Does Cluster Participants' Cooperation Really Promote to Territorial Development: Empirical Evidence from Russia

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Abstract Global practice of innovation policies of the recent decade has demonstrated the wide use of cluster concept for economic development promotion. The results of the research on the impact of clusters upon socioeconomic features of territories within developed countries have already proved there exists a positive correlation between them. Also, widely acknowledged is the fact that successful functioning of clusters depends greatly on their interaction with power bodies, manufacturing enterprises and research institutes. At the same time, the analysis of clusters' functioning in a range of developing countries proved that cluster creation as such does not necessarily lead to the desired economic effects. The aim of this study is to assess the importance and the role of clusters' members' interaction for regional development of Russian Federation. Common database was formed taking into consideration with indicators of 79 Russian Federation regions for 2015. The obtained results confirm the high level of functional dependence of territorial development from the efficient interaction of manufacturing enterprises, public bodies and science community.

Keywords Territorial development · Cluster · Cooperation · Innovative potential

1 Introduction

In recent years there has been a growing interest in the role of cluster cooperation. Term "cluster" involves such meanings as swarm, bunch, accumulation, group, and is used in many fields of science and technology. In economic research clusters are understood as «geographic agglomerations of companies, suppliers, service providers, and associated institutions in a particular field, linked by externalities and complementarities of various types» (Porter et al. 2007). The first research works to

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study clusters were published back in the 1990s (Englmann and WaIz 1995; Feser 1998; Bergman and Feser 1999; Bartik 1985; Becattini et al. 1990). It should be mentioned that the literature began to speak about clusters as about serious "applied key factors" due to the work of Porter (1993). But the very idea of enterprises' cooperation aimed at cost reduction and competitiveness improvement was originated in the middle of the nineteenth century. It became the basis of localization theory presented by Thünen (1926) in 1826. Later it was developed by Marshall (1920) in his description of industrial regions of Great Britain in 1890, as well as by Weber (1929) in his industrial location theory in 1929.

Scientists made profound analysis of economic relations in the frames of producers' cooperation. At that, despite the different denominations, such as clusters, blocks of development, industrial units, territorial-production complexes, scientific-production associations, etc., in the frames of these formations economic subjects act as the elements of the single territorial innovative system. According to European experts (Lindqvist et al. 2013), formal cluster policies and programs have gained legitimacy across the world, and today almost every country, region and international aid agency has some form of a cluster program. The cluster concept has become an increasingly popular topic for researchers and policy makers operating at different levels (Bek et al. 2013; Hernández-Rodríguez and Montalvo-Corzo 2012; Lindqvist et al. 2013; Meier zu Kocker and Muller 2015). The number of articles on clusters augmented over the year, reaching up to 200 articles per year in 2010 (Lazzeretti et al. 2012). And this is totally understandable: the research results prove the positive influence of clusters on the socioeconomic features of the territories (Kulakova 2013; Inshakov and Inshakova 2016; Parauljic et al. 2014).

Analysis of the available literature on this research topic has revealed that the following factors are usually named as the basic ones for clusters' formation: proximity of cluster's participants' location to each other; critical number of cluster-specific companies; common goals; active interaction with each other (Ketels 2004); well-developed urban environment; dominance of private initiatives; inside-cluster competition; openness to the external world (Kutsenko 2015); cluster participants' awareness concerning their own interconnectedness and belonging to the same community (Akinfeyeva 2008); active role of local authorities in the process of cluster formation; local traditions of territorial economic planning (Ksenofontova 2015).

The problem of combination of indicators for evaluating clusters' effectiveness continuous to be debatable. Andersson et al. (2004) single out such indicators as: the number of firms in cluster, employment, production rate (efficiency), export, the number of innovative projects, profits and modification of these indicators in time. Naumov (2006) and Kostyukevich (2009) propose to use the following characteristics as criteria: production structure of cluster, resource potential, investment activity, economic indexes. Zadorova (2009) applies only four indicators for evaluation of the clusters' efficiency: cluster's share in industrial production of the region, cluster's share in total number of employed people, index of labor productivity at the enterprises of cluster, cluster's share in the export structure of the region.

We think that all these factors mentioned above to some extent display the results of specific economic subjects' performance, and these subjects are represented in the following core institutional sectors—public authorities, business and science. This statement can be also confirmed in the frameworks of the world-known Triple Helix concept of Etzkowitz and Leydesdorff (2000). According to this concept, cooperation of public sector, science and industrial enterprises is always of key importance for the emergence of synergy effects in the process of cluster's functioning. Stemming from all of the above, productive (efficient) cooperation is a necessary element in the development of cluster networks and their further successful functioning.

It should be noted that clusters are defined as being networks of production of strongly interdependent firms (including specialized suppliers) linked to each other in a value-adding production chain (Roelandt and Hertog 1999). Except basic economic entities (industrial and service companies) that are associated with each other in the value chain and operated in a similar market environment cluster's structure involves the following types of participants: innovative-research and educational institutions; group of companies providing related facilities (financial and insurance institutes, consulting companies and etc.); federal/regional local authorities. Within the cluster, it is possible to unite the main innovative infrastructure actors from industry, government and education. So successful cluster functioning depends greatly on their interaction. The aim of our study is to assess the importance and the role of clusters' members' interaction for clusters quality and for territorial development as well.

2 Date and Methodology

We carried out our study on the example of the Russian regions. In Russia clusters support at the state level began only in 2012 when the Government approved the list of 25 territorial innovation clusters. They were structured into six branch-wise directions ("Modern materials", "Production of aircraft and spacecrafts, shipbuilding", "Pharmaceutics, biotechnologies and medical industry", "Chemistry and petro chemistry", "Information technologies and electronics" "Atom and radiation technologies").

By now, in Russia clusters are supported by the state on the territory of 22 regions, which is 26% of the total number of regions. According to the data of the Ministry for economic development of Russian Federation, during the last 4 years (2013–2016) the innovation clusters obtained over 100 bln RUB (1.7 bln USD) from the budgets of various level and also over 400 bln RUB (6.7 bln USD) additionally in the form of investments from various non-budget sources (IPSD 2015). Despite the significant volumes of cluster's financing by public authorities, our research fails to confirm any significant influence of clusters on the indicators of regional development in Russia. There may be the following reasons for that: first of all, it is too early to tell since clusters have been functioning on the territory of our country for a short period of time so far; secondly, most of clusters have been formed by the top-down principle, that is, the vector of their development has been initially determined by the federal authorities; thirdly, the size of the country serves as a hindering factor in establishing cooperation due to significant cross-regional differences; fourthly, despite the large size of the country and radical differences between its regions, norms and rules of spacial organization are rather unified, disregarding regional specifics; fifthly, low level of cooperation between the clusters' participants which is partially predetermined by the dominating role of large enterprises in clusters' structure and functioning. Solving all these problems outlined above would increase the quality of clusters' overall functioning and would also have its positive influence on the parameters of regional and national development. In this study we will try to measure the importance of cluster participants' interaction for territorial development on the study case of Russia's regions.

Theoretical and methodological grounds for this study have been shaped by numerous works in the field of geopolitics, production forces allocation, network economy, industrial regions' development and clusters. The information and empirical basis for this research consists of Russian legislation and regulatory acts; information & analytical databases available online on the site of the Federal Service for Public Statistics of Russian Federation; results of the sociological surveys; other materials published in Russian and foreign research sources; media sources. Common database was formed taking into consideration with indicators of 79 Russian Federation regions for 2015.

Several key approaches are suggested for application in this study. First of all, the methodology within institutional evolutionary economic theory. It would enable defining the regularities in formation and development of the institutes needed for the functioning of cluster structures as the leading form of cooperation between economic subjects. The second approach is based on the ideology of hierarchical analysis of territorial economic systems. Within the framework of the hierarchical approach we study the processes taking place at various levels of the economy. This approach also includes the analysis of the hierarchical structure of the participants and their interconnection within particular regions. It also covers the determination of opportunities for their efficient cooperation. Thirdly, we aim at application of mathematical statistics methods (including correlation and regression analysis, grouping/clustering method and cluster analysis).

This study includes the following parts:

- grouping of the regions by the level of clusters' development;
- designing of a indicators system, describing the level of development of scientific, state administrative and industrial potential by regions;
- calculating of an integral indicators of clusters' successful development;
- mathematical evaluation of the indicators' influence on the level of regional development.

3 Results and Discussion

To reach the aim of the study firstly we have classified the regions by the level of clusters' development by dividing all territories into three groups (Fig. 1).

The first group (regions are marked in dark blue) includes the regions whose applications were supported by the RF Ministry of Economic Development. They have got funding. All of them are regions with a high level of development. The second group (regions are marked in purple) includes regions that have applied for cluster support. However, for different reasons RF Ministry of Economic Development did not support these applications. This is due to the fact that the readiness for clustering in these regions was not enough. Finally, the third group (regions are marked in grey) includes regions that even did not apply for participation in the competition. There are no clusters on their territory, or even if they are—they are in the initial stage of development.

After all these, we developed a system of indicators, describing the scientific and technical potential, production capacities and social infrastructure development by regions. The system was based on the "Triple Helix Model" by Etzkowitz-Leydesdorff. According to this model, the key importance in the innovative development of the region belongs to the cooperation of science, business and authorities. We have chosen the next indicators of grouping: quality of life and social infrastructure development (as a result of the government work); production potential and capacities (as indicator of industrial development); scientific and technical and educational potential (as a result of innovative-research and educational institutions work) (Fig. 2).

Fig. 1 Grouping of the RF regions by the level of clusters' development. Source: Authors own study

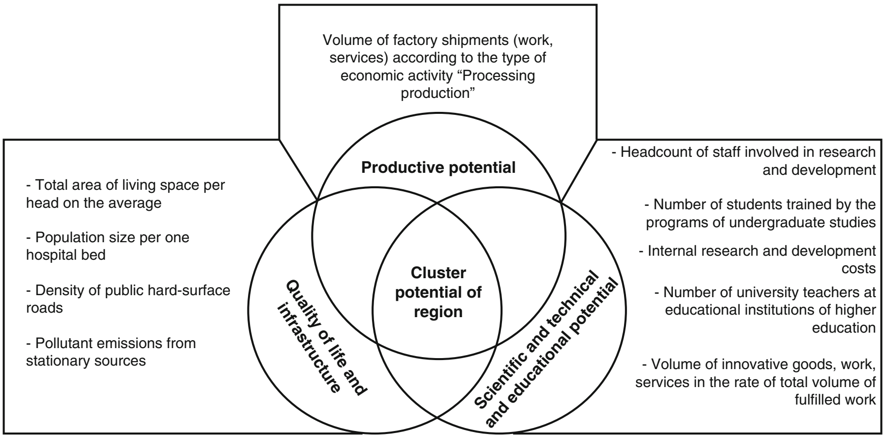

Fig. 2 Indicators of grouping for regional typology. Source: Authors own study

Common database was formed taking into consideration with 10 indicators of 79 Russian Federation regions for 2015. To calculate integral indexes X, Y, Z it was defined the levels of every indicator's importance in their groups of factors with the help of expert appraisal. Integral indexes were calculated by formulae (1)–(3):

$$X = \sum\nolimits_{i=1}^{n} \alpha_i x_i \tag{1}$$

where xi—i-factor, characterizing the indicator of "Quality of life and infrastructure", $i = \overline{1, n}$, n—total number of factors, α_i—expert appraisal of i-factor weight, though $\sum\nolimits_{i=1}^{n} \alpha_i = 1$, $\alpha_i \in [0, 1]$.

$$Y = \sum\nolimits_{j=1}^{m} \beta_j y_j \tag{2}$$

where yj—j-factor, characterizing the indicator of "Productive potential", $j = \overline{1, m}$, m—total number of factors, β_j—expert appraisal of j-factor weight, though $\sum\nolimits_{j=1}^{m} \beta_j = 1$, $\beta_j \in [0, 1]$.

$$Z = \sum\nolimits_{k=1}^{l} \gamma_k z_k \tag{3}$$

where zk—k-factor, characterizing the indicator of "Scientific and technical and educational potentional", $k = \overline{1, l}$, l—total number of factors, γ_k—expert appraisal of k-factor weight, though $\sum\nolimits_{k=1}^{l} \gamma_k = 1$, $\gamma_k \in [0, 1]$.

All factors used for calculation of integral indexes of the X, Y, Z were standardized by linear transformation according to the formula (4):

$$y(x) = \frac{x - x_{min}}{x_{max} - x_{min}} \tag{4}$$

To confirm the assumption, that successful functioning of clusters depends greatly on the interaction with main innovative infrastructure subjects from industry, government and university (Triple Helix actors), the pair correlation coefficients between government and industry, government and university, industry and university were determined. Actually, in regions where clusters function successfully (the first group), the intensity of interaction between participants is higher. For example, the correlation coefficient between government and industry in the first group is 0.44, and in the third group it is only 0.05 (Table 1).

Thirdly, we have carried out the mathematical evaluation of the indicators' influence on the level of GRP per capita as significative of region economic development. To prove the hypothesis, multiple correlation coefficients were calculated for all groups of regions. In the first group of regions, the coefficient of multiple correlation is higher than in the second and the third (Table 2).

The pair correlation coefficients between GRP per capita and each individual integral indicator of quality of institutions of government, university and science were also calculated. The impact of each individual institution on GRP per capita is much lower than their combined effect (Table 3).

4 Conclusion

The obtained results confirm the high level of functional dependence of territorial development from the efficient interaction of manufacturing enterprises, public bodies and science community. The achieved estimations prove that artificial creation of clusters by means of public pressure is not expedient. Cluster unions which later on are not supported by the real cooperation between their participants, cannot have any positive impact on territorial development. Moreover they are able to decelerate considerably the realization of system innovations which are the foundation of progressive and uniform development of all national economy.

Therefore, the main task of government is to develop favorable institutions to enhance interaction between cluster members. This conclusion creates certain preconditions for further research in this direction, namely, on the selection of practical instruments for regional cluster policy implementation. It will make possible to define principally new vector of managerial influence on formation of favorable institutional conditions providing creation of valid system of cluster nets as the accelerator of national economy's innovative development.

Table 1 Calculation of pair correlation coefficients between cluster participants

Correlation coefficients	Groups of regions		
	Group 1	Group 2	Group 3
Government/industry	0.44	0.17	0.05
Government/university	0.45	0.34	−0.15
Industry/university	0.78	0.77	0.65
Mathematical evaluation			
Government/industry	$\lvert t\rvert(=2.01) < t_{Critical}(=2.11) \Rightarrow$ the correlation coefficient is not significant	$\lvert t\rvert(=0.76) < t_{Critical}(=2.05) \Rightarrow$ the correlation coefficient is not significant	$\lvert t\rvert(=0.19) < t_{Critical}(=2.05) \Rightarrow$ the correlation coefficient is not significant
Government/university	$\lvert t\rvert(=2.05) < t_{Critical}(=2.11) \Rightarrow$ the correlation coefficient is not significant	$\lvert t\rvert(=1.48) < t_{Critical}(=2.05) \Rightarrow$ the correlation coefficient is not significant	$\lvert t\rvert(=0.64) < t_{Critical}(=2.05) \Rightarrow$ the correlation coefficient is not significant
Industry/university	$\lvert t\rvert(=5.20) > t_{Critical}(=2.11) \Rightarrow$ the correlation coefficient is significant	$\lvert t\rvert(=4.98) > t_{Critical}(=2.05) \Rightarrow$ the correlation coefficient is significant	$\lvert t\rvert(=3.51) < t_{Critical}(=2.05) \Rightarrow$ the correlation coefficient is significant

Source: Authors own study

Table 2 Mathematical evaluation of the indicators' influence on the level of GRP per capita

Multiple correlation coefficient	Groups of regions		
	Group 1	Group 2	Group 3
GRP per capita/industry and university and government	0.82	0.81	0.67
Mathematical evaluation	$F_{Calc}(=9.9) > F_{critical}(2.3) \Rightarrow$ the multiple correlation coefficient is significant	$F_{Calc}(=16.2) > F_{critical}(1.9) \Rightarrow$ the multiple correlation coefficient is significant	$F_{Calc}(=7.1) > F_{critical}(1.9) \Rightarrow$ the multiple correlation coefficient is significant

Source: Authors own study

Table 3 The impact of institutions on GRP per capita

Correlation coefficients	Groups of regions		
	Group 1	Group 2	Group 3
GRP per capita/ government	0.12	−0.37	−0.60
GRP per capita/ industry	0.71	0.61	0.16
GRP per capita/ university	0.74	0.23	0.39
Mathematical evaluation			
GRP per capita/ government	$\|t\|(=0.51) < t_{Critical}(=2.11) \Rightarrow$ the correlation coefficient is not significant	$\|t\|(=1.64) < t_{Critical}(=2.05) \Rightarrow$ the correlation coefficient is not significant	$\|t\|(=3.10) > t_{Critical}(=2.05) \Rightarrow$ the correlation coefficient is significant
GRP per capita/ industry	$\|t\|(=4.14) > t_{Critical}(=2.11) \Rightarrow$ the correlation coefficient is significant	$\|t\|(=3.17) > t_{Critical}(=2.05) \Rightarrow$ the correlation coefficient is significant	$\|t\|(=0.68) < t_{Critical}(=2.05) \Rightarrow$ the correlation coefficient is not significant
GRP per capita/ university	$\|t\|(=4.57) > t_{Critical}(=2.11) \Rightarrow$ the correlation coefficient is significant	$\|t\|(=0.99) < t_{Critical}(=2.05) \Rightarrow$ the correlation coefficient is not significant	$\|t\|(=1.72) < t_{Critical}(=2.05) \Rightarrow$ the correlation coefficient is not significant

Source: Authors own study

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