

Econometric Modeling of Clustering Processes in the Agricultural Sector and its Prospects

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Abstract

World experience of the past years shows that the formation of regional clusters is one of the most promising forms of spatial economy organization. In the regional management system, this approach concentrates all the effects of public-private partnership and interaction of business entities by stimulating the emergence of synergies within the spatial-network regional structures due to the diffusion of innovations that, ultimately, leads to the rapid socio-economic development of deprived areas.

Keywords: regional economy, cluster policies, life cycle, agro-industrial region

Cluster form of economic organization in Russia became relatively widespread in various industries and fields in the 2000s. Among scientists and specialists in the regional and industrial economy, the organization and operation of clusters are adequately researched. However, there are various theoretical and methodological applied aspects remaining beyond the scope of economic science, reflecting the peculiarities of the cluster establishment and functioning in the agricultural sector of the economy. Terminological differences in interpreting "cluster" economic category are determined by cluster characteristics allocated as a difidenda, i.e. its essential basis. For descriptive interpreting this economic category, we highlight its signature characteristics enabling to identify the cluster forms of economic development in practice. These are as follows:

- the high share of the industry (a group of enterprises) in the total gross product of the territory and hence the significant export potential;
- spatial characteristics of the cluster elements' placement supporting active interaction not only within the production elements but also with suppliers, counterparties, consumers, service providers, each of whom enhances its specialization by interacting with the cluster;
- significant advantages in characteristics of the available potential resource (according to M. Porter "factor conditions"), which can be attributed not only to the availability and geographical proximity of natural-resource raw objects, but also to the qualifications of employees, a competitive segment of suppliers, an established system of maintaining the innovative component of the company (interaction with research institutes and universities), the required infrastructure availability, etc.;
- positioning the cluster as the main "employer" for the population in the region (territory);
- effective interaction and high competition in related, servicing and supporting sectors of the economy based upon the principles of a competition combined with cooperation to ensure the collective promotion of innovative goods applying subcontracting practices;
- orienting cluster participants to create a high value-added product based on high consumer requirements and domestic market preferences.

Currently relevant remain the issues of developing mechanisms as well as instrumental and methodological apparatus enabling to identify the life cycle stage and the signature characteristics of the cluster at the startup, development, maturity-fading and decline phases with a large number of works from national and foreign authors dedicated to their research (Ablaev, 2015) (Sosnovskikh, 2017) (Kopczewska, 2018) (Porter, Delgado, & Stern, 2016) (Aggarwa, 2011) (Behera, Kim, Lee, Suh, & Park, 2012) (Marchi & Grandinetti, 2014) (Ketels, 2013) (Coulibaly, Erbao, & Mekongcho, 2018). Clusters including ones of the agricultural sector are characterized by the stages of startup, development, maturity-fading and decline, whereas the effects they produce on the socioeconomic systems of traditional agricultural regions will vary in composition and content at each of the life cycle stages.

In the modern theory and practice of the regional economy, there are many approaches to a cluster identification (Vertakova, Plotnikov, & Fedotova, 2016) (Goremykin, Sokolov, & Safronova, 2012) (Eraslan, Donmez, & Akgu, 2016). In our research, we use the approach within the framework of the theory of territorial competitive advantages. It involves an assessment of the established cluster development determinants (local competitive advantages), which assesses the resource potential of the territory, the characteristics of related and service industries, the state of demand for output, a common vision for the cluster development, and maintaining principles of competition and cooperation. We selected this approach due to the availability of official statistics for all assessment blocks. Following the logic of the research, we will proceed with describing the selected quantitative indicators of prospects for cluster formation in the regional economy.

1. Location quotient of production In calculating this indicator, as total production value in the region and the country we will use the Gross Regional Product value and, accordingly, for GDP the country. This is a classic indicator in the theory of regional specialization, and it can be slightly modified, allowing to assess different aspects of specialization. To calculate the location quotient according to the employed staff number, we will use the employment data in the three sectors of the economy at the regional level in relation to the total population and divide the resulting value by the same country-level ratio. Thus, these quotients show the ratio of the share of the analyzed industry in the production structure (number of employees, fixed assets value) of the region to the share of the same industry in the country.
2. Per capita output quotient is calculated as the ratio of the share of the regional branch of the economy in the corresponding structure of the country industry to the share of the regional population in the country population: In this, we used not the total population of the region (country) to calculate this indicator but the number of the economically active population. This indicator, in fact, characterizes a comparative performance in the industry of the region being quite relevant in terms of assigned tasks of the indevelopment methodology.
3. Regional merchantability quotient is calculated as the ratio of the export of goods from the territory to its regional production: In case the actual value of the above indicators exceeds one, these industries can be considered as the basis of the regional market specialization.
4. Balassa index (index of revealed comparative advantage, (RCA)). Assuming that one of the cluster's main identification features is that the territory profits off of products' exporting, this indicator is quite informative in the context of the research. According to this index, a region may be identified as specializing in the product or service export if it's market share for a given product is above the national average: In case a regional indicator value exceeds one for a particular industry, it means the export is above expectations based on data on its demand in the total export volume of the region.
5. Cluster focus (according to M. Porter) (S) is calculated as the ratio of the employed population in the sector i of the region j to the total number of employed in the region j : In fact, this is one of the variations of localization indicator and according to M. Porter characterizes the size of the agglomeration, i.e. the higher the indicator value is, the greater the agglomeration appears to be.

6. The density of economic space in the sector i of the region. This indicator is a spatial characteristic of a potential cluster functioning. It is calculated as the ratio of industrial enterprises to the size of the territory. The greater the number of enterprises located within 1 sq. km of the region, the higher the density of economic space and the more opportunities for interaction and cooperation therefore are. 7. The indicator of the industry economic prosperity characterizes the ratio of an employee's salary in the industry to the average annual salary in the region: This indicator can be interpreted as follows: if the industry is experiencing an increase or the availability of high-paying jobs that paid higher than in other sectors of the economy, the industry can be considered as prosperous.

2.2. Calculating indicators for assessment cluster perspectives Table 1 Indicators for calculating location quotients in sectors with cluster-forming potential of Stavropol territory (ST) (data for 2016)

Indicators	Potential cluster-forming sectors	Tourism and recreation	Manufacturing	Agriculture
Annual average number of employed in industry of ST, thsd. people	24,9	146,4	216,7	10281
Annual average number of employed in industry of RF, thsd. people	1217,6	10281	6730,4	103470
Industry production volume of ST, mil. rubles	11728,1	161181	3261695	373985,201
Industry production volume of RF, mil. rubles	22802348	3261695	70614	87337
Industry value of fixed assets in economy of ST, mil. rubles	-	70614	87337	8876602
Industry value of fixed assets in economy of RF, mil. rubles	-	8876602	3127209	42
Exporting main types of product, mil. rubles (according to average rate of US Dollar for 2011)	42	23862	7470	10210
Nominal average monthly salary of employees	10210	14685	12693	1316888,9

It should be noted there is no "tourism and recreation" industry in the classification of types of economic activity. Therefore to calculate selected indicators the data on "hotels and restaurants" was used. In addition, for calculating the index of revealed comparative advantage (RCA) the data on the export of food products and agricultural raw materials was used for agriculture; the data on chemical industry, rubber sector, machinery, equipment and vehicles was used for manufacturing; the data on hotel and restaurant services export was used for tourism. In addition to the above indicators, some generalized data on the economy of the Stavropol territory and the Russian Federation would be required for the calculation (table 2).

Table 2 Generalized data on economy of Stavropol territory and Russian Federation for calculating assessment indicators for regional cluster-forming potential

Indicator	Russian Federation	Stavropol territory
Gross product, mil. rubles	37398520,1	316888,9
Total number of economically active population, thsd. people	75752	1373
Total value of fixed assets, mil. rubles	30736997	360357
Annual average number of employed in economy, thsd. people	67727,2	1245,3
Nominal average monthly salary of employees	23369,2	15588,7

In general, it should be noted that according to the location quotient assessment two industries can be highlighted: "agriculture", i.e. a potential agro-industrial cluster, and "tourism and recreation". Thus, the location quotient according to the volume of output, works and services for these industries amounted to 3.74 and 3.70 respectively, while for manufacturing industries the indicator value was below one (0.83). In turn, the highest location quotient for the number of employed was also identified in "agriculture" – 1.78 (table 3).

Table 3 Calculating location quotients in sectors with cluster-forming potential (data for 2016)

#	Indicators	Potential cluster-forming sectors	Tourism and Recreation	Manufacturing	Agriculture
1	Location quotient by volume of output, works and services	3,7010	0,8342	3,7439	II III I
2	Location quotient by number of employed	1,1282	0,7857	1,7764	II III I
3	Location quotient by value of fixed assets	0,4342	0,6785	2,3822	III II I
4	Per capita output quotient	1,7302	0,3999	1,7502	II III I
5	Regional merchantability quotient	0,0036	0,1480	0,0722	III I II
6	Index of revealed comparative advantage (RCA)	0,0012	0,1854	0,1353	III I II
7	Cluster focus index (according to M. Porter): ratio of employed population in sector to total number of employed in region	0,0200	0,1176	0,1740	III II I
8	Density of economic space in sector i of region (enterprises per 1 thsd. sq. km territory)	21,1	59,1	205,1	III II I
9	Economic prosperity indicator (ratio of employee salary in industry to average				

annual salary in region) 0,6550 0,9420 0,8142 III I II 10 Sum of places 24 18 12 In terms of per capita output, the benchmark indicator (1) is not exceeded only in the manufacturing sector (0.399), while the maximum value of the regional merchantability quotient is identified in this industry, which export capacity is the highest among the analyzed economic activities. This also confirms the index value of identified comparative advantage with the maximum value registered in "manufacturing" (0.19). Notably, almost all the export capacity of the industry is ensured through the chemical industry. For "agriculture", the ratio between produced goods and exported ones is much lower confirming the sector's orientation mainly towards domestic markets, while the RCA index for "agriculture" is 0.14. The cluster focus index is another signature indicator of strong economic incentives to clustering processes. According to its value, the largest potential cluster in the Stavropol territory is for "agriculture" (0.17), "manufacturing" is in second place (0.12) with "tourism and recreation" being the third (0.02). At the same time, "agriculture" has the densest economic space that also provides additional incentives for cooperation and deeper interaction (205.1 enterprises per 1,000 sq. m. territory). For the overall interpretation of the obtained data analysis, it is necessary to rank the calculated indicators according to their value in terms of three industries. This enables applying the method of comprehensive rating for separate types of economic activity in the context of their clusterforming potential. This method implies summing places: the smaller the sum of places for a particular industry is, the greater this industry's potential in terms of implementing cluster initiatives appears to be.

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