentrate in these locations; the number of employees or the turnover not so much. Nevertheless, the growth rates of all the three indicators is higher for the global industries in these areas, which suggests a strengthening of the position of these industries in the national economy and shows a shift to an economic structure that can be encountered in more developed countries in Western Europe. Going into detail, we can often see that the figures showing the composition of individual sectors hide relevant information that can help us not only to validate certain identified local industrial clusters, but also to understand fluctuations which otherwise could lead to erroneous conclusions.

Secondly, we can see that the emerging industries have been identified based on the complex relationships between cluster categories and other individual global industries, most of them playing an extremely important role in the Romanian economy. By applying the same methodology, we can see major differences between the role of these industries in the Romanian economy and the role played by emerging industries in Western Europe; the main features are the low number of companies and employees in the case of emerging industries with a high-

tech component, and the lower labour productivity of these industries, particularly in the manufacture of biopharmaceuticals and automotive industry, compared to the national average. However, overall the emerging industries have performed well above the economy in general.

Regarding the connection between the presence and performance of these industries and the economic and social welfare of the population in those areas, we can say that, although there is a correlation between the percentage of people with higher education and labour productivity or the number employees in emerging industries or entrepreneurship, these are rather weak and volatile relationships; sometimes they are weaker in ZAICs than the rest of the country, even though a close correlation between the number of doctors per capita and the number of employees in the ten emerging industries is found precisely in these areas. On the other hand, we have not been able to find a connection between the presence and performance of these industries (e.g. digital industries) and the improved performance in others (medical equipment, mobility technologies, etc.), which suggests that the interaction among these fields of major importance in Romania is extremely weak. Moreover, the lack of correlation between the presence of emerging industries and indicators such as public administration income per capita, lower unemployment, infrastructure development, illiteracy, etc. makes us wonder whether or not the State aid granted to large companies that promised to create jobs and the development of those areas are justified.

As regards the use of ZAICs as a suitable framework to analyse the progress and performance of emerging industries, the conclusions resulting from the calculation of the territorial autocorrelation are mixed; the answer largely depends on how the results are used. While the results proved to be significant in all emerging industries, particularly in terms of employee increase and specialization in ZAICs, when analysing individual emerging industries the results may not only help confirm or rule out the presence of local industrial clusters but also identify traits which - if addressed through coherent and well-thought development policies - will contribute to sustainable economic growth in those areas. Using the territorial autocorrelation, we have been able to map compact areas which - even though they do not stand out at national level in terms of the number of employees - with the above average values of the analysed indicators extending to wider areas may represent a real cradle for improved performance in certain emerging industries, the spillover effects spreading quickly into adjacent areas.

Lastly, regarding the relation between the fields identified as having a high potential for creating cluster-type associative structures and the field or location of the projects submitted under the two Operations of the Sectoral Operational Programme for Increase of Economic

Competitiveness (Call 1.3.1. Competitiveness Poles and Call 1.3.3. Clusters), we can see that there are more differences than similarities in this case as well. Nevertheless, the results of this comparison can be extremely valuable in the next programming periods, for they provide not only the opportunity to analyse the reasons that prevented local actors from coagulating into associative structures to attract grants and set common development goals, but also relevant inputs to develop new funding programmes, since they are a real representation of the private sector needs at the time.

We can also see that, depending on the methods used, the conclusions may be extremely different even on the same issues in the same sectors; however, we believe they should not necessarily be treated as contradictory but rather as complementary. Given the growing complexity of economic activities and the increasing interconnectivity and dynamics of sectors, each of the analysis elements can capture only some aspects of the phenomena to be studied, and the results should be interpreted in an integrated way.

Considering the above and the imminent release of the new edition of the European Cluster Panorama, we are looking forward to seeing whether the categories of clusters and the emerging industries will be maintained in their current form or their structure will be rearranged in order to better reflect the development trends of the new intersectoral linkages in the global economy. Either way, we hope that some elements of the presented methodology will be used by the decision makers responsible for the preparation programming documents and policy instruments, and that the results of this paper may help increase the effectiveness of specific funding instruments and development policies.

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