Competitiveness advantage analysis as one method for cluster identification in regions

JAN STEJSKAL
University of Pardubice
Faculty of Economics and Administration, Institute of Economics
Studentska 95, Pardubice, Czech Republic
jan.stejskal@upce.cz

Abstract

The cluster birth process must start with identification of industrial branches strengths which are the fundaments for cluster increasing. When the cluster establisher will continue in this process the final result – cluster need not be the most effectiveness result and all money will be wasted.
For cluster identification can be used some approaches. The first approach follows the identification of key industrial branches having the potential (or real) competitiveness advantage. This identification proceeds by the statistics data analysis (mostly quantitative data). The second approach investigates the internal processes and relations among existing firms. It uses the qualitative data what are obtained from interviews or question-forms. The combination of both mentioned approaches is the most effectiveness process. In this case the missing data can be compensated from the second approach, or the concrete relations and their mentions can be understand. This approach must be realized in cluster potential analysis in specialized industrial branches.
There are many various methods for cluster identification in literature sources. But no more methods are applicable in practice because of the data are not available. Presentation of method based on Porter diamond model is goal of this paper. This method is the combination of quantitative and qualitative methods. We can name it as method of competitiveness advantage analysis.

Key words: clusters, cluster identification process, method, competitiveness advantage

JEL Classification: R11, R12

1 Introduction

The conception of the regional policy and regional development is still an evolving process. The economic growth is the limelight in context of the European regional policy. The main growth determinant is also increasing competition of the municipalities, regions and countries. It can be realized thanks to engines (centres of excellence, clusters) support. These centres are the carriers of the main part of the local and regional economic development. At these levels there are many tools of local and regional development used.

The keystone of contemporary European political cohesion is Lisbon Strategy, which is actually the promoter of theses changes and shifts. If EU is to reach the aims of Lisbon Strategy, all regions have to be engaged, especially those with the highest levels of productivity and employment. According to European Commission communication COM 0299 there are several ways by the medium of which the policy of cohesion might significantly contribute towards Lisbon priorities. This involves investment into areas with a higher growth potential. Considerable revenues are also possible when investing in regions which have the potential to catch up with the rest of EU, but whose domestic sources are insufficient to utilize all existing opportunities.

Another way is investing into driving forces of growth and employment. That is why the policy of cohesion focuses on investment into physical and human capital, which is critical

for the potential of growth and employment, including research capacities, innovations, education and vocational training and adaptability of employees.

Among new principles of the discussed policy in the new planning period 2007 – 2013 there is (1) enhancing attractivity of member states, regions a towns for investments, (2) support of innovations, spirit of enterprise and economic growth based on knowledge by means of capacities for research and innovations, including new technologies, (3) increasing and improving employment.

As it is evident in individual principles and strategies, the common denominator is economic growth, regional and local development. Among their determinants there can be found innovations, investment encouragement, science and research in businesses, **creation of industrial networks, industry clusters**, and creation of new jobs thanks to afflux of new investors into the region. Last but not least, there is an influence of education, knowledge, skills and ability of employees to learn.

But all these tools of regional policy must be realized in the most effectiveness way because they are financed from public budgets. There are some studies about the non-effectiveness cases of applications in EU countries (see Maier 2007). The goal of this paper is to introduce the new model (method) for cluster identification – competitiveness advantage analysis method.

2 Briefly about business chaining and clustering

The business networks, business chains and also the clusters became very important elements of development in every region and country. They are considered as the elements for prosperity increasing and surviving in contemporary economical crisis. The tendencies leading to association of small and medium entrepreneurs are the effects of globalized economy of last fifteen years. It can be realized thanks to increasing of IT systems, information and communication channels and systems. From practice was discovered that the chaining of business is the right and rich idea what can bring competitive advantage of all interested.

But we know that the idea of chaining and clustering must be understand right. The chains, networks and clusters are not universal medicament for all economic problems of all regions. The problems must be first analyzed and then according to the results the methods can be chose.

Already Alfred Marshall in 1890 has thought that the industrial branches are very often concentrated in one region or place, and they can obtain wide benefits from externalities – t. e. spillovers effects flow from these concentrations. Further development of these structures was not so fast. The modern conception of the business chaining and clustering was established in second half of 20th century.

This trend converges with today theory and practice of regional innovative clusters. Besides the highly qualified labour force, the development of so called “engine industries” (for example in industries: automobile, aircraft, space etc.) which attract huge amount of small suppliers can be considered as a reason for development of regional clusters. Although there are different definitions of clusters, it is generally agreed that clusters are a collection of companies that are geographically co-located and interrelated (Porter 1998).

According to Porter (1990, 1998), the local competition creates incentives to emulate best practice and boost pressures to innovate, while also connecting the strengths of competition with the virtues of selective cooperation. The concept of clusters was related to the "competitiveness" of industries and of nations.

Clusters are a geographically proximate group of interconnected companies and associated institutions in a particular field linked by commonalities and complementarities. Clusters encompass an array of linked industries and other entities important to competition (...) including governmental and other institutions – such as universities, standard setting agencies, think tanks, vocational training providers and trade associations. (Porter 1998).

The chaining and clustering bring many positive externalities, for example: (a) attracting and development of related industrial branches which provide the special outputs and services; (b) making the supply of specialized labour forces with all knowledge, skills and know-how what are needed for selected industrial branch; (c) ideas, knowledge and technological development spreading between firms and entrepreneurs in selected industrial branch; (d) the industrial atmosphere making with amount of formal and informal labour methods, habits, traditions, social values and specialized institutions which allow the effective existence of selected industrial branch.

3 Cluster identification methods

There are many other tools for cluster identification (cluster potential measurement) in literature and other sources. In according to higher mentioned two fundamental ways the methods can be divided into two groups: qualitative and quantitative.

Among quantitative methods we can count:

- localization coefficients (LQ),
- input-output analysis,
- shift-share analysis,
- Giniho coefficient of localization,
- Ellison and Glaeser index of agglomeration,
- Maurel-Sédillot index.

Among qualitative methods we can count:

- interviews with experts and management of the firms,
- researches (question-forms),
- case studies.

The method based on Porter diamond model is the combination of quantitative and qualitative methods. We can name it as ***method of competitiveness advantage analysis***[1].

Berman, Feser (1999) have also own list of methods:

- expert examination,
- specialization indexes,
- input-output analysis for business relations,
- input-output analysis for innovations (unsuitable for cluster identification),
- network analysis, graph theory (rather tool for visualization)

[1] First publication of this method in STEJSKAL, J., HÁJEK, P. The Influence of Business Climate on Industrial Clusters. *South Asian Journal of Socio-Political Studies - SAJOSPS*, Vol. 9, No. 1, 2008.

- statistical and economical overviews.

Among presented methods there are some which integrate in themselves some mechanisms from other methods. The Elison and Glaeser index is a clear example – it integrates geographic concentration, industrial concentration index and Hirschmann-Herfindahl index. That is why we can define some other methods for cluster identification:

- diversity index (RDI) for the measurement of regional industrial specialization according to Duranton and Puga (2000),
- index of geographic concentration measuring geographic concentration or spatial distribution of national industries.

Own taxonomy of the methods for cluster identification can be found in Goetz et al. (2007). They grouped the methods into AHP (Analytical Hierarchy Procedure) methods and CBM (Community-Business Matching Model).

Each of the methods affords specific results, and the interpretation is the most important phase of the whole identification process of clusters or industries suitable for clustering.

4 Method of competitiveness advantage analysis

The cluster potential must be integrated with development of the competitiveness advantage which was defined by Porter in his diamond (see Porter 1998). Generally this potential conception can be identified with:

- development ability in future,
- ability of "move" local (regional or national) economy,
- space making for the new innovations birth,
- creating some vacancies.

The cluster potential is the useful tool for rating of industrial branches and new trends identifying as the tool for regional or spatial management. This concept can be used also in business, industrial branches and regions.

Method of competitiveness advantage analysis flows from Porter diamond model which describes the competitiveness model of economical environment in which the cluster exist. The model shows competitiveness in the microeconomic environment of cluster (we can discuss if all components are microeconomic) and its components. These can be analyzed and modelling.

This method is very demanding for input data, but that is the reason for very high interpretation ability. Method can help map the cluster potential in all main industrial branches in analyzed region. The dependence on opinions of managers from regional actors is the disadvantage of the method. It can be removed with big amount of target group.

The method is based on interview with managers or economical workers from firms in region where we can define the cluster potential. Among the questions there are many questions for opinion on:

- accessibility of specialized sources needed for production in the industrial branch (human, capital, infrastructure, nature),

- relations among the firms in region (aggressive relations, evaluation of entrepreneur climate etc.),
- suppliers chains (suppliers for demanding end customers),
- local subcontractor systems, flexibility of local firms,
- relations among the firms in region and their branch orientation.

Every respondent can evaluate the answers by 4-point scale (positive (+2), rather positive (+1); rather negative (-1), negative (-2)). The answer with neutral evaluation was not included because it does not contribute to unambiguous result (it represents a non-committal answer). The result is calculated as the sum of points for each industrial branch. The proportional result (%) expresses the positive or negative position of the result on the graphic tool (tetragon). The minimum of the scale is -100 %, while the maximum is +100 %.

Except of the factors which were included in the Porter diamond model there can be applied also the indicators of industrial branches´ growth (input output analysis). The localization coefficients are used for the analysis of industrial clusters most frequently. Thus, we investigate their influence on the results compared with the determinants of competiveness advantage resulting from the Porter diamond model.

For example I present this method in application – see Fig. 1. This chart was made according to results of interviews realized in one of the region of Czech Republic – Pardubice region.

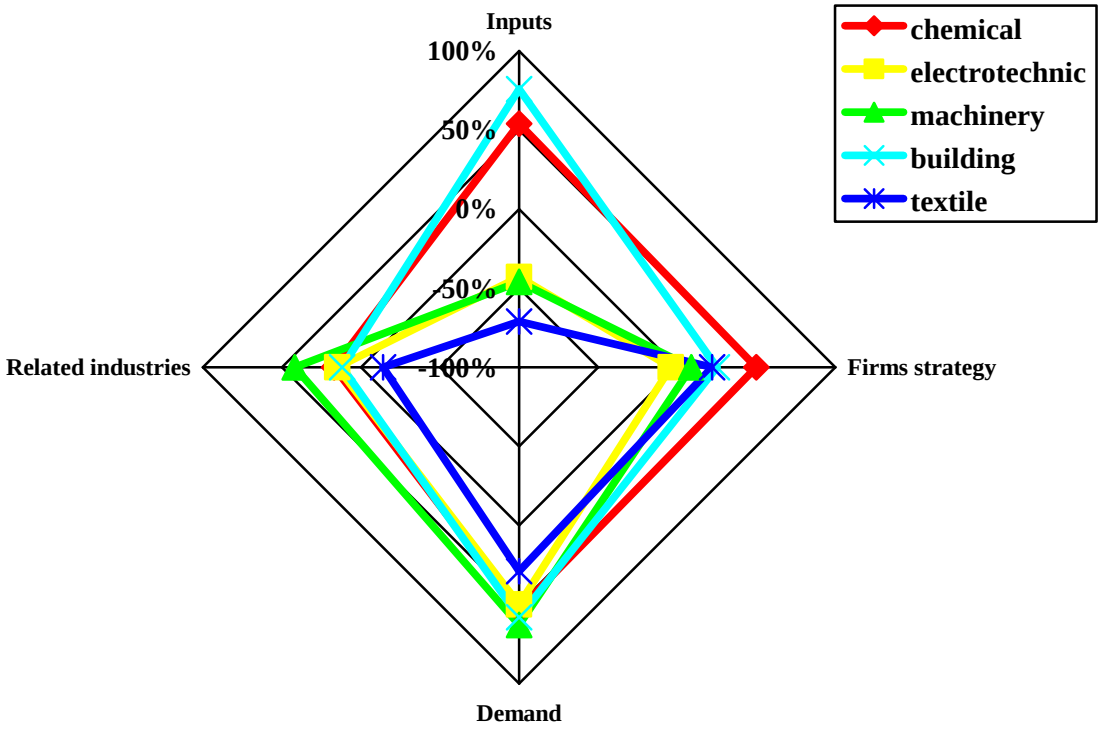

Fig. 1. The cluster potential of selected industrial branch presented by Method of competitiveness advantage analysis

The results can be verified by expert examination. This method can be used also for other analysis – for example for correlation calculations of used factors, for PDA or factor analysis.

5 Experimental Results for Selected Region

The assignment of a cluster potential to sample of 72 enterprises of Pardubice region is the goal of the modelling. The enterprises are divided into the following branches.

Table 1 The Branches of the monitored enterprises

FoI – Food industry	MaI – Machinery industry
ChI – Chemical industry	FuI – Furniture industry
TI – Textile industry	EI –Electrical industry
MeI – Metalworking industry	BI – Building industry

The input data was acquired by a field research. The enterprises answered questions concerning four principal areas (human resources availability, infrastructure, capital and natural resources availability, growth of turnover and employment). The enterprises assigned subjective ratings (from 1 to 4) to these factors, where 1 is a fully satisfaction and 4 is a fully dissatisfaction. The missing values are replaced by the means of variables. The data was pre-processed by means of standardization (Jolliffe, 1986) as the dependency on units was removed. The following variables are considered as the input variables:

x_1 - human resources availability,
x_2 - capital resources availability,
x_3 - infrastructure availability,
x_4 - natural resources availability,
x_5 - growth of employment,
x_6 - growth of turnover.

The correlations between variables $x_1, x_2, \ldots, x_6$ and their descriptive statistics are presented in Table 2 and Table 3.

Table 2 Correlation coefficients between input variables

	x_1	x_2	x_3	x_4	x_5	x_6
x_1	1.00	0.32	-0.04	-0.09	-0.20	-0.09
x_2	0.32	1.00	0.05	-0.10	0.03	-0.17
x_3	-0.04	0.05	1.00	0.38	0.32	0.35
x_4	-0.09	-0.10	0.38	1.00	0.44	0.28
x_5	-0.20	0.03	0.32	0.44	1.00	0.34
x_6	-0.09	-0.17	0.35	0.28	0.34	1.00

Table 3 Descriptive statistics of input variables, where sd is standard deviation

	x_1		x_2		x_3		x_4		x_5		x_6	
	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
FoI	1.85	2.21	1.29	0.72	-0.33	1.70	0.15	1.28	2.63	0.92	0.51	1.12
ChI	1.78	1.47	1.30	0.95	-0.40	1.47	-0.57	0.84	1.73	0.96	0.05	0.91
TI	1.32	1.03	0.74	0.30	0.42	1.21	0.02	1.50	2.17	1.11	0.57	1.27
MeI	1.14	0.33	1.86	1.52	0.31	1.03	0.06	1.18	2.14	0.95	-0.54	1.14
MaI	1.42	0.67	3.57	6.00	0.01	1.30	0.03	0.73	1.68	0.67	-0.39	0.79
FuI	1.10	0.48	1.60	1.02	0.11	1.43	0.41	1.36	2.44	1.13	0.10	1.17
EI	1.73	0.91	2.98	1.77	0.43	1.65	0.21	1.12	1.69	0.85	0.22	1.45
BI	1.06	0.44	1.94	1.07	-0.39	1.47	-0.08	0.93	1.80	0.95	0.06	1.34

The goal of the PCA modelling is the reduction of 6 input variables to less number of variables which represent most of the variation. The results of the experiments show that it is suitable to create two principle components. The first principle component represents 33.04% and the second principle component represents 17.47% of input data variation (Fig. 2). Further, its eigenvalue is higher than the given threshold value 1.

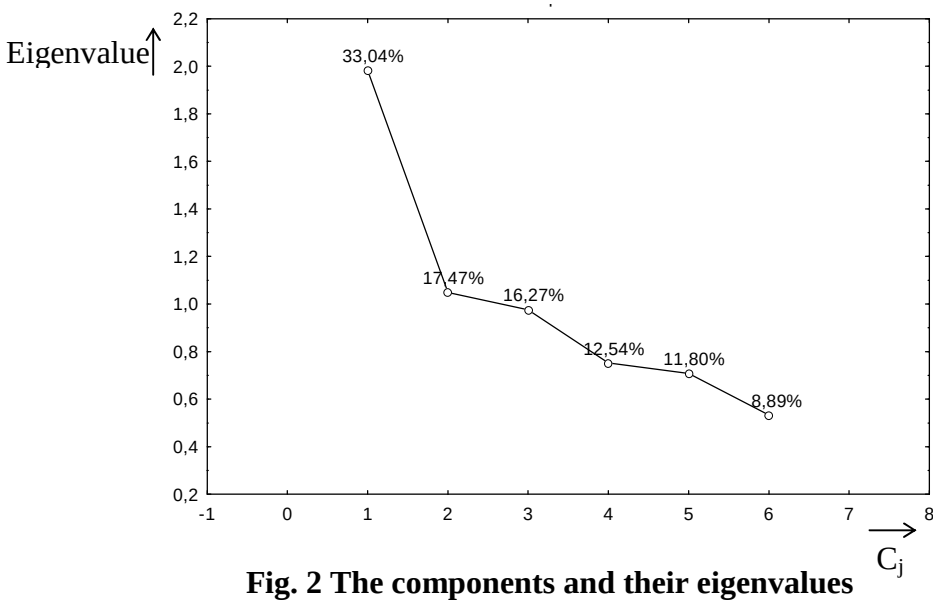

Fig. 2 The components and their eigenvalues

The loadings (weights) of input variables $x_1, x_2, \ldots, x_6$ in the first and second principal components are presented in Fig. 3. According to this, the first principle component represents the variables x_3, x_4, x_5 and x_6 (resources availability) and the second principle component represents the variables x_1 and x_2 (growth of employment and turnover).

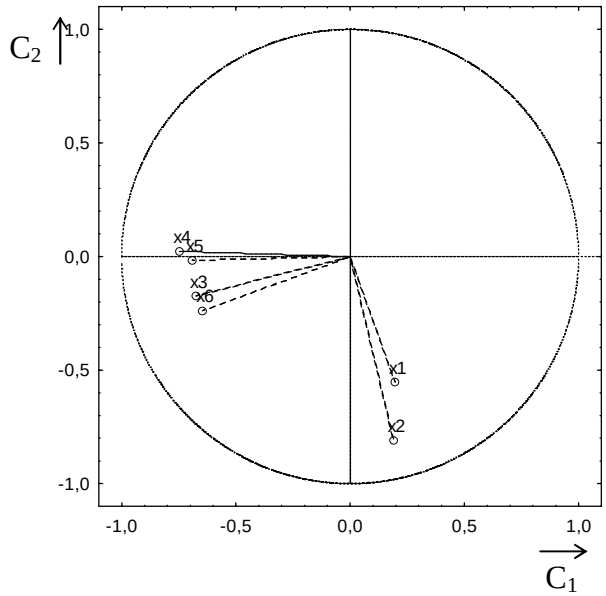

Fig. 3 The loadings of the variables $x_1, x_2, \ldots, x_6$ in the components C_1 and C_2.

Based on these loadings, the values of the first component C_1 (cluster potentials CP_{PCA}) for the individual industry branches can be calculated this way

$$CP_{PCA} = 0.197 \times x_1 + 0.192 \times x_2 - 0.674 \times x_3 - 0.747 \times x_4 - 0.691 \times x_5 - 0.646 \times x_6. \quad (1)$$

The goal of our analysis presented in this paper was to evaluate the influence of selected business climate factors:

- human resources,
- capital resources,
- infrastructure,
- natural resources,
- growth of employment,
- growth of turnover.

The evaluation was analysed for creating of industrial clusters. At the beginning the fundamental question was done – which of these factors has the biggest influence on the industrial clusters creating (or birth).

From presented analysis the human resources only factors capital resources, infrastructure, natural resources have the bigger influence. The rest of selected factors have the lower influence. But these four factors must be in economy in one balance. If one is wider in one region than the rest, there is no possible to wait the better results in total.

Summing up the results – the fundamental presumptions for industrial cluster creating are resources – human, capital, infrastructure and natural. The rest factors of positive entrepreneur surrounding are not so important for cluster birth.

6 Conclusion

Many researches and authors of papers have proved the evidence that the clusters and entrepreneur chains and business networks have the positive influence on the regional development. They belong among the important tools of regional development in many developed countries all over the world. But in all economies the public finances must be spend efficiency and that´s the reason for developing the new helpful tools what can help measure the industrial cluster potential. The potential needed for the industrial clusters, cooperation chains, business networks in various industrial branches.

Many methods for measurement of the spatial concentration and industrial specialization, agglomeration advantages are commonly used in region or local situation. High quality data and information are the condition for many rigorous methods using in practice. The hard data can be obtained from the statistical reviews or agencies. But the reality is not so ideal – the statistical data are not divided in desired groups and levels of the industry in the economy. Many sorts of the data are not available at all or they are un-usable for un-quality. There are many imperfections in the group of quantitative methods especially:

- high dependence on the quality of input data,
- less factors on which the result depends (mostly one-factor models),
- complexity of the computations,
- un-definiteness of the result (only one number is often the result. This result must be interpreted by the researcher or specialist in regional science. The interpretations are not objective, but they are depended by their opinions and experiences).

If the quantitative methods are not realized, the other group – qualitative can be available. But these methods have also some imperfections. The result about the industrial cluster potential is depended on the specialist and his opinion. From practice application we can certify that these methods can get the more quality of the results.

The described imperfections can case the impotence of some methods for the practice application. The new method was suggested in the framework of this paper. This method can eliminate some of described imperfections and can use all positives from both groups of methods (for example: more factors; go out from available data; afford the unequivocal result, is very easy for applications). The method for competitiveness advantage analysis of the industrial cluster uses the good knowledge of the microeconomic environment via the top managers of the firms (the respondents), uses the ability of the Porter diamante model thesis and his four forces of the competitiveness advantage for the industrial cluster birth and existence. Therefore the mathematical methods which can help us with computing with the matrix of the data are useable, can help to know the representativeness of the data, can obtain the dependence of the variables etc. The result interpretation is available with the graphic apparatus.

The ability to show the weakness of the industrial branch in analyzed region is the next positive asset of the suggested model. Every force can be analyzed separately and more detailed information can be obtained (for example the insufficient factors what can be improved by the better cooperation, support from the regional authority or better regional network among the regional players). None from mentioned methods can provide these possibilities.

The suggested method was also in this paper verified. The result of the new method was very exact what was verified by independent expert examining (qualitative method). Next the hypothesis about some other factors (except four forces) what influence the cluster potential was analyzed and computed. The hypothesis was not verified. In tab. 3 there you can find the results which can help to identify the force and the importance of the analyzed factors in selected industrial branch in the region.

According to the components we are able to recommend if the industrial cluster can be established or recommend only cooperation among the entrepreneur network or chaining. The worst results show the insufficient preconditions for whichever sort of important cooperation what would present the competitiveness advantage in region and bring the benefits for the interested firms.

In the conclusion we must mention that the practice needs the easy methods what can afford normative than positive results.

Acknowledgement

This paper was made as the output of solution of the grant from Grant Agency of Czech Republic No. 402/09/P009 under the name “Methodology of clusters and entrepreneur chains identification in Czech regions”.

References

[1] BERGMAN, E. M., FESER, E. J.: *Industrial and Regional Clusters: Concepts and Comparative Applications*. Virginia: WVU Regional Research Institute, 1999.

[2] DURANTON, D., PUGA, D.: Diversity and specialisation in cities: Why, where and when does it matter? In: *Urban studies.* Vol. 27, No.1, pp.535–555

[3] GOETZ, S., DELLER, S. et al.: *Targeting regional economic development: An outline of a national extension educational program*. In:CDS annual meetings, Wiskonsin, 2007.

[4] JOLLIFFE, I. T.: *Principal Component Analysis*. New York: Springer Verlag, 1986.

[5] MAIER, G.: Cluster policy: A strategy for boosting competitiveness and wasting money? *In: Proceedings from 2nd CERS*. Technical University in Košice, Košice, 2007.

[6] PORTER, M. E.: *The Competitive Advantage of Nations*. New York: The Free Press, 1990.

[7] PORTER, M. E.: *On Competition*. Boston: Harvard Business Review Book, 1998.