THE COMPARISON OF CLUSTERING ISSUES BETWEEN SLOVAKIA AND POLAND

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Abstract: This paper introduces the selected issues of clustering in various field of industries in Slovak and Polish republics. It provides an overview of basic differences between Slovak and Polish conditions for clustering from the point of view of quantitative aspects. The paper consists of two parts. In the first the focus is oriented on comparison of regional economy measured by indicators on which the operation of clusters has impact through the cluster analysis. The second part is oriented on comparison of selected issues of cluster policy that is prerequisite for clustering of regional stakeholders. The results showed similarities in both cases. The aggregation of regions into the clusters by using cluster analysis depends on using indicators and we can't follow the influence of clusters in region on regional indicators. From the point of view of issues of cluster policy we can conclude that situation in this field is better in Poland than in Slovakia.

Keywords: Cluster, region, cluster analysis, quantitative aspect

1 Introduction

The actual situation of the European economy as well as the economy of both countries brings intensifications of competition. New platforms for entrepreneurship have become more and more important. Their establishment, acting and supporting is in focus of the European strategies at various level, from local through regional, national until European (Kordos, 2016, Bohátová et al. 2016, Mucha, Peráček, Strážovská, 2016, Mura et al. 2017, Olsovska & Svec, 2017, Tkáčová et al. 2017). Due to the increasing emphasis on the role of gaining competitive advantage of business entities, mutual relations among them and other regional stakeholders (including universities, e. g. Aziz et al., 2016, Slabá & Fiala, 2014, Gavurová et al. 2016, Lietava & Fáziková, 2017) grouped in one area and economic branch are the phenomenon, which is gaining importance. These relations are characterized in the literature as clusters. Clusters have become an inseparable part of economic development and building strategies of the EU member states. (Piatkowsky, 2015 or Tvaronaviciene, 2017). For comparison of countries, regions, cities etc. methods of multi-criteria evaluation of alternatives are usually used but sometimes if groups of similar countries or regions are needed, cluster analysis is suitable. The combination of both principles was used in the analysis of Kuncová & Doucek (2011) where clusters of the EU countries from the ICT point of view were created. Various studies focused on the importance of cluster cooperation point on the main reasons and advantages of doing business in this form. Enterprises grouping in clusters with the characteristics of close geography and correlation find relevant the innovation platform, knowledge spill overs, enhancing the speed of technical innovation and competition, have more competitive advantages and stronger innovative power and performance as non-grouping entities (Youli & Huiwei, 2011, Zaušková & Madleňák, 2012, Hitka et al. 2018 or Žiška et al. 2018). Clusters create synergies, bring many positive externalities, and are seen as an important tool for developing competitive industries, regions and respectively economies. (see also Masárová & Koišová, 2107, Grancay et al, 2015, Gavurová et al. 2017). The results of cluster activities could be seen in new employment opportunities, new products and services, new companies, new R&D activities, new patents and in other issues of economic and competition development. (Kordos, 2015, Štverková & Mynarzová, 2017; Duľová Spišáková et al., 2017). These facts are closely related to research and development, and its result – innovation is an important determinant of the competitiveness and success of firms, regions and nations (Sipa et al.,2015, Ivanová & Masárová, 2016, Benešová et al. 2018). Cluster plays an important role also in regional development and competitiveness (Bembenek et al., 2016, Nagy, 2016). Innovative regional clusters are a network mechanism for coordinating actions on the formation of an innovative man. (Gerasimova et al., 2014; Mura & Rózsa, 2013, Fuschi & Tvaronaviciene, 2016, Mazurek, 2018). Its main effects consist of various benefits for all stakeholders. The concept of a cluster is a well-known issue but the involvement of regional players in this form of cooperation is limited. The existence of clusters in regions is affected by several conditions. It is possible to examine them from two perspectives: quantitative and qualitative. The quantitative conditions are conditioned by the level of employment in economic branch in which the cluster is conducting its activities, the economic results of regions, the level of national and regional support for clusters, the level and conception of cluster policy, etc (Kordos et al., 2016, Fenyvesi, 2015). From qualitative point of view it is necessary to assess the real connection among the cluster and the regional stakeholders, the level of awareness about the clustering effects among regional stakeholders, but also politicians at both level, national and regional.

However to ensure an effective development, the cluster policy should create necessary conditions for the productive accrual of educational potential, consider the complexity and nuances of joint cooperation between the companies, as well as build a well-functioning infrastructure of cluster management. Cluster policy could be seen from several point of view: national, regional, type of industry, etc.. National cluster policy depends on the basic conditions of clusters comprising various regional characteristics such as the size of industry agglomeration, industrial specialization, firm size distribution, local firms' research potential, the number and quality of research institutes including universities, and the initial level of inter-firm and university-industry research collaboration. National cluster policies can be classified according to the selection process of target clusters (i.e., administrative or competitive) and financial support rules (i.e., full or matched funding). (Okamuro &Nishimura, 2015) The governance of regional cluster policy includes aspects of initiation and funding and is a reflection of regional governance structures combined with horizontal and vertical interactions, i.e. with neighbouring regions and superordinate levels of governance (Kiese, 2012, Hanáčková & Bumbalová, 2016). The regional cluster policy also depends on the characteristics of clusters and on the effectiveness of policy instruments to replicate such characteristics. (Pessoa, 2012, Švec, 2011).

The different contributors all call for a longer-term perspective aimed at coherent goals when designing and implementing cluster policies. (Champenois & Menu, 2012)

An important factor of the development, in this aspect, is state policy (Gerasimova et al., 2014). The increasing popularity of clusters is also connected to the growing number of policies and initiatives supporting them (Haviernikova b et al, 2016, Gorzeń-Mitka, 2016). This is also confirmed by Nishimura and Okamuro (2011) who reported, that cluster policies can be regarded as regional, industrial, or technological policies and implemented as targeted subsidization or networking support under any of these aspects. On the other side Falck et al. (2010) stated that nothing guarantees that political action based on a cluster concept actually has the desired results. So if a policy's justification depends on whether its existence and implementation is an improvement on its absence, there is no direct justification for a cluster policy. However, it does not mean that every political action defined to be a cluster policy is ineffective; it simply means that pursuing a cluster policy is not guaranteed to be a success just because it is a cluster policy. The policy will require a detailed description of its concrete objectives before its effectiveness can be evaluated. This is the

reason why Garanti & Zvirbule-Brezina recommended to evaluate whether the significant differences exist between the policy promoted and natural clusters.

In the context stated above, the paper is focusing on the preliminary assessment stated areas from quantitative point of view.

2 Material and Methods

Analysis of regional disparities in various points of view is conditioned by obtaining of relevant data. The choice of method for this analysis depends mainly on the pursued objective, the processes under review, claims for statistically processed input data. (Jaskova, 2015, Cseh Papp et al., 2018) The quantitative aspects of cluster cooperation in both countries were assessed by using cluster analysis that help us to search in empirical data the clusters of similar objects. By this method the regions were grouped on the base of their similarity. For this method the regional indicators closely related with cluster cooperation were used. The following data for each region were then recorded: Regional gross domestic product (EUR), Gross value added (EUR), Number of entrepreneurs in regions, Economically active population aged 15 years and over (thousand person), employment rate (%), number of employees in research and development (persons), Expenditure on research and development (per capita). Each indicator is presented by different measures. Due to this reason, the next step of cluster analysis was data standardization. Given these data the research hypothesis was stated: do these regions form "natural" clusters that can be labeled in a meaningful way? First we performed a joining analysis (hierarchical clustering) on this data. For the cluster analysis we choose: as a distance measure – Euclidean distance, Linkage rule: Ward method. The results of cluster analysis were then compared with the number of clusters in regions. As a next part of qualitative context assessment were compared the basic preconditions of cluster policy in each country. Compared were the existence of holistic cluster policy, documents focusing on cluster development, supporting programs at regional and national level and also the time frame of cluster programs, relationship between cluster policy and related policies and focus on SMEs.

3 Empirical experiences

The Slovak republic consists of 8 self-governing regions and Poland of 14. There are clusters in each of these regions. The number of clusters in regions are presented in Table 1 (Slovakia) and Table 2 (Poland). For each region the designation is given for further analysis.

Table 1 Number of clusters in Slovak regions

Region	Sign	Number of clusters
Bratislava	BA	3
Trnava	TT	4
Trenčín	TN	2
Nitra	NR	3
Žilina	ZA	4
Banská Bystrica	BB	2
Prešov	PO	2
Košice	KE	5

Source: own research

We can observe more than 20 clusters in Slovak regions. The highest number of clusters is in Košice region (5), the lowest in Banská Bystrica (2) and Prešov (2) regions. The placement of clusters from a point of view of typology corresponds with economic structure of regions. Slovak cluster typology according SIEA (Slovak Innovation and Energy Agency) is using clustering in two groups of clusters: technological and tourism. This typology is not very suitable, because it is not clearly defined what technological means and also it is not easy to use it in international comparison. The more appropriate is cluster typology that divided the clusters to tourism clusters, industrial clusters, information and communication technologies clusters, creative and cultural industries clusters.

Table 2 Number of clusters in Polish region

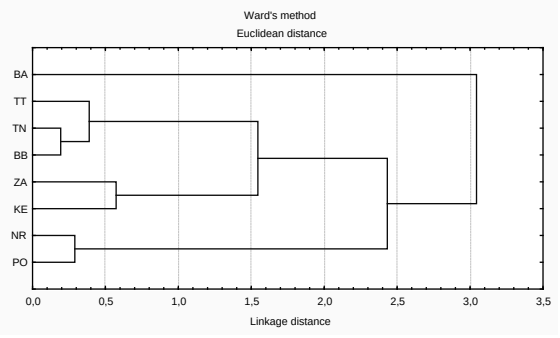
Region	Sign	Number of clusters
Dolnośląskie	DS	11
Kujawsko-pomorskie	KP	4
Łódzkie	LO	3
Lubelskie	LBE	11
Lubuskie	LBU	4
Małopolskie	MP	10
Mazowieckie	MZ	13
Opolskie	OP	1
Podkarpackie	PDK	12
Podlaskie	PDL	8
Pomorskie	POM	5
Śląskie	SL	28
Świętokrzyskie	SW	4
Warmińsko-mazurskie	WM	2
Wielkopolskie	WIE	12
Zachodniopomorskie	ZCHP	6

Source: own research

There are more than 130 clusters in Poland. The highest number of clusters is in region Śląskie (28) the lowest in regions Opolskie (1) and Warmińsko-mazurskie (2). The cluster typology in Poland is extensive , the PARP (Polish Agency for Enterprise Development) recognizes 28 types of clusters: information and communication clusters, various industrial clusters, biotechnology, creative industry, pharmaceutics and cosmetic, geodesy, etc. It is also suitable to use typology that helps better recognition of similar types of clusters in international comparison.

In the next part of this paper the focus is oriented on realization of cluster analysis. The first similar regions with the result of economic development are Trenčín and Banská Bystrica. In both regions we can observe 2 clusters. The distance between these regions is 0,19. As the last joined region was Bratislava region, which has very different regional indicators due to the specific positioning of this region (the capital of Slovakia; there are a lot of important enterprises, receives foreign direct investment, etc.). If we take into account the distance to the value 1,0, we can see 3 main clusters of regions: (1) Trnava, Trenčín, Banská Bystrica, (2) Nitra, Prešov, (3) Žilina, Košice.

Figure 1 Cluster analysis for Slovak regions



Source: own processing in program Statistica

We are interested in what is the profile of the regions in each cluster. The table 3 shows the mean values and standard deviations of the standardized data of regions belonging to clusters. Based on the results of data presented in table 3 and figure 2 we can conclude, that the highest differences among regions in clusters we can observe only in case of indicators Number of entrepreneurs in regions and Expenditure on research and development (per capita). The average values of rest of the indicators are very similar. These results are specific and depend on used regional indicators.

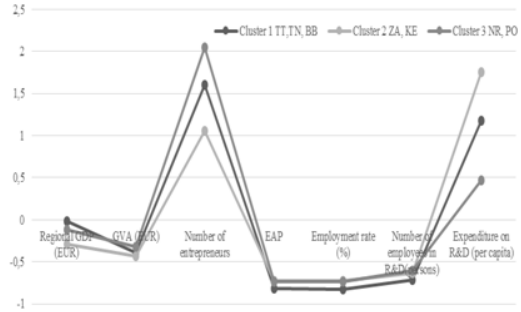
Table 3 Mean values and standard deviations of standardized data in cluster analysis (Slovakia)

Regional indicator	Cluster 1 (TT,TN, BB)		Cluster 2 (ZA, KE)		Cluster 3 (NR, PO)	
	μ	σ	μ	σ	μ	σ
Regional GDP (EUR)	-0,018	0,180	-0,290	0,003	-0,119	0,150
GVA (EUR)	-0,392	0,043	-0,434	0,034	-0,325	0,030
Number of entrepreneurs	1,601	0,016	1,051	0,329	2,049	0,061
EAP	-0,820	0,045	-0,723	0,022	-0,732	0,059
Employment rate (%)	-0,825	0,045	-0,727	0,022	-0,738	0,059
Number of employees in R&D(persons)	-0,720	0,066	-0,634	0,023	-0,603	0,063
Expenditure on R&D (per capita)	1,174	0,068	1,757	0,231	0,468	0,062

Source: own processing in program Statistica based on data from Statistical office of the Slovak Republic and Eurostat. Notice: μ - average, σ – standard deviation

Due to the result of mean values of standardized data in cluster analysis, we can measure as the worst regional cluster consists of Žilina and Košice regions (2). There are 9 clusters in various fields of industries. If we compare these results with the number of clusters, we cannot observe connection between the placement of clusters in regions and the economic results of regions.

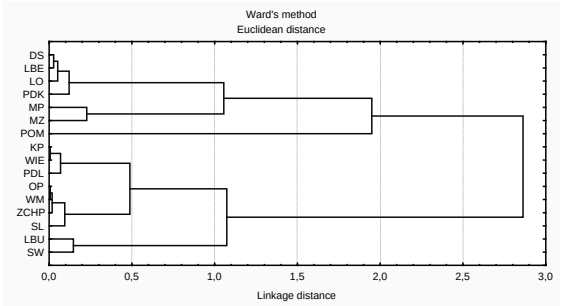
Figure 2 Mean values of standardized data in cluster analysis (Slovakia)



Source: own processing

In case of Polish cluster analysis the first similar regions with the result of economic development are Kujawsko-pomorskie and Wielkopolskie, where the distance between these regions is 0,0066 and regions are different due to the number of clusters. Second cluster with low distance between regions is cluster with regions Opolskie and Warmińsko-mazurskie with distance 0,0071. We can see low number of clusters in these regions.

Figure 3 Cluster analysis for Polish regions



Source: own processing in program Statistica, based on data from Statistical office of the Slovak Republic and Eurostat

If we take into account the maximum distance of 1,0 we can observe 5 main clusters: (1) Pomorskie, (2) Dolnośląskie, Lubelskie, Łódzkie , Podkarpackie, (3) Lubuskie, Świętokrzyskie (4) Małopolskie, Mazowieckie, (5) Kujawsko-pomorskie, Wielkopolskie, Podlaskie, Opolskie, Warmińsko-mazurskie, Zachodniopomorskie, Śląskie.

For finding the profile of Polish regions the mean values and standard deviations were computed. The results are presented in Table 4 and Figure 4.

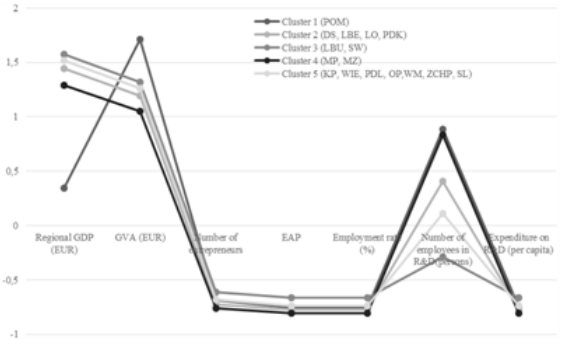
Table 4 Mean values and standard deviations of standardized data in cluster analysis (Poland)

Regional indicator	Cluster 1 (POM)	Cluster 2 (DS, LBE, LO, PDK)		Cluster 3 (LBU, SW)		Cluster 4 (MP, MZ)		Cluster 5 (KP, WIE, PDL, OP,WM, ZCHP, SL)	
	μ	μ	σ	μ	σ	μ	σ	μ	σ
Regional GDP (EUR)	0,344	1,444	0,014	1,573	0,008	1,289	0,060	1,517	0,018
GVA (EUR)	1,713	1,193	0,013	1,319	0,009	1,052	0,055	1,261	0,017
Number of entrepreneurs	-0,684	-0,724	0,003	-0,613	0,017	-0,761	0,002	-0,682	0,013
EAP	-0,752	-0,774	0,006	-0,663	0,021	-0,805	0,008	-0,735	0,014
Employment rate (%)	-0,753	-0,774	0,006	-0,664	0,021	-0,805	0,008	-0,735	0,014
Number of employees in R&D(persons)	0,883	0,409	0,048	-0,287	0,095	0,834	0,138	0,111	0,088
Expenditure on R&D (per capita)	-0,751	-0,774	0,006	-0,665	0,021	-0,804	0,009	-0,736	0,013

Source: own processing in program Statistica, Notice: μ - average, σ – standard deviation

The worst results of regional indicators are observed in case of cluster 4 Małopolskie, Mazowieckie, where are more than 20 clusters. The best results were obtained by regions in cluster 3 Lubuskie, Świętokrzyskie with 8 clusters in total. We cannot confirm the relationship between the economic results of region measured by selected indicators and the number of clusters in various fields of industries.

Figure 4 Mean values of standardized data in cluster analysis (Poland)



Source: own processing

In the next part of this paper we have focused on the main differences in issues of cluster policy in both countries that are necessary for establishment and future existence of clusters in various fields of industries. The first precondition is the holistic cluster policy, which is to support clusters in different directions (financial, nonfinancial, legislative, educational, etc.) The cluster policy in Slovakia is only partially incorporated in various documents that are oriented on innovation strategy and innovation policy. The holistic cluster policy is absent. The documents containing selected issues of cluster policy are updated, but issues of cluster policy in widespread context are missing. Openness of cluster policy means that support is providing for cluster organization in vertical as well as horizontal way. It means the support is oriented on cluster organizations regardless to sectoral, value and branch specialization. Cluster policy is governmental body as Ministry of Economy and some of its departments that are responsible for part of cluster policy issues (mainly financial support), but body oriented on cluster policy is missing. In previous period important tasks in this issue were played by SIEA and UKS (Union of Slovak clusters). At this time, the financial support is provided only for industrial cluster organizations from The Scheme of aid de minimis, in previous programming period also from operational programs. The accreditation system that asses the cluster is still missing. The Slovak clusters were involved in the evaluation system of ESCA (European Secretariat for Cluster Analysis). See also Haviernikova a) et al. (2016).

Table 5 Comparison of differences between cluster policy issues between Slovakia and Poland

Issues of cluster policy	**Slovakia**	**Poland**
Holistic cluster policy	x	x
General aspects of cluster policy presented in other policies	✓	✓
Cluster policy updates	x	x
Openness of cluster policy	x	✓
Institutionalization of cluster policy	x	✓
Financial and nonfinancial support of cluster policy	✓ /x	✓
The national cluster accreditation system	x	✓
The assessment of cluster outputs	X	✓
Regional support for clusters	✓	✓
Cluster typology	Single, not suitable	Widespread
Connection between cluster policy and other sectoral policies	✓	✓

Source: own research

Situation in Poland is similar in several aspects to situation in Slovakia. The holistic cluster policy in Poland is not defined explicitly. It also results from several strategic documents defining and shaping the economic policy in Poland (National development plans, documents in the context of European regional policy, operational programs, etc.). General aspects of cluster policy result from other medium and long-term policies. The validity of documents that have connection with cluster policy is just for relevant programing period, because most of the documents t including issues of cluster policy are related to European regional policy. The supporting authority in Poland is mainly the Ministry of Economic Development. In addition, the Polish Agency for Enterprise Development (PARP) is executive agency and the Parliamentary Group on Cluster Policy is a consultative body for the Polish legislator. Financial and nonfinancial support of cluster policy is on higher r level than in Slovakia; some programs are specifically devoted to clusters and cluster organizations were supported directly. In 2014 the Polish Agency for Enterprise Development (PARP), in collaboration with the Ministry of Economy and external experts, developed a set of criteria and drafted procedures for appointing the Key National Clusters (KNC). The objective of granting the KNC status is to select clusters which have a significant potential for developing the Polish economy according to and are competitive internationally. At regional level, only some of voivodeships have taken actions related to cluster support, including the choice of key regional clusters. In Poland, in principle, there are no sector limitation for clusters organizations. Therefore there is foreseen the support only for companies within regional or national smart specialization which affects the activity of the clusters (Frankowska, et al., 2016).

4 Conclusions

The result of cluster analysis realized in both countries brings similar results. The division of regions into similar clusters depends on using indicators. In this paper we selected the indicators on which the existence of clusters from various field of industry should have impact. Based on these indicators, the regions were categorized to regional clusters and the results were compared with number of clusters operating in these regions. We can conclude that the number of clusters has week impact on the economic results of regions compared in this study. This is why the implication for future studies is to realize a questionnaire survey to find out the real situation in clusters, e.g. economic growth in region, the share of employment person in cluster on regional employment, the share of expenditures on R&D on regional level, etc.

Regarding the cluster policy we can recommend to improve the issues of cluster policy in the Slovak Republic. Recommendations are oriented on elaboration of holistic cluster policy documents, improving the cluster typology, establishment of the authority responsible for cluster policy and elaboration of accreditation system for cluster performance assessment.

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Primary Paper Section: A

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